An indicator-based approach to assessing the environmental performance of European marine fisheries and aquaculture

Scoping study

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Summary

Fisheries and aquaculture affect the coastal and marine environment in several ways. Marine capture fisheries pose a main threat to marine biodiversity as the recently published EEA report on Europe's biodiversity shows.

The common fisheries policy (CFP) of the European Union has failed to keep fisheries sustainable. The reform of the CFP is delayed. A biodiversity action plan on fisheries has been developed by the European Commission as well as a communication on the integration of environmental protection into the CFP. Both policy documents foresee the development of a set of indicators to measure the implementation of policy actions.

The European Environment Agency has decided to directly address this emerging issue of fisheries/aquaculture impact on the environment for possible inclusion in the development of a core set of indicators covering the whole driving forces–pressure–state–impact–response (DPSIR) assessment framework from driving forces in the fishing and aquaculture industry; through pressures from fleet capacity; to status of fish stock; impact on species and habitats; and finally on measures taken to minimise the impacts.

A review of fisheries and aquaculture indicators developed by international and regional fisheries and environmental organisations has been undertaken for this report. Based on this review, a list of 52 potential candidate indicators has been compiled, of which 29 are being recommended for a core set of DPSIR indicators on fisheries and aquaculture for coastal and marine as well as inland waters. A storyline has been developed to link these indicators to each other and to relate them to policy objectives.

The data availability for the proposed indicators has been investigated and data sets and their sources have been compiled in 31 data sheets.

This report forms the basis for EEA's present and future development of indicators on fisheries and aquaculture and their related indicator fact sheets. The first four indicators have already been published in *Environmental signals 2002* (European Environment Agency, 2002) and further indicators have been produced for the report being prepared for Environment Ministers Conference in Kiev in 2003. International and regional fisheries and environment organisations will undertake an evaluation of the proposed indicators during a joint EEA/DG Fisheries/DG Environment workshop on fisheries indicators in autumn 2002.

1. Introduction

In order to monitor the integration of environmental protection into the EU common fisheries policy, the European Environment Agency (EEA) has initiated a scoping study to assess the requirements for indicators to help track the environmental performance of European marine fisheries and aquaculture. The proposed fisheries and mariculture indicators have been prepared by EEA according to the DPSIR (driving forces–pressure–state–impact–response) assessment framework (EEA, 1999), which has been successfully employed for other environmental indicators, e.g. eutrophication, hazardous substances (EEA, 2000). The EEA adopted typology classifies the indicators into the four following groups depending on the questions they address.

Type A or descriptive indicators — What is happening to the environment and to humans?

Type B or performance indicators — Does it matter?

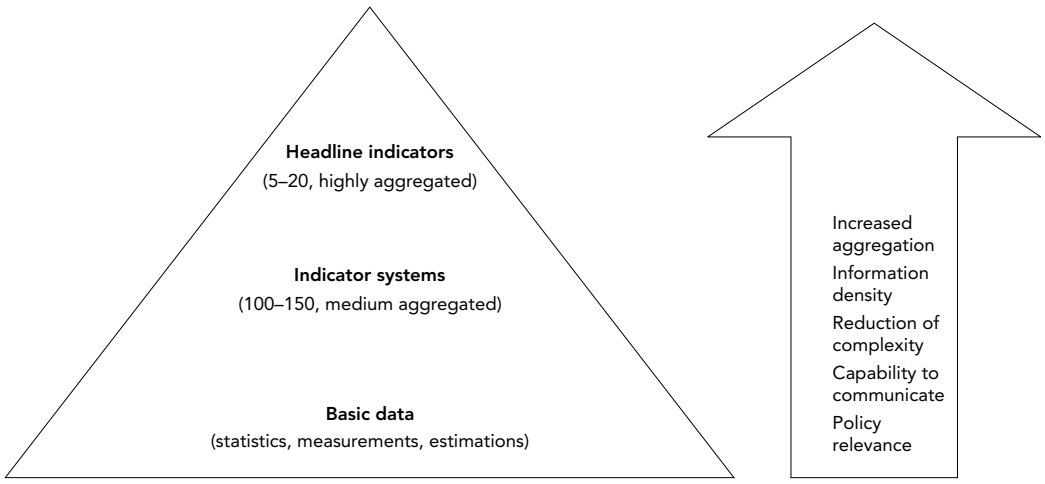
Type C or efficiency indicators — Are we improving?

