

Indicator Fact Sheet

(FISH3) Aquaculture production

Authors: Steve Nixon (WRc), Nikos Streftaris (HCMR)

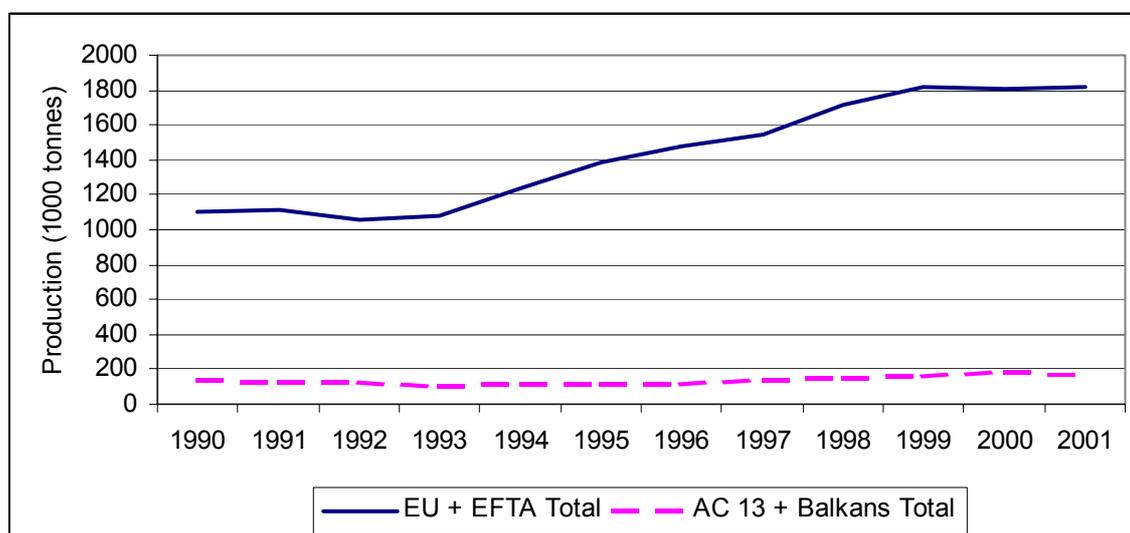
EEA project manager: Niels Thyssen

Indicator code / ID	FISH3
Analysis made on (Assessment date)	7 May 2004
EEA contact / fact sheet responsible Name: Pavla Chyska Email: pavla.chyska@eea.eu.int	Fact sheet development contact point Name: Nikos Streftaris, HCMR Email: nstrefta@ncmr.gr Name: Steve Nixon, WRc Email: nixon@wrcplc.co.uk

Key message

☹ European aquaculture production has continued to increase rapidly during the last 10 years, due to expansion in the marine sector in the EU + EFTA Countries. This represents a rise in pressure on adjacent water bodies and associated ecosystems. The precise level of local impact will vary according to production scale and techniques as well as the hydrodynamics and chemical characteristics of the region.

Figure 1 Annual aquaculture production by major area, 1990-2001



Source: FAO FISHSTAT Plus.

Notes: Aquaculture production includes all environments i.e. marine, brackish and freshwater.

EU + EFTA: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Sweden, UK, Iceland, Norway and Switzerland.

AC 13 + Balkans: Albania, Bulgaria, Czech Republic, Croatia, Estonia, FYR Macedonia, Hungary, Latvia, Lithuania, Poland, Romania, Yugoslavia, Slovak Republic, Slovenia, Cyprus, Malta and Turkey.

Luxembourg, Liechtenstein and Bosnia-Herzegovina, are not included due to either no aquaculture production or lack of data.

Results and assessment

Policy relevance:

Overall production is a simple and readily available indicator of environmental pressure in its various dimensions. However, as a stand-alone indicator, its meaning and relevance is limited because of widely varying production practices and local conditions. It should be integrated with other indicators relating to production practices to generate more specific indicators of pressure (such as total nutrient production or total chemical discharge). Coupled with information on assimilative capacity of different habitats this would allow for estimation of impact and ultimately the proportion of carrying capacity used and the limits to expansion.

Policy context:

Until recently there was no general policy for European aquaculture, although the Environmental Impact Assessment (EIA) Directive (85/337/EEC & amendment 97/11/EEC) requires specific farms to undergo EIAs and the Water Framework Directive requires all farms to meet environmental objectives for good ecological and chemical status of surface waters by 2015. There are few national policies specifically addressing the diffuse and cumulative impacts of the sector as a whole on aquatic systems, or the need to limit total production in line with the assimilative capacity of the environment. However, limits on feed inputs in some countries (such as Finland) effectively limits production.

