

Norwegian Salmon and Trout Farming

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Introduction

The development of Norway's Atlantic salmon, *Salmo salar*, and rainbow trout, *S. gairdneri*, farming in coastal waters is, in the opinion of many observers, the most significant event in the history of European aquaculture. Norwegian production of farmed salmon and trout has increased dramatically during the past decade, from only 500 metric tons (t) in 1971 to an estimated 15,500 t in 1983, and production is expected to double by 1990. Norway's production of farmed salmon and trout, the vast majority of which is exported, is in the forefront of fish farming developments in Europe and has been that aquaculture industry's most striking commercial success.

Farms and Methods

The success of saltwater aquaculture has attracted many former Norwegian fishermen, disillusioned with declining fishery catches, to apply for licenses to start a salmon or trout farm. It is estimated that between 20 and 30 percent of the license holders are former fishermen. Many of these potential salmon or trout farmers inhabit the isolated communities along the fjords and islands of the western coast of Norway (Fig. 1). The Norwegian Government encourages fish farming in the sparsely populated coastal regions for both

strategic and social reasons. Government officials regard salmon fishing as one of the most lucrative commercial activities available to residents of many isolated coastal communities.

Modern fish culture methods have enabled aquaculturists to start with relatively small investments and gradually expand their operations. The Norwegian Government assists small operators by guaranteeing loans through the Regional Development Fund and the Agricultural Development Fund. The Government, however, has restricted salmon farming investments by large companies, and has also imposed a size restriction on salmon farms to limit the industry primarily to small, owner-operated farms. In 1973, a law limiting the size of salmon farms to a floating net cage capacity of 8,000 m³ was enacted¹. Farms having over 8,000 m³ of cage capacity, but approved before 1973, were exempted from this law.

Norwegian statistics show that 286 marine fish farms² were operating during 1982. Although the Norwegian Government had in effect suspended the issuing of new licenses in 1977, it granted 100 new licenses in October 1983 for farms with a maximum net cage capacity of 5,000 m³. Farms which had been operating continuously for at least 3 years before October 1983, are allowed to apply for permis-

sion to increase their cage capacity from 5,000 to 8,000 m³ to improve their profitability.

Although most Norwegian fish farms are relatively small, a few large ones were in operation before the 1973 law restricted net cage capacities. The largest Norwegian fish farm, operated near Bergen by the Mowi Company³, produces over 500 t of cultured salmon per year. The Mowi company was founded in 1969 and its shares are partly held by the state-owned Norwegian electric power company, Norsk Hydro⁴. Mowi has developed techniques for raising Atlantic salmon smolts and transferring them to saltwater cages in the fjords where they are protected and fed until reaching marketable size in 3-4 years. Mowi exported its first cultured salmon in 1971 and by the mid-1970's had expanded its production to the point where it could guarantee regular supplies to its major customers.

Production

Two species of fish are extensively cultured in Norway: Atlantic salmon and rainbow trout. In recent years, the Atlantic salmon has come to dominate the industry.

Atlantic Salmon

Norwegian culturing of the Atlantic

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¹It is estimated that a farm with a capacity of 8,000 m³ produces about 60 t of salmon annually (Edwards, 1978).

²Of this total, 215 farms raised Atlantic salmon and 189 raised rainbow trout. There were 118 farms which raised both salmon and trout.

³Mention of trade names or commercial firms does not imply endorsement by the National Marine Fisheries Service, NOAA.

⁴Norsk Hydro's British subsidiary, Norsk Hydro U.K. Ltd., has purchased the U.K. fish-farming firm Golden Sea Produce, Ltd., and its subsidiary Scottish Sea Farms, Ltd.

Table 1.—Norway's farmed Atlantic salmon and rainbow trout production, 1971-86.¹

Year	Production (t)		Total
	Atlantic salmon	Rainbow trout	
1971	98	433	531
1972	146	778	924
1973	171	1,001	1,172
1974	601	1,726	2,327
1975	862	1,655	2,517
1976	1,431	2,045	3,476
1977	2,137	1,795	3,932
1978	3,540	2,105	5,645
1979	4,389	2,988	7,377
1980	4,312	3,668	7,980
1981	8,907	4,485	13,392
1982	10,266	4,690	14,956
1983 ²	17,500	3,000	20,500
1984 ²	24,500	3,750	28,250
1985 ²	35,000	4,500	39,500
1986 ²	47,500	4,500	52,000

¹Sources: FAO Fisheries Statistics Unit, Department of Fisheries (1971-80 data). Royal Norwegian Embassy in Washington (1980-86 data).