Type D or total welfare indicators — Are we on the whole better off?

The development of a multi-purpose core set of indicators on fisheries and aquaculture would present a major challenge for the EEA and its European topic centres (ETCs). Regular communication of what is possible against what is needed is important as is the articulation of the multi-purpose opportunities provided by a common core set of indicators and common work programmes. The hierarchy of environmental indicators is summarised in the indicator pyramid in Figure 1.

The scoping study addresses the selection of a number of representative indicators based on indicator developments of international organisations in this field. The proposed set of indicators on fisheries and aquaculture will be further analysed and assessed by a joint EEA/ DG Fisheries/DG Environment workshop in autumn 2002 and, once endorsed by the workshop and agreed for inclusion in the EEA work programme, by the development of indicator fact sheets for each proposed indicator.

A multi-purpose hierarchy scheme of environmental indicators proposed by the EEA Figure 1



2. Background

Fishing and aquaculture are two of the most important sectors, which use and produce living resources in the seas and inland waters. As well as providing a healthy and enjoyable source of food they create much-needed jobs in coastal areas and promote the social and economic well-being of the European Union's fishing regions. Despite the European Union being the world's third largest fishing power, the market demand for fish exceeds production by European capture fisheries and aquaculture.

2.1. Capture fisheries

As an environment sector, fisheries include the catch of fish and also the catch of mussels, shrimps and other shellfish, squids and, in some cases, whales. However, fishing activities are known to have significant effects not only on target (commercially exploited) species, but also on the wider marine environment. This is a result of incidental captures of non-target species, and gear-related damage to benthic habitats and communities. Over 100 research projects on the interactions between fisheries and the environment have been funded by the European Commission (Ecologic et al., 1999) and many more at the national level. A large number of results from such studies are published in over 1 000 scientific publications, listed and summarised by MRAG (1998).

Almost 20 years after its inception, the common fisheries policy (CFP) is confronted with major challenges. Although it has yielded positive results (settled conflicts at sea, avoided total collapse of stocks), it has not led to a sustainable exploitation of fisheries resources (Green Paper on the CFP, European Commission, 2001c). We have to face the fact that the common fisheries policy has not succeeded in reversing the decline of many fish stocks, especially those fish on which the prosperity of the fisheries sector has traditionally been based. Scientists are still publishing pessimistic news about the state of depletion of fish stocks. In fact, routine assessments for many individual fish stocks have revealed that 40 of the 60 major commercial stocks, in the OSPAR area, were outside safe biological limits in 1999 (OSPAR, 2000).

One of the main causes of declining fish stocks is the continuing, significant imbalance between fishing capacity and available resources. Again, the Community has not yet succeeded in finding the sustainable balance to which it is committed in the basic CFP regulations. Despite some significant reductions in fishing capacity in the mid-1990s, it appears that the Community instruments assigned to restrict fishing capacity, such as the multi-annual guidance programmes (MAGP), are not working effectively. In its mid-term review of MAGP IV, the Commission called for a fundamental review of the fleet policy.

Moreover, the CFP has failed to protect the wider marine environment. For example, damage caused to seals by fishermen is a 'hot issue' of concern in managing the interface between fishing and ensuring biodiversity. The lack of integration of environmental concerns within the framework of the present CFP was highlighted as early as 1992. At present, there is a move in the political climate towards commitment of the Union to sustainable development, which is leading to strong pressure to take environmental considerations more fully into account when managing fisheries. A thorough and urgent reform of the CFP is under progress and is one of the major incentives for the present scoping study.

Regarding management of fish stocks and issuing quotas or so-called total allowable catches (TACs), there is a need to move away from the single-species approach characteristic of the existing CFP and to adopt a multi-species and ecosystem-based management approach as indicated in the 2001 Reykjavik Conference on Responsible Fisheries in the Marine Ecosystem. Ecosystem-based management models are needed to assess external impacts on fisheries such as accidental and operational discharges from oil exploitation and shipping activities, toxic algae blooms, and runoff from land causing eutrophication and contamination.

