6. Fisheries, sealing, whaling and fish farming

The Barents Sea capelin stock has been low for several years, but is now growing. The spawning stock of Northeast Arctic cod is considered to be within safe biological limits, and illegal fishing has been considerably reduced. Development of the Norwegian spring-spawning herring stock has been very satisfactory, and it has now reached the same level as in the 1950s. Stocks of several important demersal fish species in the North Sea are still very low. In 2007, production of farmed salmon increased to 736 000 tonnes.

Most fish stocks in the Barents Sea are in good condition, and the capelin stock, which has been low for a number of years, has more than doubled from the autumn 2006 level. Illegal fishing for Northeast Arctic cod was considerably reduced in 2007.

The fisheries clearly influence fish stocks, but variations in natural conditions such as temperature are also important, affecting the spawning success and distribution of different fish stocks and the food supplies available to them. The period since 2000 has been the warmest on record in the Barents Sea since 1900 (Gjøsæter et al. 2008). Water temperatures have also been high in the North Sea and the Norwegian Sea.

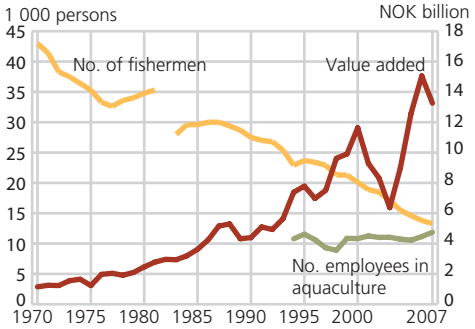
The Norwegian spring-spawning herring stock is the largest herring stock in the world. According to the 2008 annual report on marine resources and environment (Gjøsæter et al. 2008), this is because conditions in the sea have been favourable, the spawning stock is large, and the management plan is functioning well. Of the other major pelagic stocks in the Norwegian Sea, the blue whiting appears to be declining, and the mackerel stock is estimated to be around the precautionary level.

For the last five to six years, there has been poor recruitment to the sandeel, Norway pout, cod, and the North Sea herring stocks. This is mainly a result of changes in physical and biological conditions, although the cod and sandeel stocks have also been overfished. Moreover, illegal, unreported and unregulated fishing (IUU fishing) makes it difficult to calculate the size of certain stocks, particularly mackerel and cod (Gjøsæter et al. 2008).

The total catches in the world's marine fisheries were 82 million tonnes in 2006, a decrease of about 2.6 million tonnes compared with the year before. The species with the highest total catch was Peruvian anchovy, which accounts for a substantial proportion of the total harvest in the Southeast Pacific. In 2006, the catch of this species was 7 million tonnes, which was about 3 million tonnes less than in 2005. Total world aquaculture production (including fish and shellfish) in 2006 was 52 million tonnes, and in addition, production of aquatic plants totalled 15 million tonnes.

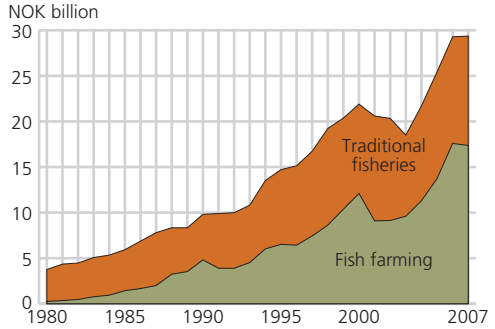
6.1. Principal economic figures for the fisheries

Figure 6.1. **Value added[1] in the fishing, sealing and whaling industry, number of fishermen and number of people employed in the aquaculture industry[2]. 1970-2007**



[1] Value added (production value minus material input) in basic values. Current prices.
[2] For the period 1994-1998: no. of people employed in salmon and trout farming only.
Source: Directorate of Fisheries and National Accounts, Statistics Norway.

Figure 6.2. **First-hand values in traditional fisheries and fish farming. 1980-2007**



Source: Directorate of Fisheries and Fisheries statistics, Statistics Norway.