²Norwegian Fisheries Ministry projections.

salmon began around 1970 and increased rapidly, from only about 100 t in 1971 to an estimated 17,500 t in 1983 (Table 1). At first, Norwegian salmon farmers had difficulties marketing their product. It was more expensive to farm salmon than to catch it in the wild, and many customers believed that cultured salmon was of inferior quality. Consumers, however, have found over the years that the quality of cultured salmon is the same, or better, than that of wild salmon. The controlled conditions under which salmon can be cultured and harvested enable fishermen to produce a high quality, uniform product. The average weight of farmed salmon is 4 kg, whereas the weight of wild salmon fluctuates from 1 to 9 kg. The high quality, uniform size and weight, and year-round availability of cultured salmon accounts for much of its marketing appeal.

The Atlantic salmon is the most important species cultured in Norway; its 1982 harvest represented about 70 percent of the total Norwegian farmed fish production. Salmon farming has proven to be a very profitable industry and most research cur-

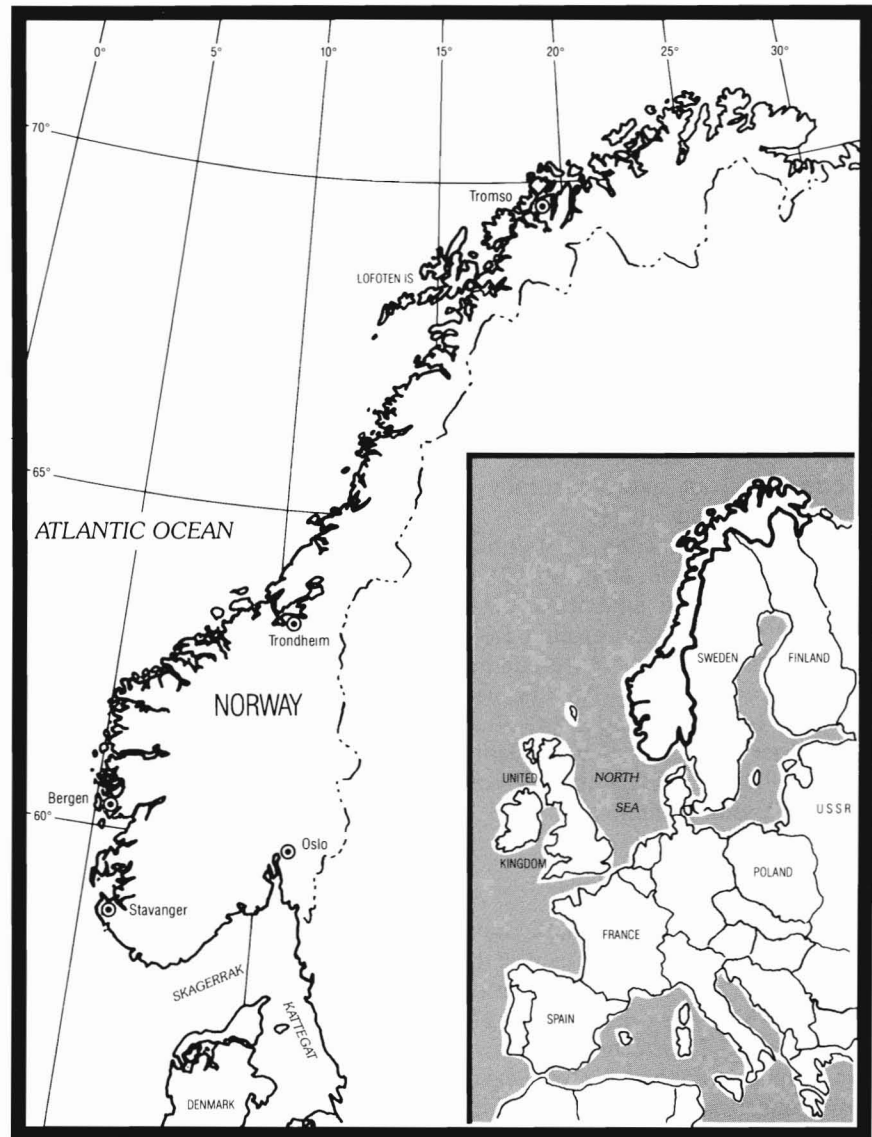


Figure 1.—The coast of Norway.