2.2. Aquaculture

Aquaculture activities include mariculture of finfish and shellfish in coastal and transitional waters as well as the farming of aquatic organisms in freshwater. Aquaculture is providing an additional food source and an additional income for coastal human communities and policies aim at moving labor from capture fisheries into aquaculture fish production.

According to FAO figures, total aquaculture production in Europe (i.e. both EU and non-EU countries) has increased by 126 % the last 15 years (2 million tonnes in 1999 versus 884 thousand tonnes in 1984). In 1999 aquaculture accounted for 14 % of the EU plus Norway and Iceland fisheries production (Cross, 2001). In contrast, total capture fisheries production (finfish, shellfish and aquatic plants) within these countries has remained steady or slightly decreased over the stated periods (from 12.2 million tonnes in 1984 to 12.3 million tonnes in 1995), with aquaculture's contribution towards total fisheries landings consequently increasing from 6.9 % in 1984 to 14.4 % in 1999 (Cross, 2001). Aquaculture is gaining an increasingly large relative importance compared to fisheries and therefore focus is also directed on this trade.

However, this intensification of aquaculture has revealed a broad spectrum of environmental problems associated with fish and shellfish farming (deterioration of quality of effluent water leading to eutrophication, local smothering of the seabed, transfer of disease agents, and impacts on biodiversity by the introduction of exotic species), so that nowadays aquaculture is considered as a potential polluter of the marine environment. International groups of experts evaluating the state of the marine environment have expressed concern about the potential harmful effects of aquaculture on the marine environment, as a potential source of eutrophication (GESAMP, 1990), or multiple impacts on coastal marine biodiversity including modification of the gene pool of wild stocks and replacement of biota by exotic species (SBSTTA, 1996).

3. Policies at EU and regional sea level

3.1. Common Fisheries Policy (CFP)

Management of fish resources within the exclusive economic zone (EEZ) of the EU takes place within the legal framework of the common fisheries policy (CFP). Aquaculture activities involving the commercial rearing of fish fall within the remit of the CFP.

> The objective of the current CFP is:
>
> '... to provide for rational and responsible exploitation of living aquatic resources and of aquaculture, while recognising the interest of the fisheries in its long-term development and its economic and social conditions and the interest of the consumers taking into account the biological constraints with due respect to the marine ecosystem'.

To achieve the objectives, the CFP may introduce specific measures in five areas:

- supervisory and conservation measures such as setting of individual catches and, in some areas, the setting of total allowable catches (TACs);
- technical measures for conservation and special ones for inshore fishing;
- structural policy to ensure a fair standard of living for fishermen;
- market policy based on similar instruments as the common agricultural policy (CAP);
- relations with non-Community countries and international agreements to address environmental concerns, e.g. the UN Agreement on Conservation and Management of Straddling Fish Stocks and Highly Migratory Species.

The Green Paper on the reform of the present CFP outlines the urgent need for change and proposes drastic measures (European Commission, 2001c).

Within European waters, the responsibility of assessment of the state of stocks is shared among the following organisations/bodies:

- International Council for the Exploration of the Sea (ICES),
- Scientific Advisory Committee of the General Fisheries Commission for the Mediterranean (GFCM),
- Scientific, Technical and Economic Fisheries Committee of the EU (STECF).

The socioeconomic sector is regulated by means of Community expenditure. The main instruments are:

1) structural assistance by providing funds to address structural, economic and social problems in order to reduce inequalities between different regions and social groups through:
   - Financial Instrument for Fisheries Guidance (FIFG),
   - European Regional Development Fund (ERDF),
   - European Agricultural Guidance and Guarantee Fund (EAGGF), and
   - European Social Fund (ESF);
2) the PESCA initiative (from 1994 to 1999) to help the fisheries sector make a successful transition by diversifying activities away from fishing and contributing to the diversification of coastal regions by developing new employment opportunities;
3) fisheries agreements with third countries; and
   management: aid to research and control.