The new Reformed Common Fisheries Policy (CFP) aims to improve the management of the sector. In September 2002, the Commission presented to the Council and to the European Parliament a communication on "A strategy for the sustainable development of European aquaculture" The main aim of the strategy is the maintenance of competitiveness, productivity and sustainability of the European aquaculture sector. The strategy has 3 main objectives:

- Creating secure employment
- Providing safe and good quality fisheries products and promoting animal health and welfare standards.
- Ensuring an environmentally sound industry.

Environmental context:

Aquaculture typically takes place in water of high quality. The principle measurable environmental pressures of aquaculture production are increased local organic matter, nitrogen and phosphorus which in turn may lead to locally increased BOD, eutrophication, and possibly algal blooms. Other pressures that may be experienced with some culture systems include escapes and increases in pathogen density which may negatively affect wild populations by genetic dilution or disease transfer. Chemotherapeutants also represent a pressure, some of which may have impacts even below detection levels. Increased production also implies increased demand for feed inputs, stimulating increased pressure on industrial fisheries that supply fishmeal for aquaculture feed (30% of the total fish landings from the North Sea are caught for reduction to fish meal and fish oil). Finally the collection of "seed" from the wild, ranging from larvae, juveniles and even large individuals, may well have a serious impact on community structure dynamics and ecological equilibria. In the absence of major improvements in industry practices, increased production is likely to be associated with increases in all these pressures. However, the relationships between these pressures and possible impacts are often difficult to establish.

Any localised degradation will lead to production problems on farms. This provides an additional incentive for producers to protect their adjacent environments. Strict food safety criteria will also encourage producers to maintain high environmental standards and limit their dependence on expensive and persistent chemical treatments. Although the environmental pressure from aquaculture will continue to grow as European aquaculture production expands, the rate of increase may be mitigated substantially by adoption of more sustainable management practices and production techniques.

Assessment:

The last 10 years have seen a significant increase in total European aquaculture production. Significant improvements in the efficiency of feed and nutrient utilisation and improvements to environmental management generally have served to partially mitigate the associated increases in environmental pressure. This increase in both production and pressure has not been uniform across countries or across production systems. Only the mariculture sector has experienced a significant production increase, whilst brackish water production has increased at a much slower rate and levels of freshwater production have declined. On regional level, EU + EFTA countries dominate production by far.

Europe's fish farms fall into two distinct groups: in western Europe the fish farms grow high-value species such as salmon and rainbow trout, frequently for export, whereas in central and eastern Europe the fish farms grow lower-value species such as carp that are mainly consumed locally.

Chemicals, particularly formalin and malachite green, are used in freshwater farms to control fungal and bacterial diseases. In marine farms antibiotics are used for disease control but amounts have been drastically reduced in the past years following the introduction of vaccines.