GDP and employment

- According to the Norwegian national accounts, fishing, sealing, whaling and fish farming contributed NOK 13.3 billion, or 0.58 per cent, to Norway's gross domestic product (GDP) in 2007. Figure 6.1 shows a sharp drop just after 2000. This was the result of a general fall in demand and low prices in 2002, and even more markedly in 2003, which created difficult conditions for the fisheries industry (Statistics Norway 2004a and b).
- The fishing industry accounted for 0.61 per cent of total employment in 2007. At the end of 2007, 13 336 fishermen were registered in Norway. The number of fishermen has dropped by almost 90 per cent since the late 1930s, and by about half since 1990 alone. Farming of salmon and trout employs about 3 800 people.

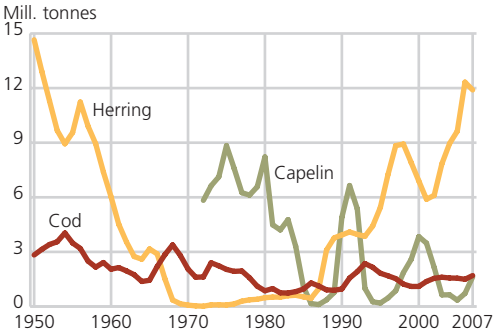
Production and prices

- According to preliminary figures from the national accounts, production in fisheries, sealing, whaling and fish farming rose by 17.4 per cent from 2006 to 2007, measured in constant prices.
- In 2003, prices were generally low and the total first-hand value of the catch in the traditional fisheries was NOK 8.9 billion. The total first-hand value was 34 per cent higher in 2007 than in 2003: the rise occurred almost entirely in 2004 and 2005. In 2007, the total value of the catch was NOK 12 billion, and herring and cod accounted for almost 50 per cent of this (Statistics Norway 2008).

- From 2000 to 2003, the average export price of salmon (fresh and frozen) dropped by 34 per cent, while the quantity exported rose by 20 per cent. From 2003 to 2006, the price of salmon rose by 50 per cent, and the quantity exported rose by 22 per cent. In the fourth quarter of 2006, salmon prices began to drop again, and were lower than in 2006 throughout 2007. The average export price of fresh and frozen salmon was 17.5 per cent lower in 2007 than in 2006, but slightly higher than in 2005 (Statistics Norway 2008).

6.2. Trends in stocks

Figure 6.3. **Trends for stocks of Northeast Arctic cod[1], Norwegian spring-spawning herring[2] and Barents Sea capelin[3]. 1950-2007**

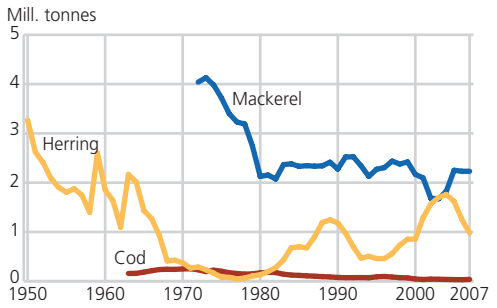


[1] Fish aged three years and over.
[2] Spawning stock.
[3] Fish aged one year and over.
Source: ICES and Institute of Marine Research, Bergen.

Barents Sea–Norwegian Sea

- The spawning stock of Norwegian spring-spawning herring was estimated to be about 12 million tonnes in 2007. Thus, the stock is well above the precautionary level of 5 million tonnes.
- The total stock of capelin in the Barents Sea was estimated to be just under 1.6 million tonnes in autumn 2007. This is a considerable rise since 2006.
- The total stock of Northeast Arctic cod was estimated to be about 1.7 million tonnes in 2007, and the spawning stock was estimated at just above 0.6 million tonnes, rather higher than the precautionary level of 0.46 million tonnes.

Figure 6.4. **Trends for stocks of cod[1] in the North Sea, North Sea herring[1] and Northeast Atlantic mackerel[1,2]. 1950-2007**



[1] Spawning stock.
[2] Southern, western and North Sea mackerel.
Source: ICES and Institute of Marine Research, Bergen.