3.2. Relevant Council Regulations and Directives issued in the framework of the Common Fisheries Policy

The policy relevance of the indicators listed in Table 11 refers to the following regulations and directives. The texts of these can be downloaded from http://europa.eu.int/eur-lex/en/lif/ind/en_analytical_index_04.html.

Council Regulation (EEC) No 31/83 on an interim common measure for restructuring the inshore fishing industry and aquaculture:

'... restructure inshore fishing is necessary in order to promote the rational use of the available resources and the best use of production factors and to ensure an equitable standard of living for those who depend on fishing for their livelihood'.

Council Directive 83/515/EEC concerning certain measures to adjust capacity in the fisheries sector:

'...it is important for the Community, in the interests of fishermen and consumers, to retain, during the period in which threatened stocks are being reconstituted, Member States' production capacity at the level needed for optimal exploitation of the reconstituted stocks at a later date'.

Commission Regulation (EEC) No 3703/85 laying down detailed rules for applying the common marketing standards for certain fresh or chilled fish:

'...Whereas, to help improve the quality of fish graded on the basis of a sampling system and to prevent the marketing of fish which is not sufficiently fresh, the Member States concerned must introduce control arrangements including inspections of the preserving facilities on the vessels landing the fish concerned'.

Council Directive 85/337/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment:

'... The environmental impact assessment will identify, describe and assess in an appropriate manner, in the light of each individual case and in accordance with the Articles 4 to 11, the direct and indirect effects of a project on the following factors:

- human beings, fauna and flora,
- soil, water, air, climate and the landscape,
- the interaction between the factors mentioned in the first and second indents'.

Council Regulation (EEC) No 3252/87 on the coordination and promotion of research in the fisheries sector:

'...Whereas recent developments affecting the fisheries sector, in particular the extension of fishery zones to 200 miles, and the establishment of a Community system for the conservation and management of fishery resources have intensified the need for effective coordination of biological, technological and economic research in the Community fisheries sector, in order to facilitate the adaptation of Community fleets to the new fishing conditions;

... Whereas Council Decision 87/516/Euratom, EEC of 28 September 1987 on the framework programme for Community activities in the field of research and technological development (1987 to 1991) provides in particular for the implementation of research programmes for increased productivity, improved quality and the processing of fisheries products'.

Council Regulation (EEC) No 1382/91 on the submission of data on the landings of fishery products in Member States:

'… Whereas, in particular, the management of the market in fishery products, as provided for in Council Regulation (EEC) No 3796/81 of 29 December 1981 on the common organisation of the market in fishery products, as last amended by Regulation (EEC) No 2886/89, would be enhanced by the existence of harmonised Community statistics on the total landings of fishery products, has adopted this Regulation:
Article 1 — Each Member State shall submit to the Commission data on the quantity and average price of fishery products landed by Community fishing vessels in each calendar month in that Member State'.

Council Regulation (EEC) No 3760/92 of 20 December 1992 establishing a Community system for fisheries and aquaculture.

Commission Decision 92/448/EEC on the grant of Community aid for certain specific measures implementing the programme of options specific to the remote and insular nature of Madeira and the Azores (Poseima):

'...Whereas the Portuguese autonomous regions of the Azores and Madeira are encountering specific development problems;

Whereas, in order to cope with these problems, it is appropriate to reinforce Community support to enable these regions to fully participate in the dynamics of the internal market;
Whereas Article 1 of Council Decision 91/315/EEC of 26 June 1991 setting up a programme of options specific to the remote and insular nature of Madeira and the Azores (Poseima)'.

Council Regulation (EEC) No 2847/93 establishing a control system applicable to the common fisheries policy:

'...Whereas the success of the common fisheries policy involves implementing an effective system of control covering all aspects of the policy;

...Whereas, to achieve this aim, it is necessary to include rules for the monitoring of conservation and resource management measures, structural measures and measures on the common organisation of the market, and certain provisions to deal with failure to carry out these measures, which must apply to the entire fisheries sector from the producer to the consumer'.

Council Regulation (EC) No 369/93 laying down the criteria and arrangements regarding Community structural assistance in the fisheries and aquaculture sector and the processing and marketing of its products.