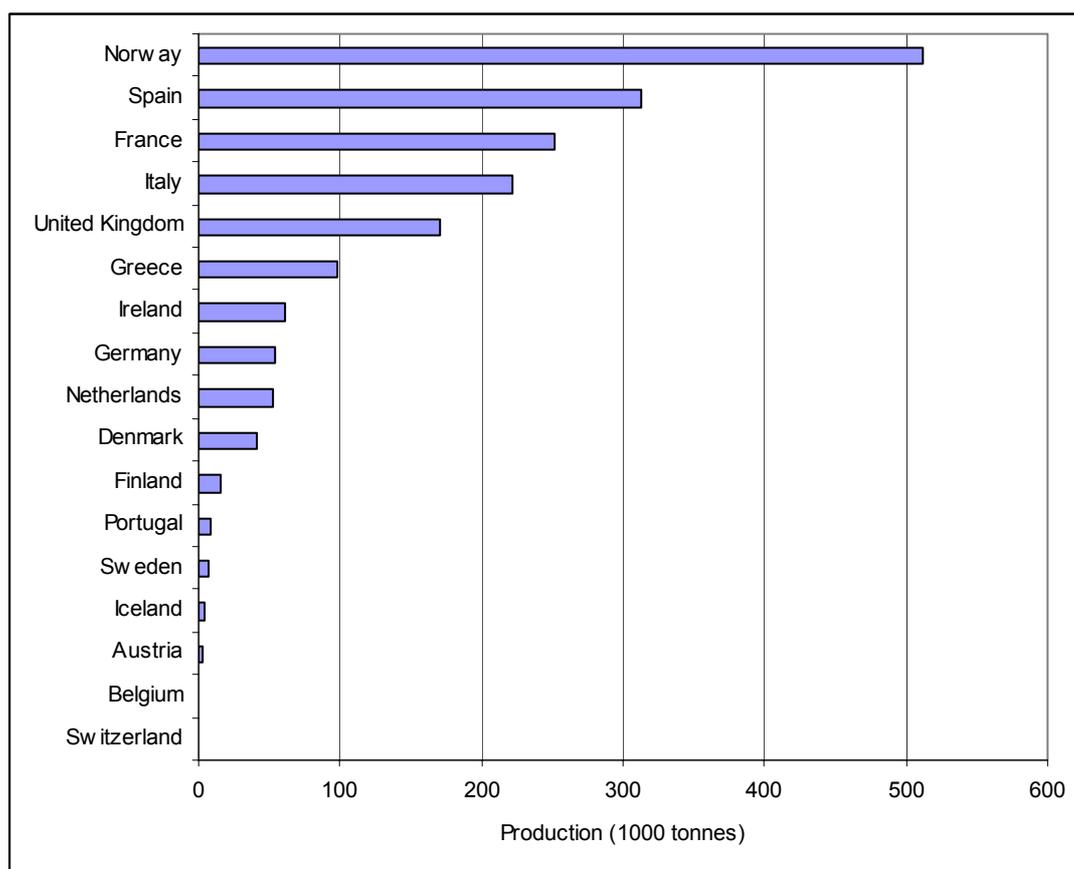
This growth in production has not come without problems. According to DG Fisheries "the European Aquaculture industry is facing a number of challenges in terms of market and of the environment. Its future will depend on its ability to become economically self-sufficient and its capacity to respond to environmental constraints".

Sub-indicator 1: Production by country

Key message

- The largest European aquaculture producers are found in EU + EFTA region: Norway is the largest producer. Turkey is the largest producer in AC 13 + Balkan countries.

Figure 2 Annual aquaculture production by country in 2001 – EU + EFTA

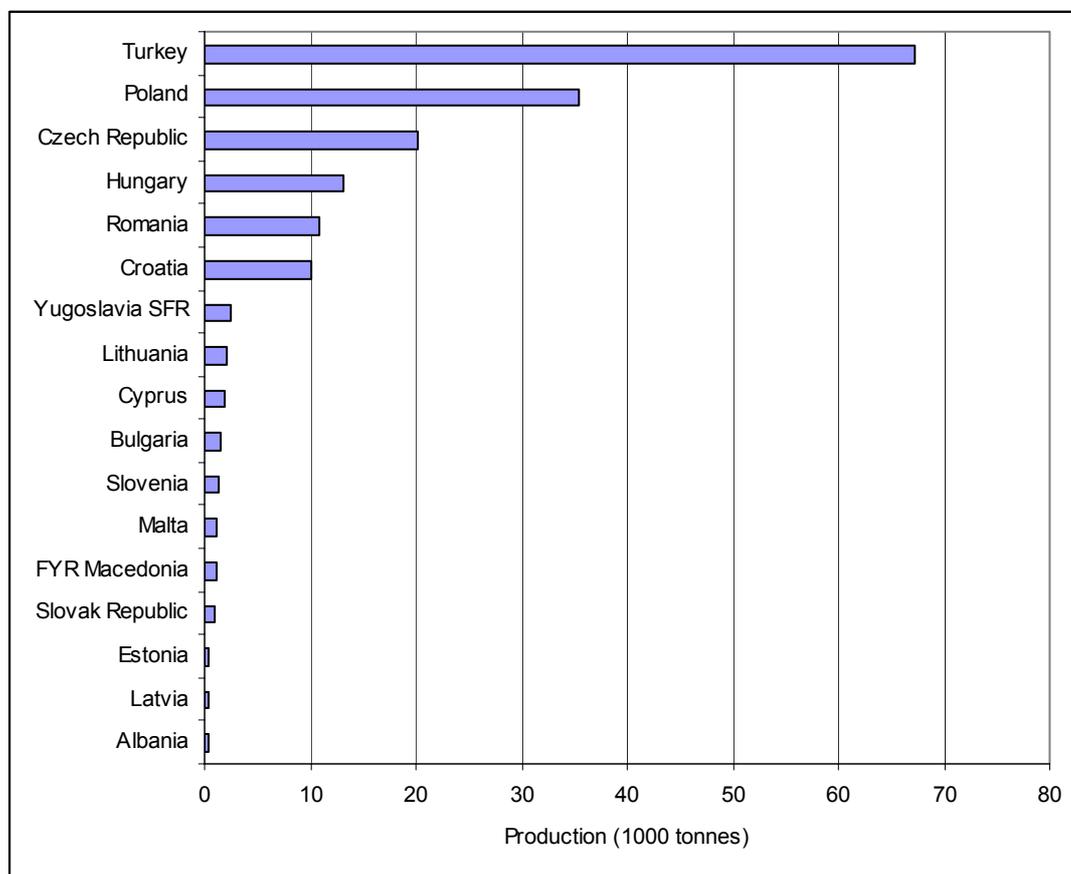


countries

Source: FAO FISHSTAT Plus.

