2.5. Fisheries and aquaculture

A complex set of driving forces has resulted in overexploitation of most of the capture fisheries of Europe, leading in turn to increased catches of compensating species. Many stocks are now considered to be outside safe biological limits, and some are in a critical state. A range of alternative management regimes has been introduced, but most of these have failed to achieve policy objectives, primarily because the forces driving overexploitation have not been addressed. Indeed, government subsidies to the sector may have exacerbated the problem.

It is this aspect of persistent chronic overexploitation that is the greatest current environmental concern. Care is also needed to ensure that the current overcapacity in Europe is not exported to other countries, either through the sale of fishing vessels or through fishing agreements with third-party countries. The new common fisheries policy of the EU, which entered into force on 1 January 2003, aims to tackle this as well (European Commission, 2002a).

While fisheries economic production is generally in decline, aquaculture has grown dramatically, especially marine aquaculture in western Europe. The main aquaculture-related environmental concerns are associated with intensive cultivation of salmon and other marine finfish species and with trout or carp in freshwater. Also, intensification of aquaculture increases the demand for fish feed, which then increases fishing pressure on wild stocks. The local effects of aquaculture practices on the aquatic environment are well understood and highly regulated and monitored in the main producing countries. The wider impacts on the nutrient status of receiving waters, and effects on wild populations via escapees and parasites are, however, less well understood and more difficult to monitor and manage. In the European Union, these concerns should be more effectively addressed under the water framework directive and under the European Union recommendations on integrated coastal zone management and strategic environmental assessment.

2.5.1. Introduction

The Food and Agriculture Organization of the United Nations (FAO) code of conduct for responsible fisheries, agreed by all major countries of the world, defines a responsible fisheries policy as follows. It is one which ensures 'effective conservation, management and development of living aquatic resources with due respect for the ecosystem and bio-diversity in order to provide, both for present and future generations, a vital source of food, employment, recreation, trade, and economic well-being for people'.

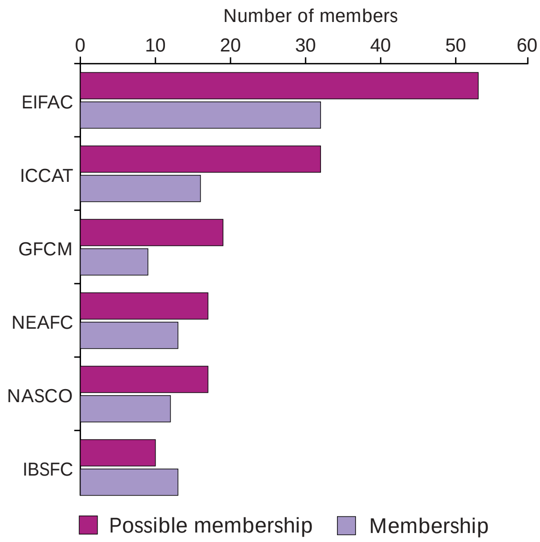
Greater integration of environmental concerns, and the application of the 'precautionary principle' to fisheries and aquaculture management are key elements of EU fisheries policy and are specifically mentioned in the EU's plans for the reform of the common fisheries policy (CFP) (European Commission, 2002b). Most of these elements are reiterated in other national, bilateral and regional agreements and conventions. Commitments are increasingly being made, at national, international and EU levels to a more ecosystem-based approach to fisheries and aquaculture management.

Management regimes are normally designed to control pressures (e.g. fishing capacity) and impacts through a combination of quotas, gear controls, closed areas, and vessel restrictions. Controls on the economic driving forces (e.g. capping prices, sales or salaries) are rarely considered - indeed, subsidies are often available which may undermine other management initiatives.

Membership of international fisheries organisations (IFOs) (see Figure 2.5.1) gives a rough indication of a country's commitment to fisheries management.

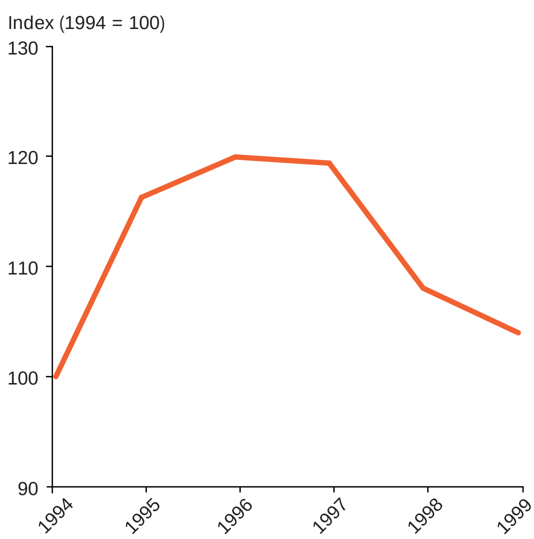
Membership of IFOs is high in western European (WE) and central and eastern European (CEE) countries but low among the countries of eastern Europe, the Caucasus and central Asia (EECCA). Many of the fisheries in EECCA are in large transboundary inland lakes or seas (e.g. Caspian Sea, Aral Sea, Lake Peipus). It is not necessary to form an IFO in these situations, but coordinated management is required. This is becoming more common, which is encouraging. The role of IFOs in the management of international fisheries is expected to expand with increasing monitoring and the application of sanctions in cases of non-compliance.