North Sea

- The spawning stock of North Sea herring was estimated to be about 1.0 million tonnes in 2007, somewhat lower than the precautionary level, which is 1.3 million tonnes. All the year classes after 2001 have been weak.
- The spawning stock of North Sea cod is at a historical low, and the harvest is unsustainable.
- The total spawning stock of mackerel appears to have declined at the beginning of 2000s. The 2007 estimate indicates that the spawning stock is around the precautionary level, which is 2.3 million tonnes, but is very uncertain.

Box 6.1. Reference points for the spawning stock of some important fish stocks

The International Council for the Exploration of the Sea (ICES) has defined reference points for the levels of different species' spawning stocks and fishing mortality. These are important tools for the authorities in their efforts to take a precautionary approach to fisheries management.

The critical spawning stock reference point (B_{lim}) is considered to be a danger level below which there is a high probability of poor recruitment. The level is defined on the basis of historical stock data and current theories on the dynamics of fish stocks. The precautionary reference point (B_{pa}) is somewhat higher, and can be interpreted as a warning level: if a spawning stock falls below this level the authorities should consider taking steps to allow the stock to recover to a higher and safer level in order to safeguard sustainable fisheries.

The table below shows B_{lim} and B_{pa} for some important stocks, and their estimated spawning stocks in 2007.

Stock	B_{lim} (critical reference point) 1 000 tonnes	B_{pa} (precautionary reference point) 1 000 tonnes	Estimated spawning stock 2007. 1 000 tonnes
Northeast Arctic cod	220	460	610
Northeast Arctic saithe	136	220	830
Norwegian spring-spawning herring	2 500	5 000	11 900
North Sea herring	800	1 300	980
North Sea cod	70	150	40
North Sea saithe	106	200	280
Mackerel (total stock)	No biological basis for definition of limit	2 300	2 230

See Chapter 2, Figure 2.9.

Box 6.2. More about stock trends and fisheries management

- The stock of Norwegian spring-spawning herring is now about 12 million tonnes, which is well above the precautionary level of 5 million tonnes, and the same level as in the 1950s. According to the 2008 annual report on marine resources and environment (Gjøsæter et al. 2008), this is because conditions in the sea have been favourable, the spawning stock is large, and the management plan is functioning well.

- The Barents Sea capelin stock is growing. It declined considerably at the beginning of the 2000s due to weak recruitment, increased natural mortality and reduced individual growth. Predation by cod and herring on capelin and capelin larvae is an important cause of higher natural mortality. There has been no commercial fishery for capelin in the Barents Sea since 2003. The Norwegian-Russian Fisheries Commission decided not to open the fishery in 2008.

- The spawning stock of Northeast Arctic cod was in excess of 600 000 tonnes in 2007, and above the precautionary level, which is 460 000 tonnes. Illegal fishing is a serious problem, but its scale seems to have been considerably reduced since 2005. The TAC for 2008 was 430 000 tonnes, a moderate increase from the year before.

- The blue whiting stock is declining, although the spawning stock is still above the precautionary level, which is 2.25 million tonnes. There has been a substantial international fishery for this species for a number of years, and total catches have been around or above 2 million tonnes since the turn of the century.

- The spawning stock of North Sea herring was substantially depleted in the period 1989-1994, from about 1.2 million tonnes to about 500 000 tonnes. The poor state of the stock in 1990s was a result of years of overfishing. A strict management regime has resulted in low fishing mortality of mature herring and limited catches of young herring, and has given satisfactory results. The current spawning stock is just under 1 million tonnes, somewhat below the precautionary level, which is 1.3 million tonnes. However, recruitment to the stock has been only moderate in recent years, and the year classes since 2001 are the weakest registered since the late 1970s. The fishing pressure is also considered to be high.