Notes: Production includes all environments i.e. marine, brackish and freshwater

Figure 3 Annual aquaculture production by country in 2001 – AC 13+ Balkans



Source: FAO FISHSTAT Plus.

Notes: Production includes all environments i.e. marine, brackish and freshwater.

Assessment:

The biggest European aquaculture producers are found in EU + EFTA region. Norway has the highest production by far with over 500 thousand tonnes in 2001, followed by Spain, France, Italy and the UK. These 5 countries account for 75.5 % of all aquaculture production from all 34 European countries. Even the smallest of these, the UK, produced 170 thousand tonnes in 2001, which is significantly higher than production in any European country outside of this region. Turkey's production of 67 thousand tonnes represents substantially the highest production in the AC 13 + Balkan region. The country ranking situation in 2001 in terms of production is identical to that in 2000 with only minor changes.

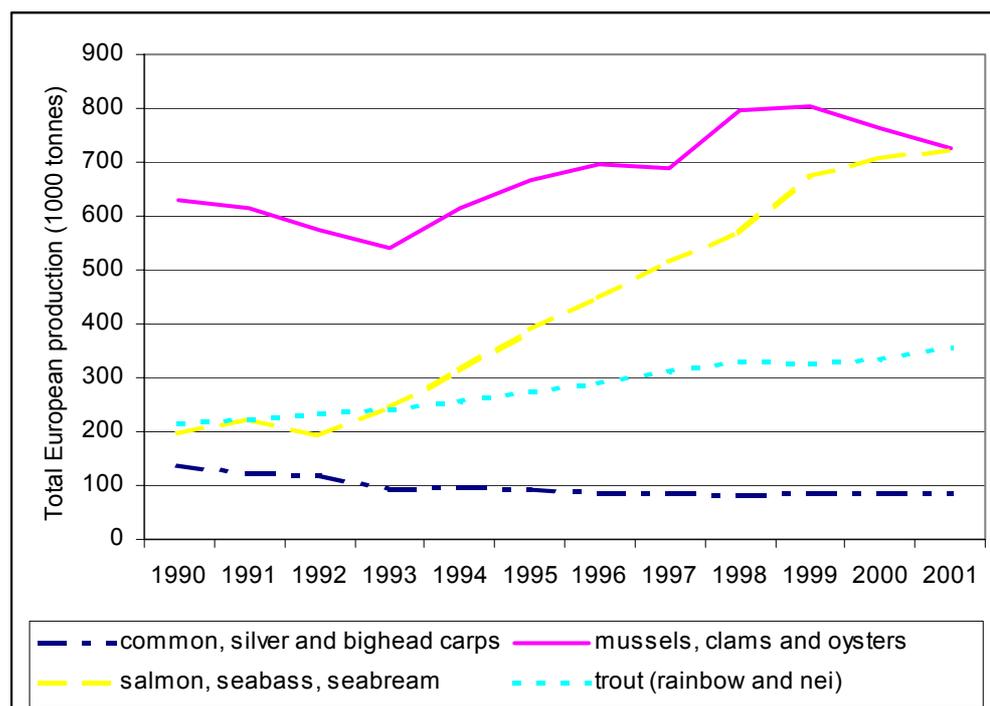
The dominant aquaculture producer is Norway with about 90 % of its production as Atlantic Salmon. It is of note that in 2001, farming of this single species in Norway exceeded the combined total of all production species from all AC 13 + Balkan countries. Spain, the next biggest producer, is dominated by production of blue mussel, followed by France whose production is dominated by Pacific cupped oyster (*Crassostrea gigas*). Turkish production is mainly from trout, sea bream and sea bass.

Sub-indicator 2: Production by major commercial species groups

Key message

- Different types of aquaculture generate very different pressures on the environment. Intensive finfish production in marine and freshwater generates the greatest environmental pressure, and it is this kind of production, which has increased most rapidly in recent years.

Figure 4 Annual production of major commercial aquaculture species groups, 1990 – 2001



Source: FAO Fishstat Plus.