Figure 2.5.1. **European membership of international fisheries organisations with a European area of operation 2002**



Notes: EIFAC: European Inland Fisheries Advisory Commission. ICCAT: International Convention for the Conservation of Atlantic Tuna. GFCM: General Fisheries Commission for the Mediterranean (responsible for the Mediterranean Sea, Black Sea and connecting waters). Georgia, the Russian Federation and Ukraine are not members of GFCM, but experts participate at GFCM meetings concerning the Black Sea. NEAFC: North East Atlantic Fisheries Commission. NASCO: North Atlantic Salmon Conservation Organization. IBSFC: International Baltic Sea Fishery Commission. Possible membership: the number of countries with fisheries relevant to the international fisheries organisations' area of operation. Membership: the number of countries that are members of the international organisation. Some EU countries are not represented on international organisations individually but by the European Union. Countries represented by the EU are included in the number of countries counted as being 'members'. Some countries are also members of other international fisheries organisations, which have a remit for fisheries in other areas of the world, e.g. the North West Atlantic, the Antarctic.
Sources: EIFAC, GFCM, IBSFC, NEAFC, NASCO, ICCAT

Figure 2.5.2. **Western European fisheries economic production index**



Notes: The economic fisheries production index provides a signal of income levels derived from fishing. Under the circumstances of a falling index fishermen and vessel owners are more likely to seek to increase income from further fishing activity, while others may choose to leave the industry. The reverse is likely in a rising index. The index has been calculated using the first-hand value of fish catch expressed in terms of value per full-time fisherman, modified by the strength of the local economy, and the technological scale (power) of the local fleet, indexed against a base year of 1994. Includes only Belgium, France, Greece, Netherlands and United Kingdom as all required data were only available for these. 1999 data point should be approached with caution as not all data are available for all countries.
Sources: Anon, 2000 and 2001b; FAO, 2002; OECD, 2001; Eurostat New Cronos database, 2002; Pacific Exchange Rate Service, no date; Anon, 2001b; World Bank, 2001

2.5.2. Fisheries

2.5.2.1. Economic drivers and pressures

Most of the fisheries in Europe are overexploited and declining catches have not reduced fishing pressures. In some cases, the profitability of fisheries has decreased and those with significant committed investment have had little choice but to fish harder to pay off their investment. This type of influence is represented in the fisheries economic production index shown in Figure 2.5.2, which suggests that income has declined in recent years following a peak in the mid-1990s. This may elicit a variety of responses from fishermen: to fish harder in order to maintain income; to circumvent legal constraints on fishing activity; to leave the industry if suitable alternatives exist; or to shift to other fisheries, such as shellfisheries. Subsidies, and especially capital subsidies, have exacerbated the problem.

On a more positive note, technical advances and improved labour productivity have, to some extent, compensated for declining catches. Further, rising prices associated with declining catches have tended to stabilise earnings, but these same factors can also facilitate and encourage substantial increases in effort and levels of exploitation. Profitability, tradition and, in some places, lack of alternatives remain the main incentives to invest in fishing enterprises and continue fishing.

The decline in the fisheries economic production index for the third year running indicates the worsening economics of marine fishing in western European countries at a general level, and signals rising incentives to increase fishing effort and work round control regulations in order to maintain economic benefits at previous levels, or to leave the industry.

One of the most commonly used indicators of fishing pressure — fishing capacity measured in terms of the combined main engine power of the fleet — has decreased since 1990 (Figure 2.5.3.). The largest reductions have been in the EU fleet, driven by EU fisheries policy and financial assistance for decommissioning. The EECCA fleet size has also decreased following the collapse of many previously state-operated fishing enterprises.

Although some fleet capacity reductions in terms of engine power have been achieved in the EU, this positive influence may be neutralised by increases in fishing efficiency or effort (for example days at sea). Much larger reductions are needed as a matter of urgency to reduce overfishing. The current process of reform of the CFP indicates that a further reduction of around 40 % is still required (European Commission, 2001; 2002b). This will require strong political will and some measures to reduce the adverse short-term socio-economic impacts.

The increases in the capacity of the Norwegian and Icelandic fleets suggest a worsening of the situation, but it should be noted that these changes are taking place in the context of national management regimes and practices that are the most advanced in Europe in supporting and encouraging responsible and sustainable fisheries.

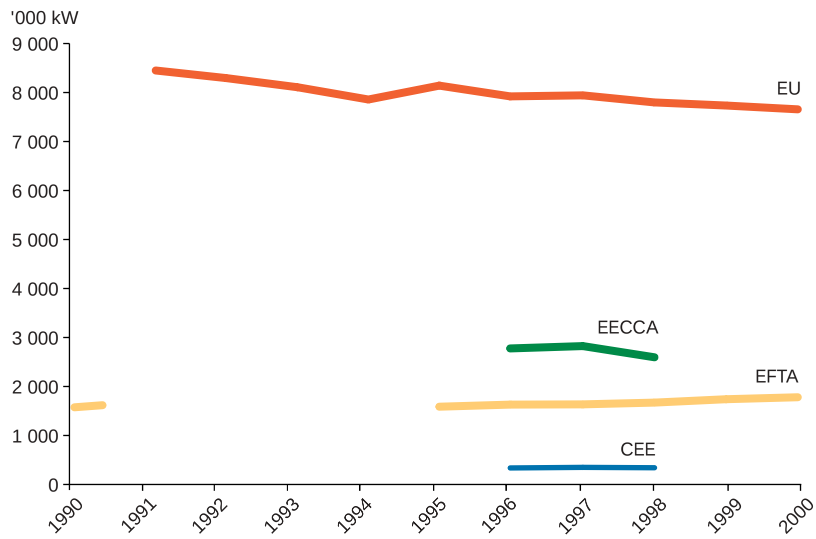
> Compared with the indicative policy objectives, only modest reductions in the capacity of the European fleet as a whole have been achieved over the past decade.