rently being done on fish farming in Norway involves salmon. This effort has made Norway by far the world's leading producer of farmed Atlantic

salmon with its 1981 harvest accounting for nearly 90 percent of the world total (Table 2). Furthermore, Norwegian officials expect that their

farmed Atlantic salmon production could reach nearly 50,000 t by 1986.

Rainbow trout

The production of rainbow trout, *Salmo gairdneri*, is not expected to increase significantly because its export possibilities are poor. Less than half of the trout harvested is exported, and the home market is limited because rainbow trout is not indigenous to Norwegian waters and is not well known to Norwegian consumers (Edwards, 1978). Also, broodstock for their rainbow trout must be taken from captive stocks because the species does not spawn naturally in Norway (Edwards, 1978).

Although production of rainbow trout increased from 400 t in 1971 to 4,700 t in 1982, its annual harvest is expected to stabilize at around 5,000 t. Trout farming, however, is still important because new fish farmers generally begin culturing trout, which are easier to rear than Atlantic salmon, before turning to the more profitable salmon culture.

Trade Associations

Norwegian aquaculturists have three organizations. The largest is the Norwegian Fish Farmers Association (NFFA) which was organized in 1970 and represents 70 percent of Norway's fish farmers. It lobbies the Norwegian Government and also deals with domestic and foreign buyers. NFFA represents almost all of the large producers. NFFA has its own magazine, the *National Fish Farmer*, which provides the largest information on fish-farming techniques and on new markets.

The Norwegian Trout Organization (NTO) was established in 1965. Representing over 50 percent of the rainbow trout farmers, the NTO buys trout from the smaller farms and sells it to processors, thereby giving the smaller producers a greater leverage in deciding market prices. The NTO also provides financial assistance to its members when necessary.

The Norwegian Meat Marketing Board (NMMB) became involved in

salmon marketing in 1974. As a result of the expanding salmon farming industry, the NMMB began providing loans and marketing services. Most of the salmon farmers dealing with the NMMB are small producers.

Exports

Farmed Atlantic salmon has become an important Norwegian fishery export. In 1982, Norway exported 9,400 t of cultured salmon, or over 90 percent of its total farmed salmon production (Tables 1, 3). France was the main market, buying 2,700 t, or 30 percent of Norway's exported salmon that year. The Federal Republic of Germany (FRG) and Denmark also bought large quantities of the Norwegian salmon. Exports to the United States were 762 t in 1982, or about 8 percent of Norway's total salmon exports.

Exports of Norwegian farmed trout in 1982 amounted to 2,200 t, around 45 percent of the total trout production that year. Sweden, which imported 580 t of trout, was the largest single market. Other major markets were France, FRG, and Denmark (Table 3).

The success of Norwegian Atlantic salmon exports is due to several factors. The salmon is of very high quality and is mostly shipped fresh by the Scandinavian Airlines System. Because the fish are farmed and not caught in the wild, fresh shipments can be guaranteed at any time of the year, and are especially valued at those times when the catch of wild salmon is down. The high quality and year-round availability of Norway's farmed salmon makes it particularly valuable to such specialized customers as restaurants, hotels, gourmet stores, etc.

Impact on the United States

U.S. salmon fishermen are concerned about the impact which developments in Norway will have on their industry. The rapidly expanding production of Norwegian farmed salmon, the vast majority of which is exported, will mean increased com-

Table 2.—World production of farmed salmon and trout, 1981.