Notes: Includes all countries and production environments for which data are available.

nei = not elsewhere indicated.

Trout (rainbow and nei) includes all species of trout.

Assessment:

The major part of the increase in aquaculture production has been in marine salmon culture in Northwest Europe, and to a lesser extent trout culture (throughout Western Europe and Turkey), seabass and seabream cage culture (mainly Greece and Turkey), and mussel and clam cultivation (throughout Western Europe); although the latter exhibits a downward trend since 1999. By contrast, inland aquaculture of carps (mainly common and silver carp) has declined significantly throughout Eastern and Central Europe (AC 13 and Balkan countries), in part related to political and economic changes in Eastern Europe.

The main environmental pressures from aquaculture are associated with intensive finfish production, mainly salmonids in marine, brackish and freshwaters, and seabass and seabream in the marine environment.

It is precisely these sub-sectors that have experienced the highest growth rate in recent years. Although the cultivation of bivalve molluscs has also increased substantially, the environmental pressures associated with this type of aquaculture, which include removal of plankton and local concentration and accumulation of organic matter and metabolites, are generally considered to be less severe than those from intensive fin-fish cultivation. Pond

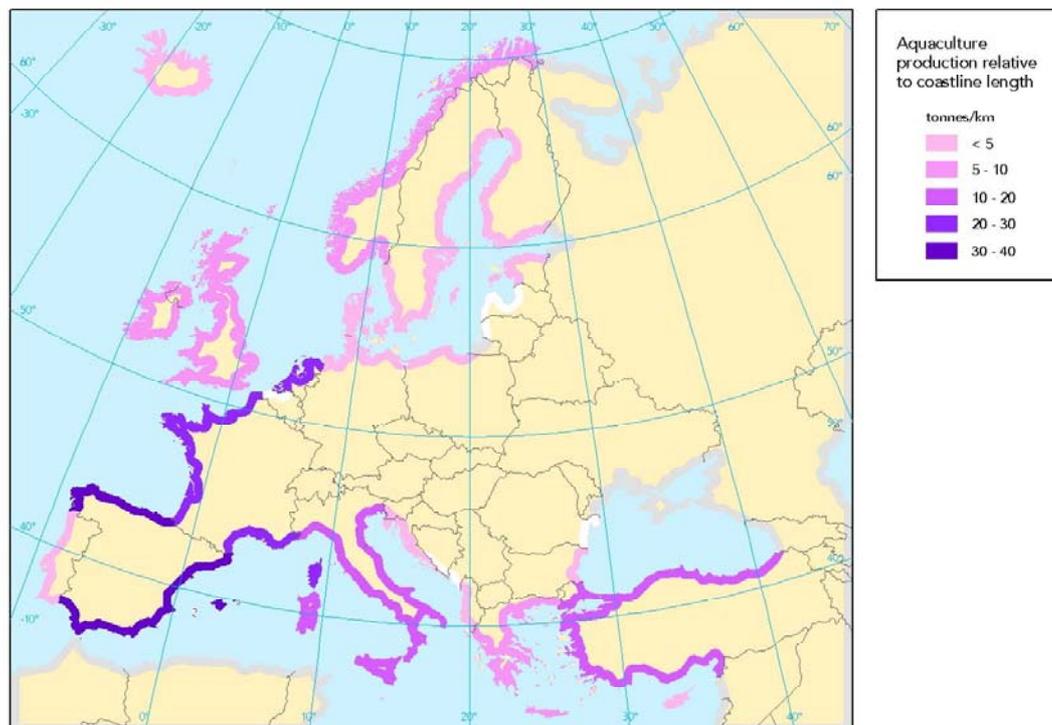
aquaculture of carps in inland waters usually requires less intensive feeding, and in most cases a greater proportion of nutrients discharged are assimilated locally. Environmental pressure is likely to be less per unit production than for the more intensive salmonid production. Furthermore, this type of aquaculture has decreased in recent years. Once again, no significant changes have been observed since the last assessment (2000).

Sub-indicator 3: Production relative to coastline length

Key Message

- Environmental pressures exerted from aquaculture are not uniform. Of the EU countries, Spain, France and the Netherlands, and in terms of Accession countries, Turkey, have the greatest marine aquaculture production in relation to coastline length.

Figure 5 Marine aquaculture production relative to coastline length



Source: FAO FISHSTAT Plus and World Resources Institute.

Notes: Only marine and brackish waters production.

Average production density values for countries with a coastline and with coastline data available.