In the past, some of the overcapacity of the European fleet, and in particular the EU fleet, has been 'exported' to third-party countries, either through fishing agreements (the EU has concluded around 20 such agreements) or through the sale of fishing vessels. This has undoubtedly increased fishing pressure in some other parts of the world, and may have had knock-on socio-economic effects.

2.5.2.2. Impacts of fishing

The most direct impact of fishing is the removal of a significant proportion of target fish populations — the catch (see Box 2.5.1.). Since 1990, total landings of marine catch have increased by 25 % (Figure 2.5.4), although longer time-series data show catches may be returning to pre-1990 levels. This increase has occurred throughout Europe and for most major types of fish and shellfish. Landings of many key stocks, e.g. Atlantic cod, Atlantic mackerel and blue-fin tuna, have declined significantly in recent years and alternative species have been caught e.g. Alaskan pollock as a substitute for cod. The overall increase in landings is due to fishing fleets catching species that were not caught previously, such as industrial and deep-water species, some of which are used to underpin the growth of aquaculture (see Section 2.5.3).

European fishing fleet power Figure 2.5.3.



Notes: EU includes all coastal countries. EFTA is represented in these figures by Norway and Iceland only. Of the CEE countries, figures were only available for Croatia, Cyprus, Estonia, Latvia, Romania and Slovenia. EECCA includes Azerbaijan and the Russian Federation. Other countries not included due to lack of data or absence of fishing fleet. FAO data on CEE and EECCA countries' fleets only include information on decked vessels.

Sources: Eurostat; Anon, 2001b; Norwegian Directorate of Fisheries; FAO, 2002

Box 2.5.1. Discards and by-catch

The catch is composed not only of fish that are landed and sold, but fish that are discarded and subsequently die, as most do, and non-targeted species such as starfish, marine mammals and seabirds. These discards form a source of food for many scavenging sea creatures and seabirds. In fact, discards of fish form a large proportion of the diet of many seabirds in the North Sea.

The level of discarding is very variable and depends on the interaction of a range of factors. High levels of discarding may occur if there are lots of juvenile fish in the sea. This may be due to natural fluctuations in breeding.

Discarding is affected by the net mesh size and minimum landing size (MLS) allowed. If mesh sizes are such that large numbers of fish just below the legal minimum landing size are caught, then discarding will be high. Ensuring that regulations are complementary and do not undermine or contradict each other can alleviate this problem.

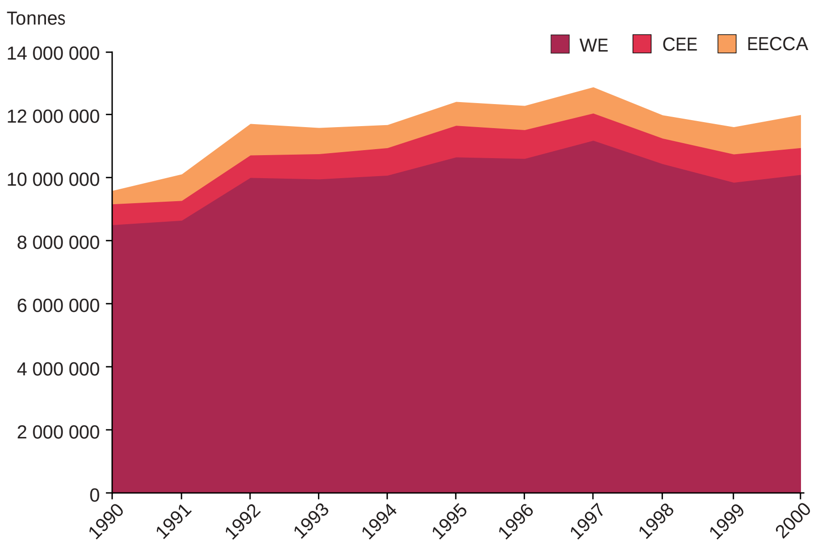
Quotas can also affect discard rates. Low quotas mean that fishermen have to discard all fish of a particular species once their quota for that species has been fulfilled. Low quotas can also lead to 'high grading', whereby low-value (e.g. small or damaged) fish are discarded in the hope that higher-value examples can be caught in the future, in order to gain the most income from a given quota. Other management regimes, such as that in Norway, prohibit any discarding.

Economics and market conditions can also affect the level of discards. If a previously discarded species becomes marketable, then discards will decrease, but overall the amount of fish caught will remain the same since that species is now being caught and sold instead of caught and discarded.

Illegal landings of sturgeon in the Caspian Sea are many times greater than legal landings and illegal trade in sturgeon products, especially caviar, continues to fuel illegal fishing. Official landings of sturgeon have fallen dramatically since 1992 (see Box 2.5.2).