Country	Production (t)	
	Rainbow trout	Atlantic salmon
Denmark	19,000	
Finland	7,000	
France	21,000	
Germany (FRG)	12,000	
Italy	21,000	
Japan	20,000	
Norway	4,000	8,900
Sweden	2,000	
United Kingdom	5,200	1,000
United States	20,000	
Total	131,200	9,900

Source: Cedrins (1983).

Table 3.—Norwegian exports of farmed Atlantic salmon and rainbow trout, 1982.

Country	Exports (t)		
	Salmon	Trout	Total
France	2,710	260	2,970
Germany (FRG)	1,850	350	2,200
Denmark	1,240	280	1,520
Sweden	590	580	1,170
United Kingdom	930	110	1,040
United States	762	243	1,005
Switzerland	350	140	490
Belgium	370	90	460
Spain	270	40	310
Finland	140	40	180
Netherlands	120	60	180
Japan	40		40
Other	40	5	45
Total	9,412	2,198	11,610

Source: Fisheries Attache, Royal Norwegian Embassy, Washington, D.C., pers. commun., 1984.

petition for U.S. fishermen in both domestic and foreign markets. The excellent quality, freshness, and year-round availability of the Norwegian farmed salmon makes it a highly-valued commodity among demanding consumers.

Norwegian companies have targeted the United States as a primary market for their farmed salmon. Although the United States is a major salmon producing country, Norwegian export companies believe that they can successfully market substantially increased amounts of fresh Atlantic salmon in the United States⁵. In 1982, according to

⁵The Norwegian salmon is generally shipped in Styrofoam containers, each fish individually wrapped in cellophane, by SAS to Kennedy Airport in New York.

Norwegian statistics, U.S. firms bought 760 t of farmed salmon from Norway, compared with only about 21 t purchased in 1981. These exports accelerated rapidly in 1983 and totalled 2,300 t valued at \$16.8 million. Norwegian officials believe that the United States eventually will replace France (which imported 2,700 t of Norwegian farmed salmon in 1982) as Norway's major market for this commodity.

Norwegian salmon exporters also have well-established markets in Western Europe and are expanding their sales in other parts of the world. France, FRG, and Denmark each bought over 1,000 t of Norwegian salmon in 1982, and seven other European countries purchased significant quantities (Table 3). The Norwegians have also decided to try to increase exports to the Far East (despite the fact that Japan bought only 40 t of the farmed salmon in 1982) because of their success in shipping fresh salmon to the United States. The SAS airline is interested in planning marketing campaigns to establish new markets for fresh salmon shipments.

Although the United States exports much more salmon than Norway (about 135,000 t of Pacific salmon

Oncorhynchus spp., in 1982 compared with about 9,000 t of Atlantic salmon for Norway; U.S. commercial fishermen catch almost no Atlantic salmon) and supplies most of the salmon for the domestic U.S. market, it faces strong competition from the Norwegians for "top-of-the-line" salmon. Since the U.S.-produced Pacific salmon is caught in the summer, it is available fresh for only a limited time, and most U.S. salmon is produced in frozen or canned form. The Norwegian product, on the other hand, can be shipped fresh year-round and is exported to the United States and other countries mainly in the winter and spring. The Norwegian product, furthermore, is the Atlantic salmon which many consumers value more highly than the Pacific salmon. Thus, Norway is able to compete effectively with the U.S. for "top-of-the-line" salmon. The export potential of Norway's Atlantic salmon is evidenced by the fact that it has even been sold in Seattle, Wash., one of the centers of the U.S. Pacific salmon industry.

Future of Norwegian Aquaculture

Prospects for farmed fish produc-

tion in Norway are very good, and industry expansion, primarily salmon production, is expected to continue. The Norwegian Ministry of Fisheries, which is investing large amounts of time and money into the research and development of farmed fish in Norway, is very optimistic. The Ministry is, however, concerned that too rapid an expansion of salmon farms could lead to a decline in prices obtained by salmon aquaculturists.

As a result, the Ministry is attempting to encourage fish farmers to also begin working with other equally cost-beneficial species (i.e., cod). The decline of the once flourishing Norwegian cod fishery in recent years has led many scientists to experiment with cod farming. Early results of these experiments have been good, and Ministry officials hope that a lucrative farmed cod industry can one day help supplement dwindling natural resources.

Literature Cited

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