Commission Decision 94/929/EC of 22 December 1994 on the adoption of the Community programme for structural assistance in the fisheries and aquaculture sector and the processing and marketing of its products in Germany (Objective 5(a) outside Objective 1 regions — the period 1994 to 1999).

Council Regulation (EC) No 25(4)/97, multi-annual guidance programmes for the period 1997/2001 were adopted by Commission Decisions 98/119/EC to 98/131/EC (5):

'… Whereas the data necessary in order to follow these programmes must be forwarded to the Commission, including fishing effort data for individual vessels or aggregated by segments of the fleet or by fisheries, depending on the particular cases'.

Council Directive 97/11/EC of 3 March 1997 amending Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment.

Council Regulation (EC) No 1181/98 of 4 June 1998 amending Regulation (EEC) No 3760/92 establishing a Community system for fisheries and aquaculture:

Monitoring the decision-making process: aquaculture; authorised catch; catch quota; common fisheries policy; fishing area; fishing regulations.

Commission Regulation (EC) No 2090(6)/98 establishes the basis for the transmission of data to the fishing vessel register of the Community.

Commission Regulation (EC) No 2091/98 of 30 September 1998 concerning the segmentation of the Community fishing fleet and fishing effort in relation to the multi-annual guidance programmes.

Special report No 18/98 on Community measures to encourage the creation of joint enterprises in the fisheries sector (pursuant to Article 188c, second subparagraph, of the EC Treaty) (98/C 393/01):

The joint enterprise scheme was introduced in 1990 by the Council to contribute towards the reduction of the Community fishing fleet, by helping to seek viable alternatives for the affected fishing vessels. To date, 188 projects have been approved resulting in the removal from the Community fishing register of 290 vessels representing a capacity of 113 710 tonnes, at a cost of ECU 298 million.

Council Regulation (EC) No 1543/2000 of 29 June 2000 establishing a Community framework for the collection and management of the data needed to conduct the common fisheries policy.

Commission Regulation (EC) No 1965/2001 amending Regulation (EEC) No 2807/83 laying down detailed rules for recording Member States' catches of fish.

3.3. Integration of environmental considerations into the Common Fisheries Policy

As part of an overall strategy for incorporating environmental considerations into the general Community policy, in line with the process launched by the European Council meeting in Cardiff (15–16 June 1998), a strategy for integrating environmental considerations into the CFP has been formulated including Community measures. It states:

'In order to protect the environment, it is important: to improve the selectivity of fishing operations: by adopting new technical measures or revising already existing ones so as to reduce catches of juvenile fish, crustaceans and molluscs or catches of species having no commercial value requiring additional protection.

Improvements in the selectivity of fishing methods could be encouraged by granting incentives, including financial ones; to protect natural habitats or the habitats of species of Community interest: under the Habitats Directive (number) it is up to the Member States to designate special conservation areas to provide a coherent European ecological network called Natura 2000. The provisions of this directive apply automatically to the marine habitats and species located in territorial waters (maximum 12 miles). A detailed work programme and a precise timetable have been established to ensure the introduction of the Natura 2000 network.

Member States have to designate special conservation areas and to establish the necessary conservation measures involving, if need be, appropriate management plans for these sites by June 2004 at the latest; to introduce, at national level, a system for the strict protection of marine animal species in their natural range, as provided for in the Habitats Directive (for example, the establishment by the Member States of a system to monitor the incidental capture and killing of species such as the monk seal, sea turtles or cetaceans); to introduce space-time limits on fisheries activities: boxes are restricted areas inside which specific, different and generally more binding measures apply than those for the entire management area of which they form part. These restrictions can apply to the time of year, fishing gear, vessels, catch composition, or any combination of these aspects.' (Integrating environment policy http://europa.eu.int/scadplus/leg/en/lvb/l28094.htm)

Following up this 1998 initiative, the EU has further defined its integration strategy into fishery policies through:

- communications from the Commission to the Council and the European Parliament and their subsequent adoption ('Elements of a strategy for the integration of environmental protection requirements into the common fisheries policy' and 'Adoption of the precautionary approach for the conservation and management of resources/TACs and quotas');
- Biodiversity action plans including management actions for fisheries;
- Green Paper on the future of the CFP;
- Council conclusions on Commission communication ('Elements of a strategy for the integration of environmental protection requirements into the CFP);
- Presidency conclusions, Göteborg, 15–16 June 2001;
- actions foreseen in the sixth Environmental Action Programme (EAP).