The indirect and less easily observable impacts of fishing are those on the wider

Figure 2.5.4. Total landings of catch in Europe, 1990–2000



Notes: All catches of all species in North East Atlantic Ocean (includes Baltic Sea), Mediterranean Sea and Black Sea (including the Azov Sea) and Arctic Ocean . Caspian Sea and Aral Sea not included, as these are considered to be 'inland waters' by FAO. WE: Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Monaco, Netherlands, Norway, Portugal, Spain, Sweden, United Kingdom. CEE: Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Cyprus, Estonia, Latvia, Lithuania, Malta, Poland, Romania, Slovenia, Turkey, Serbia and Montenegro. EECCA: Georgia, Russian Federation, Ukraine. Other European countries not included due to either a lack of fishing activity or a lack of data.

Source: FAO Fishstat Plus, no date

Box 2.5.3. The spawning stock biomass indicator

The total biomass of spawning stock (SSB) is one of the indicators used by ICES, the International Convention for the Conservation of Atlantic Tuna (ICCAT) and other fisheries organisations to assess the status of fish stocks. The level of fishing mortality (F) is used in conjunction with SSB. Reference points for SSB and F have been established, which indicate whether a stock is healthy or at risk of collapse.

Stocks are assessed in terms of the level that is considered to be sustainable. If SSB is too low, the stock is more likely to collapse. If fishing mortality is too high (i.e. too much of the stock is being removed by fishing activity), then the stock may also be more likely to collapse. The precautionary level of SSB (SSBpa) is the size of spawning stock below which management measures should be taken. Every effort should be made to ensure that SSB does not fall below this limit level (SSBlim). When SSB is below SSBlim, recruitment is likely to be affected and the risk of stock collapse is increased.

SSBpa and SSBlim do not take fisheries economics into account. They are purely biological reference points for sustainability against which the current state of the stock can be compared.

marine ecosystem, such as the effects of removing large quantities of fish that form the food for other species (e.g. sand eels), removing predators (e.g. cod) or causing disturbance to the seabed and its animal communities. These ecosystem impacts are poorly understood, but may have knock-on effects on other commercial fish species, marine mammals and seabirds. These issues are now being intensively researched.

Overall, total European marine landings have increased by 25 % (2.4 million tonnes) since 1990. Landings of Atlantic cod, Atlantic mackerel and blue-fin tuna have declined in recent years, which has been compensated for by increased catches of Alaskan pollock, industrial and deep-water species.

A recent International Council for the Exploration of the Sea (ICES) working group on the ecosystem effects of fishing activity (WGECO) states that the level of beam trawling activity in some areas of the North Sea (10 or more trawls per year) may be comparable to the effect of dredging for marine aggregate (ICES, 2002). Deep sea trawling operations off the west coasts of Scotland and Ireland are causing concern due to their potential to damage the fragile deep-sea coral beds in these areas. Other environmental problems that may affect the sector, such as the effects of climate change, pollution and habitat destruction on fish stocks, are poorly understood. Nonetheless, it is now well established that certain organic pollutants contaminate fish to a level where it is no longer suitable for human consumption.

2.5.2.3. Status of fish stocks

ICES considers all European stocks of Atlantic cod and Atlantic mackerel to be at risk, either because the spawning stock biomass is too low (see Box 2.5.3 and Figure 2.5.6), or because fishing mortality is too high. Stocks of eastern North Atlantic blue-fin tuna are also a cause for concern. Until now, more fishing has been allowed than is recommended by scientific advice due to the lobbying influence of the fishing industry on governments. Only some commercially important fish stocks are monitored. ICES only monitors stocks in the North East Atlantic Ocean and adjacent seas such as the Arctic Ocean, Baltic Sea and North Sea. Stocks in other areas such as the Mediterranean Sea and Black Sea are not closely monitored, although this is improving. The General Fisheries Council for the Mediterranean (GFCM) does, however, report annually on the state of key stocks although the spatial coverage of these assessments is limited — hake and red mullet are considered overfished whilst sardine and anchovy are within safe limits. Biological reference points have only been set for a few commercially exploited species.

Box 2.5.2. Caspian Sea sturgeon

Sturgeon is the most valuable fish in the world and forms an important economic component of the catch in the eastern Europe, the Caucasus and central Asia. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) lists 25 of the 27 species of sturgeon and paddlefish ('cousins' of sturgeon) in Appendix II of the convention, meaning that international trade requires special documentation. The remaining two species - including the Baltic or common sturgeon (*Acipenser sturio*) — are listed in Appendix I of the convention, which bans all international trade in these species or products derived from them (CITES, 2000).

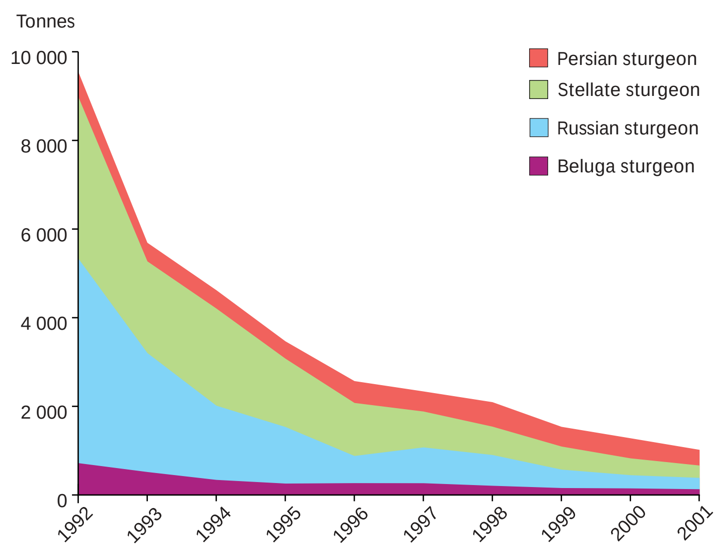
Somewhere between 60 % and 90 % of the world's caviar production comes from the Caspian Sea. The Caspian sturgeon fishery is split between five coastal countries — the Russian Federation, Azerbaijan, Kazakhstan, Turkmenistan and the Islamic Republic of Iran. The northern part of the Caspian Sea supports the major commercial stocks and it is the northernmost countries that catch most of the sturgeon.