Based on latest year for which there are data: 2001 for all countries except Bulgaria (2000), Estonia (1995) and Poland (1993).

Assessment:

Aquaculture production intensity as measured per unit coastline length has reached an average of around 8 tonnes per km of coastline in EU + EFTA countries compared to 2 tonnes per km in AC 13 + Balkans region.

In Spain the overwhelming mariculture production is of mussels. Shellfish production also predominates in France (oysters and mussels) and the Netherlands (mussels) whereas in Turkey sea bass and sea bream production are the most important.

The increasing trend observed during the past years appears to be stabilising. However, pressure is likely to continue to increase as production of new species such as cod, halibut and turbot becomes more reliable.

By presenting production relative to coastline length, it is possible to determine a more comparable value of production density. This is potentially a better indicator of pressure than a single production value, but there are difficulties with this indicator. It is inappropriate for landlocked countries; it does not apply to freshwater production; it does not consider the area of coastline that is potentially suitable for production; and the determination of coastline length is problematic and relies upon uniform scale being used for each countries determination.

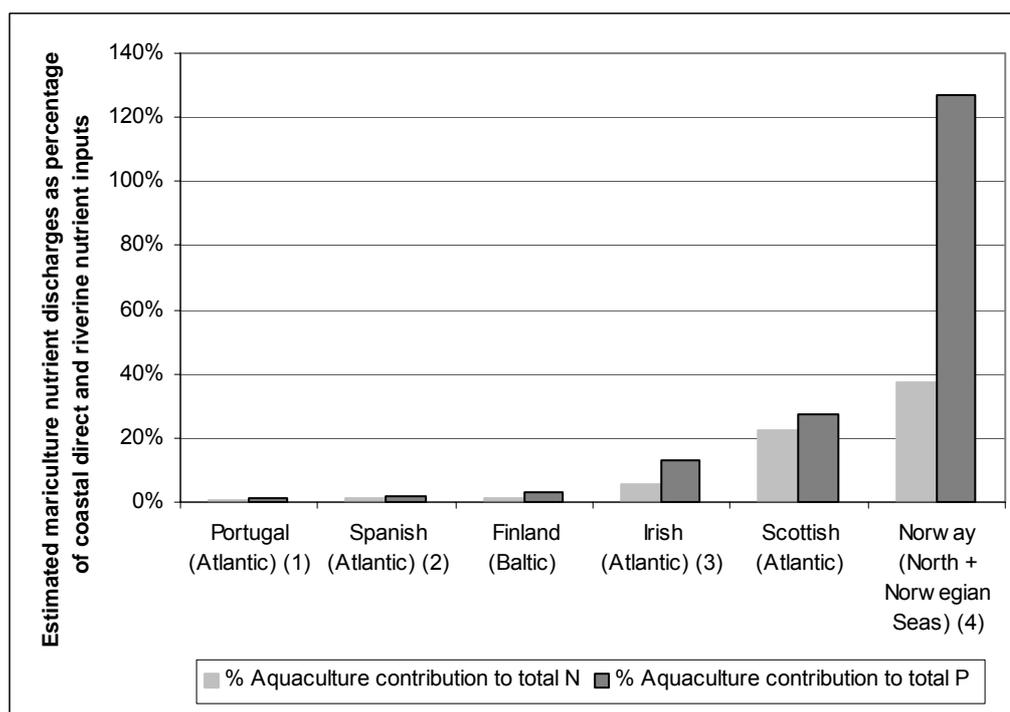
An alternative indicator could be based on the percentage coverage of key coastal habitat types by different types of aquaculture.

Sub-indicator 4: Contribution of nutrients from aquaculture to total coastal nutrients loads

Key Message

- Marine finfish culture (mainly Atlantic salmon) is now making a significant contribution to nutrient loads in coastal waters. In the case of Norway (Norwegian and North Sea coasts), phosphorus discharges from mariculture appear to exceed the total from other sources.

Figure 6 Relative contribution of nutrients from marine and brackish water finfish culture in selected countries, 1999



Source: FAO Fishstat Plus, Jonsson and Alanara, Ospar Commission, Haugen and Englestad, Beveridge, Helsinki Commission.

- Notes:**
- Nitrogen load figure limited to riverine discharge only (no data on direct inputs).
 - Phosphorus load: 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 loads from aquaculture.
 - Nutrient loads applicable to sea areas in which the bulk of marine and / or brackishwater finfish aquaculture takes place have been used.
- These figures do not include N and P discharges from inland aquaculture production. The proportion of aquaculture production which results in nutrient waste is based upon the mid-range of values stated in the OSPAR 2000 report ($55g N / production Kg$ (5.5%) and $7.5g P / production Kg$ (0.75%)).