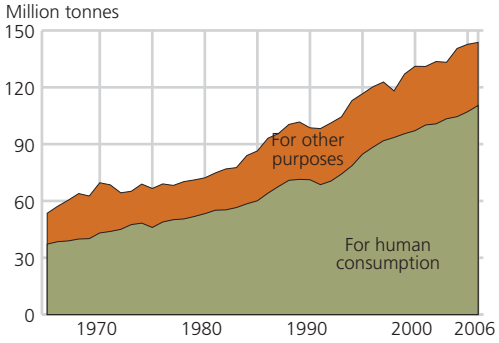
- Several of the stocks of demersal fish in the North Sea have remained low for many years. The cod stock in the North Sea has been heavily fished, and the spawning stock is at an all-time low. Recruitment to the stock has been poor in recent years. The stock size of whiting is uncertain, but seems to be close to the lowest level ever estimated. The stocks of saithe and haddock have shown positive trends in recent years. The spawning stocks of Norway pout and sandeel have been low, but both appear to have grown in 2007.

- For management purposes, the stocks of mackerel from the three spawning grounds (the North Sea, south-west of Ireland and off Spain and Portugal) are now considered as one stock (Northeast Atlantic mackerel). These stocks mix on feeding grounds in the North Sea and Norwegian Sea. The largest component of the stock is found off Ireland. Stock estimates for mackerel are made every three years. Because there are uncertainties in the catch data and considerable quantities are discarded or unregistered, the estimates of the stock size are also uncertain. The spawning stock is estimated to be close to the precautionary level, which is 2.3 million tonnes.

Source: Marine Resources and Environment 2008 (Gjøsæter et al. 2008) and ICES (www.ices.dk).

6.3. Fisheries

Figure 6.5. **World fisheries production[1], by main uses. 1965-2006**



[1] Production data does not include marine mammals (seals, whales, etc.) or plants. Aquaculture is included.
Source: FAO (2008).

Table 6.1. **World fisheries production. 2006**

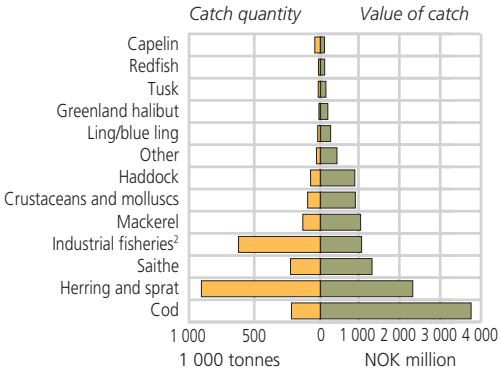
	1 000 tonnes	Per cent
Total production	143 648	100
Marine fisheries	81 931	57.0
Freshwater	10 064	7.0
Aquaculture (fish, crustaceans, etc.) in marine waters	21 799	15.2
Aquaculture (fish, crustaceans, etc.) in inland waters	29 854	20.8

Source: FAO (2008).

World catches

- Production in the world's fisheries, including both inland and marine catches and aquaculture production, has increased substantially: from slightly more than 50 million tonnes in 1965 to about 144 million tonnes in 2006.
- Of this, 77 per cent was used for human consumption in 2006. Table 6.1 shows production split by type.
- The species with the highest total catch in 2006 was Peruvian anchovy (*Engraulis ringens*) at 7 million tonnes: this figure is about three million tonnes lower than in 2005. The next two species were Alaska pollock (*Theragra chalcogramma*) and skipjack tuna (*Katsuwonus pelamis*), with catches of 2.9 and 2.5 million tonnes respectively. Atlantic herring (*Clupea harengus*) came in fourth place, with a total catch of 2.2 million tonnes.

Figure 6.6. **Norwegian catches[1] by groups of fish species, molluscs and crustaceans. 2007**

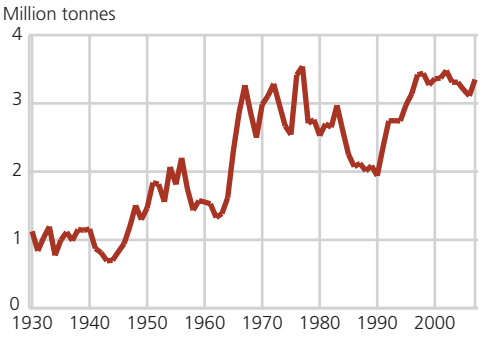


[1] Catches delivered by Norwegian vessels in Norway and abroad.
[2] Includes greater and lesser silver smelt, Norway pout, sandeel, blue whiting and horse mackerel.
Source: Directorate of Fisheries.