Despite the general trend of increased landings in most European fisheries, official sturgeon landings from the Caspian Sea have fallen dramatically since 1992. This decline is not due to reduced fishing, but to a lack of available fish and to illegal landings not being included in the data. Illegal and unrecorded landings are estimated to be approximately 10 times the legal landings. The former USSR closely controlled sturgeon fishing, banning fishing at sea and attempting to rebuild stocks with extensive hatchery and restocking programmes, but its dissolution led to fishing restrictions being lifted or not properly enforced and hatcheries being abandoned due to lack of funding. Caspian Sea sturgeon have not only been affected by fishing but have suffered greatly from pollution and access to spawning grounds being reduced or blocked by the construction of hydroelectric dams across the rivers that form their main migratory pathways.

To tackle these problems, Azerbaijan, Kazakhstan, Turkmenistan and the Russian Federation set up the Commission on Caspian Aquatic Bioresources in 1992 to control the sturgeon fishery. The commission assesses stocks and sets fishing quotas, and the Islamic Republic of Iran, where illegal fishing and trade in sturgeon is tightly monitored, undertakes a similar process. In June 2001, the five countries bordering the Caspian Sea agreed to build a management system for sturgeon stocks and to implement a commercial ban on fishing until the end of 2001. The authorities have also undertaken intensive enforcement operations against poachers, seizing illegally caught sturgeon and caviar.

Similar problems of overfishing, illegal fishing, and loss of habitat are found in the other major sturgeon fishing areas of the Black Sea (fished by Romanian, Bulgarian and Ukrainian fishermen) and the Azov Sea (fished by Ukrainian and Russian fishermen). However, increased enforcement, cooperation with CITES, intensive scientific research, restocking programmes and habitat improvement programmes are all under way in these areas, and international cooperation among the sturgeon fishing nations and the international community is continually improving.

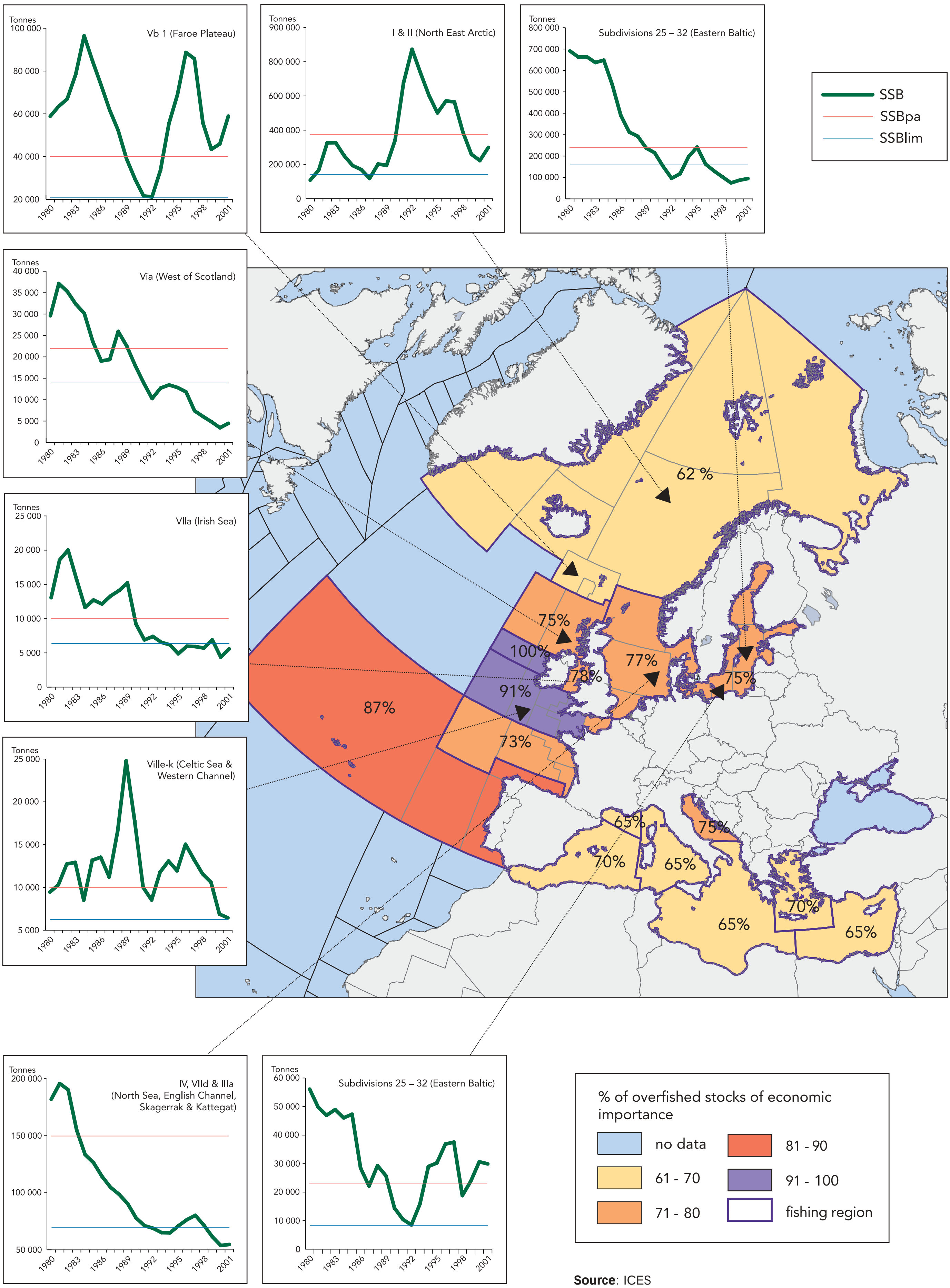
Catch of Caspian Sea sturgeon Figure 2.5.5.