The figures for Finland are based upon the HELCOM 1998. This gives both the total loads and the aquaculture load, therefore the OSPAR 2000 water ratio figure is not required to calculate aquaculture percentage of total.

Production figures relate to marine species only, except Finland, which refers to brackish water production.

Assessment:

Pressure from nutrients from intensive cultivation of marine and brackish water is becoming significant in the context of total nutrient loadings to coastal environment. The published data on total nutrient loadings to coastal waters remains poor in quality and inconsistent in coverage. The figures presented here should be treated with caution.

References

Beveridge M, pers. comm., University of Stirling, Institute of Aquaculture

FAO FISHSTAT Plus (Aquaculture production quantities 1970 - 2001)

Helsinki Commission, (1998), The Third Baltic Sea Pollution Compilation. Baltic Sea Environment Proceedings. Baltic Marine Environmental Protection Commission

Haugen, A.S. and Englestad, M., Fish farming in tune with the environment, Ewos.

Jonsson, B. and A. Alanara (1998), Svensk fiskodlings narsaltsbelastning. Vattenbruksinstitutionen, SLU Rept. 18 (26p)

OSPAR Commission, (2002). Overview of the results of the comprehensive study on riverine inputs and direct discharges (RID) in 1999

OSPAR Commission, (2000), Nutrient discharges from fish farming in the OSPAR Convention area

World Resources Institute, Coastal Statistics. www.wri.org

Data

FISH3_2003_1.xls

FISH3_Map_Data.xls

Below are some statistical tables that may provide useful further information in relation to scale of pressure. These show time series statistics at country grouping level and total production for 2001 for each country.

Table 1: Time series data for aquaculture production according to production environment

	Brackish water culture	Freshwater culture	Mariculture	Total (tonnes)
1990	91,466	355,641	792,444	1,239,551
1991	101,942	350,738	792,506	1,245,186
1992	98,849	355,776	731,048	1,185,673
1993	93,068	333,433	762,124	1,188,625
1994	107,172	348,239	897,294	1,352,705
1995	133,815	356,482	1,005,253	1,495,550
1996	114,534	358,815	1,123,623	1,596,972
1997	114,392	375,324	1,190,415	1,680,131
1998	127,157	373,774	1,363,773	1,864,704
1999	130,790	378,645	1,477,948	1,987,383
2000	139,819	384,694	1,463,475	1,987,988
2001	138,987	383,583	1,462,243	1,984,813

Source: FAO FISHSTAT Plus.

Table 2: Contribution of Aquaculture to total regional nitrogen and phosphorus loads

	total Nitrogen (t)	total Phosphorus (t)	Aquaculture N (t)	Aquaculture P (t)	% Aquaculture contribution to total N	% Aquaculture contribution to total P
Portugal	26,000	1,300	21.06	3	0.1%	0.2%
Spanish Atlantic	43,000	5,000	191	26	0.4%	0.5%
Finland	70,274	3,849	949	126	1%	3%
Irish Atlantic	14,350	1,100	995	136	7%	12%
Scottish Atlantic	26,000	3,500	6,971	951	27%	27%
Norway (North + Norwegian Seas)	57,000	2,800	23,420	3,194	41%	114%

Source: Calculation based on total production (FAO FISHSTAT Plus), total Nutrient Loads (OSPAR 2002 & HELCOM 1998) and waste nutrients proportion of production (OSPAR 2000).

Notes: See figure 6.

Table 3: Individual country total aquaculture production for 2001.

EU + EFTA Countries	Production (tonnes)	AC + Balkan Countries	Production (tonnes)
Austria	2,393	Albania	286
Belgium	1,630	Bulgaria	1,613
Denmark	41,573	Croatia	10,166
Finland	15,739	Cyprus	1,883
France	252,062	Czech Republic	20,098
Germany	53,409	Estonia	467
Greece	97,802	Hungary	13,056
Iceland	4,371	Latvia	463
Ireland	60,935	Lithuania	2,001
Italy	221,269	Macedonia	1,053
Netherlands	52,064	Malta	1,235
Norway	512,101	Poland	35,460
Portugal	7,824	Romania	10,818
Spain	312,647	Slovakia	999
Sweden	6,773	Slovenia	1,262
Switzerland	1,135	Turkey	67,241
United Kingdom	170,516	Yugoslavia SFR	2,469

Source: FAO FISHSTAT Plus.

Note: Production includes all environments i.e. marine, brackish and freshwater.