Norwegian catches

- In 2007, the total catch in Norwegian fisheries (including crustaceans, molluscs and seaweed) was 2.5 million tonnes, and the value of the catch was NOK 12.0 billion. The total catch was about 100 000 tonnes higher than in 2006, and its value was more than NOK 300 million higher.
- Cod and herring were the species with the highest catch value, NOK 3.7 and 2.2 billion respectively.
- In 2007, the blue whiting catch was 540 000 tonnes, about 100 000 tonnes less than in 2006. The mackerel catch was 131 000 tonnes, slightly higher than in 2006.

Figure 6.7. **Total production[1] in Norwegian fisheries. 1930-2007**



[1] Fish farming production is included.
Source: Fisheries statistics, Statistics Norway, and Directorate of Fisheries.

- In the last 10 years, total catches in traditional fisheries, including seaweed, have varied from 3 million tonnes in 1997 and 1998 to 2.5 million tonnes in 2007.
- The highest level of catches in the traditional fisheries in the period since 1930 is 3.5 million tonnes in 1977. In the same year, more than 2 million tonnes capelin was caught.
- Total production in the fisheries and fish farming in 2007 was about 3.3 million tonnes.

Box 6.3. World catches and Norwegian catches

Total catches in the world's marine fisheries in 2006 dropped by about 2.6 million tonnes from the year before to about 82 million tonnes. Total catches in freshwater fisheries rose to 10 million tonnes.

The catches in the Southeast Pacific dropped by 2.5 million tonnes from 2005. Total landings of anchoveta dropped by 3 million tonnes, while the catch of Chilean jack mackerel rose somewhat to about 1.8 million tonnes. These two species made up 73 per cent of the catches in the Southeast Pacific. There were no dramatic changes in catches in other marine areas. The Northwest Pacific is the world's most productive fishing area, and catches have varied between 20 and 24 million tonnes since the end of the 1980s. In 2006, catches in this area totalled 21.6 million tonnes. Total catches in the Northeast Atlantic have remained stable at about 10-11 million tonnes for a number of years, but dropped to 9.1 million tonnes in 2006.

According to *The State of World Fisheries and Aquaculture 2006* (FAO 2007), on a global scale 23 per cent of the fish stocks that are monitored are underexploited or moderately exploited. A further 52 per cent are fully exploited, meaning that catches are near the maximum sustainable yield and there is little room for expansion, and the remaining 25 per cent are overexploited or depleted.

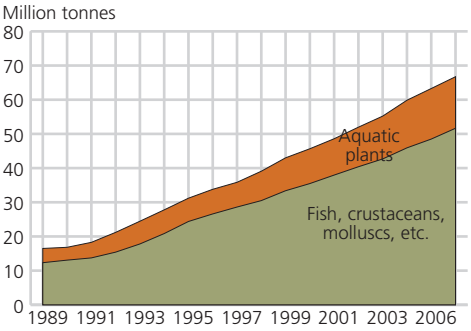
Norway ranks as number 11 among the world's largest fishing nations (excluding farmed production), with a total catch of 2.3 million tonnes in 2006. At the head of the list are China (17.1 million tonnes), Peru (7.0 million tonnes), the US (4.9 million tonnes), Indonesia (4.8 million tonnes), Japan (4.2 million tonnes) and Chile (4.2 million tonnes).

In the Norwegian fisheries, the catch of herring in 2007 was about 174 000 tonnes higher than the year before, but the value of the catch was about the same, NOK 2.2 billion. The catch of cod decreased by 3 000 tonnes from 2006, but the value of the catch rose by about NOK 400 million to NOK 3.7 billion. The saithe catch dropped by about 30 000 tonnes to 225 000 tonnes, with a value of NOK 1.3 billion. The mackerel catch rose by about 10 000 tonnes to 130 000 tonnes, with a value of just under NOK 1 billion. The 2007 capelin catch was 41 000 tonnes, and its value was NOK 95 million. There was no fishery for Barents Sea capelin in 2007. The shrimp catch was 37 000 tonnes and its value was NOK 653 million. The Norwegian catch of blue whiting was 540 000 tonnes, a decrease of about 100 000 tonnes from 2006. However, the value rose to almost NOK 850 million.