Notes: Data from the Russian Federation and the Islamic Republic of Iran have been combined to give sturgeon landings for the Caspian Sea. Landings from other countries are not included due to lack of reliable and comprehensive data. Landings of sterlet sturgeon (*Acipenser ruthenus*) and ship sturgeon (*Acipenser nudiventris*) have not been included as they are caught in only small amounts (<2 tonnes and < 25 tonnes in any one year respectively). All landings of Persian sturgeon (*Acipenser persicus*) are made by the Islamic Republic of Iran. Landings do not take into account illegal/ unrecorded landings.

Source: The Management Authority for Sturgeon of the Russian Federation, 2000

Figure 2.5.6. **Spawning stock biomass of European Atlantic cod stocks**



Source: ICES

> Most European cod stocks have declined significantly since 1980 and most are considered to be at risk of collapse.

2.5.2.4. Inland fisheries
Inland fisheries provide an important source of fish for consumption and trade, and recreational fisheries are becoming increasingly important economically. Inland waters are subject to many pressures — fishing, abstraction, pollution, aquaculture, damming, irrigation, climate change and land-use change (see Chapter 8). Although overfishing may be a problem in some areas, FAO considers environmental degradation, not overexploitation of fish stocks, to be the greatest threat to inland fisheries (FAO, 1999), as in the case of the Caspian Sea sturgeon (see Box 2.5.2). This reinforces the view that more integrated environmental management of watersheds is required especially as demand for the utilisation of inland waters is expected to increase.

> Commercial inland fisheries catches have fallen by 32 % (258 000 tonnes) since 1990 while recreational fishing is increasing. Data relating to the scale of these fisheries are very limited.

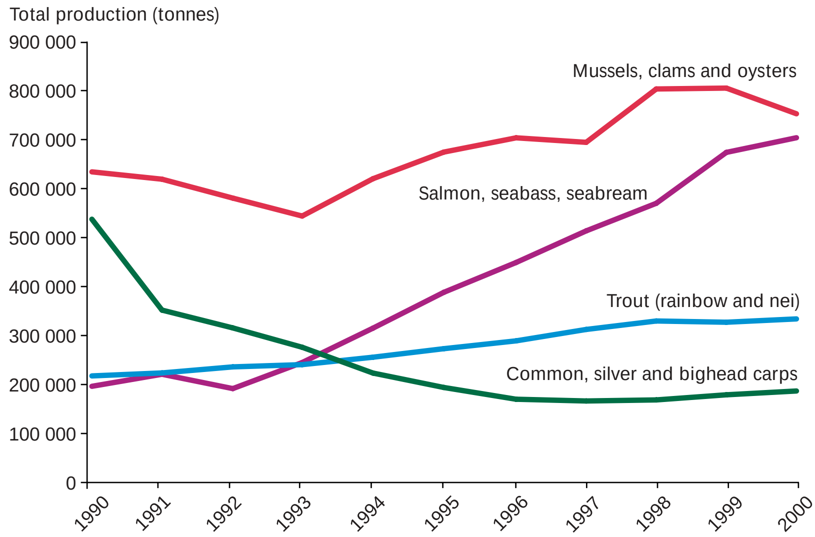
2.5.3 Aquaculture

2.5.3.1. Economic drivers and pressures
The rapid increase in the production of farmed fish is driven by strong market demand, and made possible through technical advances. Strong market demand is due mainly to:

- population growth and increased income;
- the worldwide popularity of seafood as a healthy food and as a luxury food;
- declining wild catches of high-value fish species;
- cheaper and easier international trade, transport and communications.

Total production in 2000 was just over 2 million tonnes (Figure 2.5.7.). Most of the increase during the 1990s was from marine salmon culture in northwest Europe, and to a lesser extent trout culture (throughout WE and Turkey), sea bass and sea bream cage culture (mainly Greece and Turkey), and mussel and clam cultivation (throughout WE). Inland aquaculture of carp (mainly common and silver carp) declined

European production of major commercial aquaculture species, 1990–2000 Figure 2.5.7.



Note: Includes all countries and production environments for which data are available
Source: FAO Fishstat Plus, no date

significantly throughout CEE, resulting partly from political and economic changes.

Aquaculture has also been promoted in many parts of Europe as an alternative to fisheries where these are in decline or where other development options are limited in remote regions.