These measures are examined in more detail below.

- **Elements of a strategy for the integration of environmental protection requirements into the common fisheries policy**
  A communication designed to set the basis of a strategy for enhancing the integration of environmental protection requirements into the common fisheries policy (European Commission, 2001b). To that end, it proposes a series of measures, classified by topic, supplementing the measures proposed in other Community documents such as the biodiversity action plan for fisheries, and suggests a timetable. Furthermore the Commission proposes to adopt performance indicators and a review procedure for monitoring and reporting on the effectiveness of the strategy and strengthening its implementation and enforcement or revising it as appropriate.

- **Application of the precautionary principle and multi-annual arrangements for setting TACs**
  Council invitation to the scientific community to take a number of initiatives, encouraging it and the Commission, the Member States and the fishing industry to collaborate in the appropriate national, Community and international fora to develop and apply multi-annual strategies. It also declares its willingness to consider possible improvements in the procedures for setting TACs in order to facilitate their implementation.

- **Biodiversity action plans (section fisheries)**
  Four action plans to preserve and avoid destruction of biodiversity, outlining the steps necessary in each area and identifying appropriate indicators for monitoring and evaluating their effectiveness, submitted by the Commission (27 March 2001) (Bulletin of the EU 3-2001, Environment (5/20)).

  The action plan on fisheries aims to conserve fish stocks and to protect non-target species, habitats and ecosystems. The plan provides for a reduction in fishing activity, combined with stepping up research and monitoring. In the case of

Box 1: Actions related to the development of indicators described in the biodiversity action plan for fisheries

Action I	Overall reduction in fishing pressure to promote conservation and sustainable use of commercially exploited fish stocks
Action II	Technical measures with the objective of improving the conservation and sustainable use of commercially important stocks
Action III	Technical measures with the objective to reduce impact of non-target species and habitats
Action IV	Research priorities to secure traditional support for the CFP
Action V	Research to provide enhanced knowledge related to biodiversity
Action VI	Monitoring and assessment of state of commercially important fish stocks
Action VII	Monitoring of other organisms and habitats
Action VIII	Reduction of environmental impact: refers to aquaculture
Action IX	Limit introduction of new species and secure animal health
Action X	Research to provide enhanced knowledge related to aquaculture

Source: European Commission, 2001a.

aquaculture, the measures planned are intended, in particular, to limit the introduction of alien invasive species and secure animal health.

More particularly, the actions related to the ecosystem approach related to fisheries are listed in Box 1.

- **Green Paper on the reform of the common fisheries policy**
  This highlights reform of the CFP focusing on the weaknesses of its predecessor and calling for new orientations on long-standing problems. Problems such as overcapacity, continuing depletion of commercial fish stock and the serious economic difficulties these cause the fishermen and the industry are highlighted together with the ineffectiveness of EU fleet reduction programmes to tackle the scourge of most fishing industries (European Commission, 2001c). Equally important, emphasis is placed upon the social dimension that should not be underestimated. It states that in general 'in spite of substantial subsidies, not much progress has been made towards resolving problems. Overcapacities persist and job alternatives to fishermen have not been offered'.

  Another area, which caused concern was the weakness of implementation of CFP measures in the Mediterranean. While the specificity of the Mediterranean had to be taken into account, sustainable fisheries had to be ensured there as in other parts of EU waters. These problems however, had to be analysed in the wider framework of the globalisation of the markets and the EU's commitment to ensuring sustainable economic development.

- **Council conclusions on Commission communication**
  Council conclusion on 'Elements of a strategy for the integration of environmental protection requirements into the common fisheries policy' (Bulletin of the EU 4-2001, Fisheries (10/10)) calling for more detailed study. It recognised the threat to the marine biodiversity and the long-term sustainability of the European fisheries sector. Fishing pressure and the use of inappropriate fishing techniques, along with a series of other factors unrelated to fisheries, have been identified as the main culprits.