See also Figures 6.5 - 6.7. More information about Norwegian fisheries and fish stocks at: http://www.ssb.no/english/subjects/10/05/fiskeri_en/, http://www.fiskeridir.no/ and http://www.imr.no/

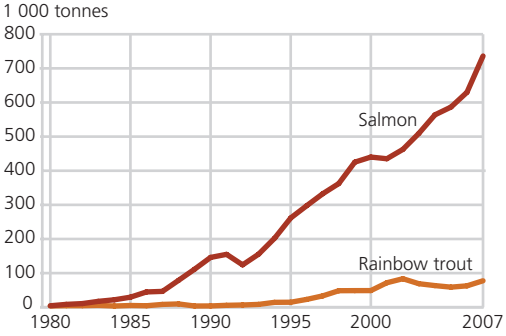
6.4. Aquaculture

Figure 6.8. **World aquaculture production. 1989-2006**



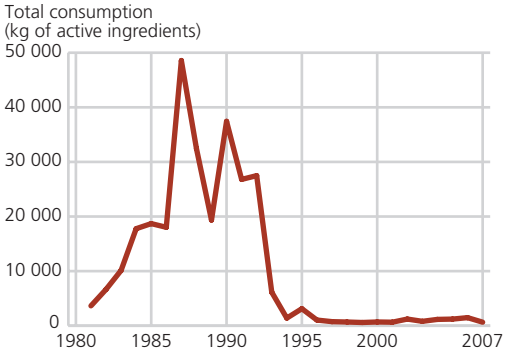
Source: FAO (2008).

Figure 6.9. **Fish farming. Volume of salmon and rainbow trout sold. 1980-2007**



Source: Fisheries statistics, Statistics Norway, and Directorate of Fisheries.

Figure 6.10. **Consumption of medicines[1] (antibiotics) in fish farming. Kg active ingredients. 1982-2007**



[1] Based on sales figures from pharmaceutical wholesalers and feed suppliers. This explains deviations from the prescription-based statistics discussed in the next section.
Source: Norwegian Institute of Public Health.

World aquaculture production

- In 2006, world aquaculture production totalled 51.7 million tonnes fish, crustaceans, molluscs, etc. corresponding to about 56 per cent of the total catch in marine and inland fisheries for that year.
- Production of aquatic plants totalled 15 million tonnes in 2006.
- World aquaculture production has more than trebled since 1989.

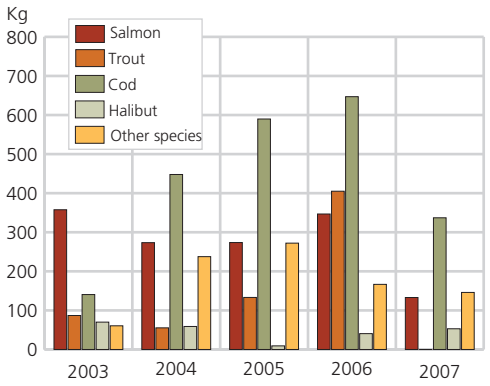
Salmon and trout farming in Norway

- Production of farmed salmonids has increased dramatically since the industry was established in the early 1970s. According to preliminary figures, salmon production (sold quantity) rose to 736 000 tonnes in 2007.
- Production of trout was 78 000 tonnes in 2007.
- In 2006, Norwegian production of Atlantic salmon accounted for a little under half the total global production of this species (1.31 million tonnes). Over 80 per cent of farmed salmon is exported.

Fish health in salmon farming

- Health problems include viral, bacterial and parasitic diseases, and other problems such as winter ulcers, gill inflammation, heart and skeletal muscle inflammation and deformities.
- The consumption of antibiotics peaked in 1987 at 49 tonnes. Consumption in 2007 was 649 kg, which is a reduction of about 800 kg or 56 per cent from 2006. These figures apply to all species of farmed fish.
- Thus, consumption has been substantially reduced. In 1987, antibiotic consumption was almost 0.9 kg per tonne slaughtered salmon and trout, but has now been reduced to well below 1 g per tonne.