Meta data

Web presentation information

1. Abstract / description / teaser:

Describes trends in aquaculture production, with demonstrated pressure on adjacent water bodies and associated ecosystems.

2. Policy issue / question:

Are we achieving sustainable aquaculture?

3. EEA dissemination themes:

Fisheries

4. DPSIR:

P

Technical information

5. Data source: principally FAO Fishstat Plus, (Aquaculture production: quantities 1970-2001 dataset). In addition some information taken from OSPAR 2000 & 2002, HELCOM 1998 and World Resources Institute
6. Description of data: FAO Fishstat Plus - Statistical database providing time series production data for all countries and all production species in all environments. Other data sources are individual reports on nutrient discharges to various European waters.
7. Geographical coverage: FAO Fishstat Plus - All countries. Other data limited to specific geographical areas. HELCOM data limited to countries bounding the Baltic Sea. OSPAR data limited to countries in the OSPAR Convention area.
8. Temporal coverage: FAO Fishstat Plus - 1970 – 2001. Other data are limited to specific years, on which the reports were based.
9. Methodology and frequency of data collection: FAO Fishstat Plus - Annual collection from national records. Other data collected on an “as and when” basis and for periodical reports.
10. Methodology of data manipulation, including making ‘early estimates’: National data for the 34 European states was manipulated first into country groupings, then into production system groupings and finally into main species and country listings. All production calculations were performed in the Fishstat Plus programme rather in the Excel spreadsheets in order to take into account production <0.5 t otherwise omitted when transferred into Excel spreadsheets.

Total marine aquaculture per km coastline = total aquaculture production in marine areas (as defined by FAO Fishstat Plus) by country ÷ coastline length of the country (km)

Major area production per km coastline = (\sum total aquaculture production in marine areas (as defined by FAO Fishstat Plus) by major area) ÷ (\sum all coastline lengths of countries in that area (km))

Aquaculture discharge of N (tonnes) = total finfish aquaculture production in marine & brackish water areas (tonnes) x 5.5%

Aquaculture discharge of P (tonnes) = total finfish aquaculture production in marine & brackish water areas (tonnes) x 0.75%

Relative contribution of aquaculture N production to marine nutrient loads = Aquaculture discharge of N (tonnes) ÷ total discharge of N (tonnes) x 100

Relative contribution of aquaculture P production to marine nutrient loads = Aquaculture discharge of P (tonnes) ÷ total discharge of P (tonnes) x 100

Quality information

11. Strength and weakness in data level

Production data provide a simple and accurate measure of total production, which acts as an indicator of environmental pressure. The strength of this indicator is the simplicity, accuracy and robustness of the data. The weakness of the indicator relates to the validity of the relationship between production and pressure. Production acts as a useful course indicator of pressure but variations in culture species, production system and management approaches mean that the relationship between production and pressure is non-uniform.

12. Reliability, accuracy, robustness, uncertainty (at data level)

The dataset for production is reliable, accurate, robust and contains little uncertainty. Data on nutrient loads are questionable both temporal and spatial. Apart from the fact that they are collected from different sources, the OSPAR is inconsistent between countries and may be inaccurate for some countries. Furthermore, data is not updated regularly.

13. Overall scoring: 2

No data problems, but some reservations over suitability

Some problems with nutrient data (see 8.).

Relevancy: To accurately determine the pressure exerted by aquaculture on regional environments more detailed analysis would be required. This would consider the specifics of the production system and the local ecosystem. It would also require more detailed monitoring. Production provides a useful general indicator of pressure but cannot be used as a hard and fast indicator of pressure for particular situations.

Scoring for production data

Accuracy: The data is accurate, readily comparable between countries and covers all countries involved in aquaculture production.

Comparability over time: Good time series are available from 1990 onwards. Good and reliable data are available for many countries before this time, but lack of information from other countries means that these data are of little comparative worth.

Comparability over space: All 34 countries report data to FAO Fishstat Plus.

Further work required

The next step is to determine the relative environmental pressure (pressure per unit production) exerted by each production system and culture species, in order to generate a more accurate indication of pressure. Factors to consider include the rate of nutrient and chemical discharge, the number of escapes, and the incidence of disease per unit production. For finfish, the food conversion ratio (food given/fish production) coupled with information on food composition would provide an effective indicator of nutrient discharge. Modest improvements in national statistics could generate this information. This data should be collected routinely and published by all major producing countries to provide time series data which could be incorporated within the EU and FAO databases.

Typical nutrient budgets are already known for oysters and mussels, and an integrated pressure indicator could be derived.