Intensive aquaculture currently depends on high quality pelleted feeds containing a significant proportion of fish meal. This is boosting demand for fish meal and generating strong incentives to increase fishing pressure on wild stocks throughout the world. This pressure should be understood in the context of global demand and trends for fish meal and oil for animal feeds generally.

The price of farmed marine finfish has declined significantly over the past decade as production has increased rapidly. This has stimulated substantial rationalisation of the industry. The bulk of production is now produced by a few major multinational enterprises. Small-scale producers find it increasingly difficult to survive.

> Intensification of aquaculture and the related increase in demand for fish feed affect the fishing pressure on wild stocks. Fishing for food becomes fishing for feed.

Recent negative publicity relating to intensive farming of marine species may lead to some fall in demand and prices unless the industry demonstrates better environmental and product-quality management.

2.5.3.2. Environmental impacts

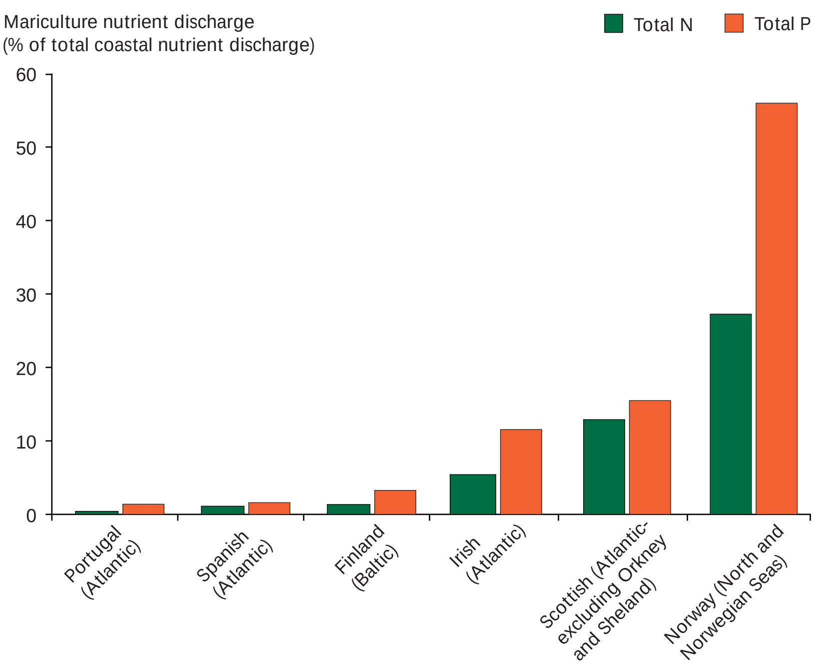
Different types of aquaculture generate different pressures on the environment. Intensive finfish production in marine waters and freshwater where production has increased most rapidly in recent years generates the greatest environmental pressure.

For intensive finfish aquaculture in marine and brackish waters and freshwater, pressures include discharge of organic matter, nutrients, chemicals and the escape of cultured organisms, and possibly increased density of pathogens. Inland pond aquaculture of carp usually requires less intensive feeding, and in most cases a greater proportion of the nutrients discharged are assimilated locally. In the case of bivalve molluscs, pressures include removal of plankton, and local concentration and accumulation of organic matter and metabolites.

Nutrients, organic matter, and chemicals discharged from intensive cultivation of finfish have well-understood effects in the immediate vicinity of cages or pond discharges, but also contribute to the overall load on the inland and coastal environment from agriculture, forestry, industry and domestic waste. Wider impacts on water quality and ecology can only be considered in the context of this wider pressure (see Box 2.5.4.). Figure 2.5.8 shows the relative significance of nutrient discharges from marine cage culture in some important producing countries. Although the figures should be treated as indicative only, it is clear that where aquaculture is a major industry in otherwise relatively undeveloped coastal areas, it can become the major anthropogenic source of nutrients. This is particularly the case within those aquatic systems (such as fjords, sea lochs, archipelagos) most suited to aquaculture. However, this does not necessarily imply a problem if well managed; for instance HELCOM (Helsinki Commission) has recently removed the major Finnish fish farming areas (archipelago and Åland Sea) from its list of 'hot spots'.

The point at which the pressure from organic matter, nutrients or chemicals triggers undesirable changes in the wider coastal environment, such as harmful algal blooms or other changes in ecology, is not well understood. In this process, there is no clear evidence that aquaculture has contributed to such problems (Scottish Association for Marine Science and Napier University, 2002). Indeed, aquaculture (especially of salmonids) generally takes place in relatively pristine waters, in which water quality historically has remained well within environmental quality standards. In most cases, however, monitoring programmes do not sample coastal waters systematically in relation to existing pressures.

Figure 2.5.8. Contribution of marine and brackish water finfish culture to total anthropogenic coastal discharges in selected countries



Notes: The data on 'other coastal nutrient discharges' comprise riverine inputs and direct discharges as reported for 1999 in the OSPAR Study on Riverine Inputs and Direct Discharges (RID). Nutrient discharge from mariculture is estimated from production using the mid-range of values stated in the OSPAR report (Ospar Commission, 2000) (55g N/kg production and 7.5g P/kg production). The figures for Finland are based upon the HELCOM 1998 data. Nitrogen limited to riverine discharge only (no data on direct inputs). Phosphorus discharge: average of lower and upper estimates. Total N for riverine discharge estimated as NH_3-N+NO_3-N. This will overestimate the relative N discharge from aquaculture. Nutrient discharge applicable to sea areas in which the bulk of marine and/or brackish water finfish aquaculture takes place have been used. These figures do not include N and P discharges from inland aquaculture production. Production figures relate to marine species only, except Finland, which refer to brackish water production.