Figure 6.11. **Use of antibiotics[1] in fish farming, by species. Kg active ingredients. 2003-2007**



[1] Prescription-based statistics. The total quantity (668 kg) therefore differs somewhat from the sales-based statistics figures (649 kg).
Source: Norwegian Food Safety Authority.

- An analysis of prescription-based statistics carried out by the Norwegian Food Safety Authority showed that cod farming accounted for 337 kg or 50 per cent of the total consumption of antibiotics in fish farming in 2007 (668 kg). However, consumption of antibiotics in cod farming has been reduced by half since 2006, and the only species where a rise in consumption of antibiotics has been registered is halibut. According to the Food Safety Authority, the reason for this is not known, but is probably related to random variations in the incidence of bacterial diseases in farmed fish.
- Consumption of antibiotics for salmonids (salmon and trout) is low relative to the production volume, and the Food Safety Authority's statistics for 2007 show that consumption in trout farming was almost zero.

Box 6.4. More about aquaculture production

In 2006, world aquaculture production of fish, crustaceans, molluscs, etc. totalled 52 million tonnes, and freshwater production accounted for just under 58 per cent of this (see Table 6.1). World aquaculture production excluding plants rose by 3.2 million tonnes (6.5 per cent) in 2006. In addition, 15.1 million tonnes of aquatic plants were produced. China is by far the largest aquaculture producer, accounting for almost 70 per cent of total production (animals and plants) in 2006.

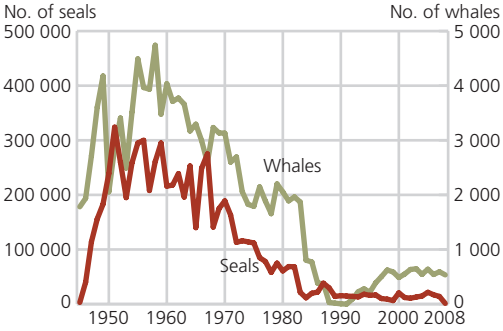
The species farmed in the largest volume was the Pacific oyster (*Crassostrea gigas*), at 4.6 million tonnes, followed by a number of species of carp. On a list of 29 farmed species of which over 210 000 tonnes were produced in 2006, Atlantic salmon ranked as number 13. World production of Atlantic salmon in 2006 was 1.3 million tonnes.

According to preliminary figures from the Directorate of Fisheries, mussel production in Norway in 2007 was about 2 700 tonnes, which is a reduction of about 1 000 tonnes from 2006. Production of other fish species than salmon and trout for human consumption is still relatively modest in volume. In 2007, 9 600 tonnes of cod and about 4 300 tonnes of other species (Arctic char, halibut, turbot, etc.) were sold in Norway.

According to preliminary figures from the Directorate of Fisheries, total losses from seawater rearing units in 2007 were 42.6 million fish (about 38 million salmon and 4 million trout). This included 379 000 salmon and trout that were reported to have escaped from fish farms. In addition, 71 000 fish of farmed marine species (cod and halibut) were reported to have escaped. The number of escaped fish was considerably lower than in 2006. Other losses are attributed to mortality, fish discarded at slaughtering plants and unknown causes.

6.5. Sealing and whaling

Figure 6.12. **Norwegian sealing and whaling[1]. 1945-2008***



[1] In the period 1988-1992, scientific whaling only.
Source: Directorate of Fisheries.

- In 2007, the total seal catch was 13 981 harp seals (7 828 in the West Ice and 6 153 in the East Ice). Preliminary figures for 2008 indicate that the total catch of harp seals was 1 263, all taken in the West Ice. Hunting of hooded seals was prohibited in 2007 and 2008, but a limited number were taken for research purposes. Sealing is currently not profitable, and is largely financed through government grants.
- The quota for the small whale hunt in 2007 was 1 052 animals, but only 593 were caught. The value of the small whale catch in 2007 was about NOK 24 million. Preliminary figures for 2008 indicate a catch of 535 whales with a value of NOK 22 million. The quota for 2008 was set at 1 052 whales.

Box 6.5. Some important diseases and health problems associated with salmonid farming

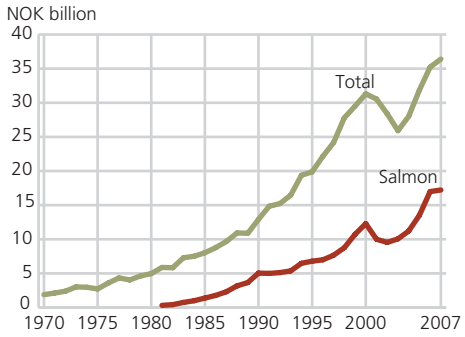
This information on the incidence of disease in salmon farming in 2007 is based on figures in *Annual report on the coastal zone and aquaculture 2008* (Boxaspen et al. 2008). Serious diseases include the following:

- Furunculosis, caused by the bacterium *Aeromonas salmonicida* (5 cases in 2007: 4 seawater sites and one river with a wild salmon stock).
- Bacterial kidney disease (BKD), caused by the bacterium *Renibacterium salmoninarum* (not registered in 2007).
- Infectious salmon anaemia (ISA), a virus disease (7 registered cases in 2007).
- Infectious pancreatic necrosis (IPN), a virus disease (165 registered cases in 2007).
- Pancreas disease (PD), a virus disease (registered at 98 seawater sites in 2007).
- Heart and skeletal muscle inflammation, a virus disease (registered at a minimum of 162 sites in 2007).

Other serious diseases that cause considerable losses include cardiomyopathy syndrome (CMS), viral haemorrhagic septicaemia (VHS) and winter ulcers.

6.6. Exports

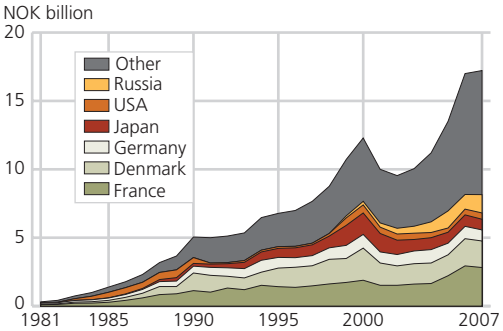
Figure 6.13. **Value of Norwegian fish exports. Current prices. 1970-2007**



Source: National accounts and forestry statistics, Statistics Norway.

- In 2007, Norway exported about 2,2 million tonnes of fish and fish products to a value of almost NOK 37 billion. Exports to EU countries accounted for 63 per cent of the export value.
- According to FAO, Norway was in 2006 the world's second largest exporter of fish in terms of value, behind China and ahead of Thailand, the US, Denmark, Canada, Chile, Vietnam and Spain. Norway's fish exports accounted for about 6 per cent of the value of total world fish exports.

Figure 6.14. **Exports of salmon[1], by main importing countries. 1981-2007. Current prices**



[1] Mostly farmed fish, although other salmon is also included.
Source: External trade statistics, Statistics Norway.

- Salmon exports were worth in excess of NOK 17 billion in 2007. This was a rise of NOK 225 million from 2006. The quantity exported rose by more than 100 000 tonnes.
- France and Denmark have for a number of years been the most important importers of Norwegian farmed salmon. There was a moderate decrease in the value of exports to both France (NOK 2.8 billion) and Denmark (NOK 1.9 billion) from 2006 to 2007.
- In 2007, the value of exports to Russia and China totalled NOK 1.3 billion and NOK 200 million respectively.

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Useful websites:

International Council for the Exploration of the Sea: http://www.ices.dk/
FAO - UN Food and Agriculture Organization: http://www.fao.org/
Directorate of Fisheries: http://www.fiskeridir.no/
Institute of Marine Research: http://www.imr.no/
Norwegian Food Safety Authority: http://mattilsynet.no/
Statistics Norway, Fishery statistics: http://www.ssb.no/english/subjects/10/05/
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