Sources: FAO Fishstat Plus, no date; Jonsson and Alanara, 1998; Ospar Commission, 2000; Haugen and Englestad, 2001; Beveridge, pers. comm.; HELCOM, 1998

Marine finfish culture (mainly Atlantic salmon) now makes a significant contribution to nutrient discharge in some coastal waters, but there is no clear evidence that this has resulted in significant undesirable changes in the wider coastal environment.

2.5.3.3. Environmental management

Aquaculture is relatively highly regulated in WE and less well regulated elsewhere (Figure 2.5.9.). Regulation is strongest in those countries where the growth of aquaculture has been most rapid, suggesting that governments have taken a precautionary approach.

However, assessment, regulation and monitoring have been concerned mainly with the micro-impacts of organic matter in the immediate vicinity of farms and have not addressed the potentially more serious impacts on wild fish populations and the wider environment (see Box 2.5.4.). These can only be addressed through comprehensive monitoring and integrated management of aquatic systems, taking account of the pressures from aquaculture and other economic activities.

Aquaculture is highly regulated in many major producing countries, but generally at the individual farm level with little attention to diffuse and cumulative impacts and few links between monitoring and regulatory response.

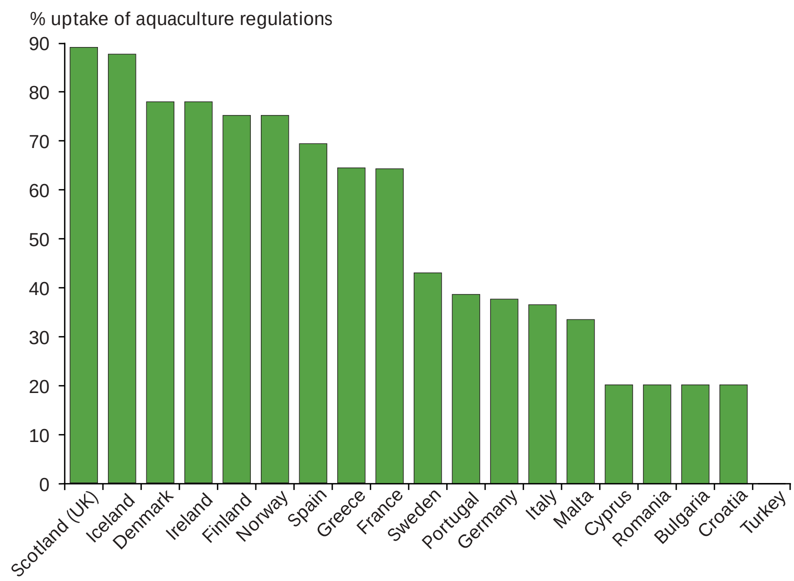
The industry itself has responded with technical and management measures to reduce waste and other environmental pressures. The efficiency of nutrient utilisation in intensive salmonid aquaculture has increased steadily. Industry sources suggest that the quantity of nitrogen discharged per tonne of production has decreased from almost 180 kg/tonne of production in the late 1970s to less than 40 kg/tonne in the mid-1990s. While these improvements have come mainly from improved feed quality, future progress is more likely to come from improved feed management systems.

Intensive work is continuing to reduce nutrient loads from aquaculture as in agriculture. In several European countries, closed system fish farms are in operation. While these do not directly pollute aquatic systems, they still generate waste that requires careful management. Some sectors of the industry have also responded to consumer concern by initiating codes of practice and joining quality management and organic certification schemes.

Box 2.5.4. Escaped fish from fish farms

Significant numbers of farmed fish escape from fish cages and may affect wild populations through competition, genetic change and disease transmission. The largest producer of salmon, Norway, recorded 276 000 escapes in 2000 (NDF, 2000), corresponding to just under one escape per tonne produced — a ratio significantly lower than that achieved in the early 1990s. This should be seen in relation to the wild stocks numbering about 1 million wild salmon. In Scotland, total recorded escapes from cages varied between 67 000 in 1998 and 420 000 in 2000 (SERAD, 2002); these have been released into an area that probably supports about 60 000 wild salmon. Salmon farming could be contributing, along with other important pressures, to the current poor state of wild salmon and sea trout stocks. Direct indicators of competition, genetic change or disease incidence in wild stocks are currently not available or reliable enough to illuminate these issues.

Levels of aquaculture regulation, monitoring and policy in selected European countries Figure 2.5.9.



Notes: The regulations, policy and monitoring requirements for which data are available are capacity limits, environmental quality standards, food standards, medicinal and pesticide regulation, self-testing of food and environmental quality, authority testing of food and environmental quality, specific aquaculture policy, national aquaculture plans, centralised administrative framework, established aquaculture zones, environmental impact assessment and genetically modified organism (GMO) legislation. The percentage score refers to the percentage of these 15 key regulatory tools that have been reported as implemented by each country. The percentage is based only on those tools for which information is available for each country. The relative figure provides an indicative value only and should therefore be treated with caution.

Source: Adapted from Fernandes *et al.*, 2000; Christofilogiannis, 2000

2.5.4. References

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