- **Presidency conclusions, Göteborg European Council, 15–16 June 2001**
  European Council conclusions on the strategy for sustainable development: 'the review of the common fisheries policy in 2002 should, on the basis of a broad political debate, address the overall fishing pressure by adapting the EU fishing effort to the level of available resources, taking into account the social impact and the need to avoid overfishing'. (http://ue.eu.int/presid/conclusions.htm)

- **Sixth environmental action programme (EAP)**
  One of the actions foreseen in the sixth environmental action programme (EAP) is the development of a thematic strategy for the protection and conservation of the marine environment (marine strategy). Therefore, the overarching objectives of the communication on a European marine

strategy with the aim to protect the marine ecosystem are (i) sustainable and healthy European seas and their ecosystems, and (ii) sustainable exploitation of renewable marine resources of these seas.

3.4. EU Directives

The following areas of EC policy are relevant to the environmental impacts of aquaculture and fisheries although not all are being rigorously applied in this context:

- the EC Birds (79/409) and Habitats (92/43) Directives;
- the EC Shellfish Water Directive, which requires coastal and brackish waters used to support commercial shellfisheries to be designated and made subject to binding water quality standards;
- the Dangerous Substances Directive, which introduces additional controls to reduce the use of chemical discharges into water from fish farms;
- the Environmental Impact Assessment (EIA) Directive (97/11), which requires EIA in fish-farm areas;
- the Water Framework Directive (2000/60/EC), which aims at good water quality for all surface waters regarding all sources of impact.

3.5. Regional fisheries and marine environment policies

At a regional level, conventions aim to protect the environment of the Baltic (Helcom), the Mediterranean (Barcelona Convention) and the North-East Atlantic (OSPAR). However, these conventions do not have specific responsibility for fisheries in EU waters and there is a strong coherence between CFP and regional fisheries agreements such as the North-East Atlantic Fisheries Commission (NEAFC), the International Baltic Sea Fisheries Commission (IBSFC), the North Atlantic Fisheries Organisation (NAFO), the International Commission on the Conservation of the Atlantic Tunas (ICCAT) and the North Atlantic Salmon Conservation Organisation (NASCO).

4. Development of fisheries and aquaculture indicators

4.1. Indicator development by the EEA and the European Commission

There are literally thousands of indicators and potential indicators, which could be developed and used. An outline of possible performance indicators has been presented in the communication on 'Elements of a strategy for the integration of environmental protection requirements into the CFP' (Table 1). In preparing a core set of indicators, the EEA held a meeting of the Inter-Regional Forum working group on indicators in April 2000. Fisheries was discussed among the major themes and indicators within the DPSIR framework for marine waters and coastal zones. The proposal from the working group is summarised in Table 2. In a first expert meeting on fisheries indicators in February 2001, the European Commission's Environment DG, EEA and Eurostat exchanged their views. Possible indicators (Table 3) were discussed with an emphasis on state and impact indicators (EEA, 2001b). The set of indicators presented in Table 3 under type A reflects mostly what can be produced based on data available in fisheries statistics. It should be kept in mind however that the reporting of most of these data also occurs in the regular fisheries reports. It thus makes sense to focus EEA reports on these aspects, which reflect major statements and 'new' information with eco-efficiency indicators and integration with socioeconomic data.

A system of indicators should be developed within the DPSIR framework and these indicators should be used for a system of periodic reporting starting by the end of 2003. The main contributors to those indicators will be FAO, OECD, Eurostat, ICES for the North-East Atlantic and GFCM for the Mediterranean.

4.2. Indicator development by international organisations

At the European level, several fisheries indicators complying to the above frameworks have been suggested and are being developed by ICES, IBSFC (International Baltic Sea Fisheries Commission), Blue Plan for the Mediterranean and the EEA. They are at a very early stage in the Mediterranean. They are more developed within Helcom and OSPAR, and even more at the national level in some Member States where they are being tested with real data. The lists of potential indicators for fisheries and aquaculture suggested or partly developed by international organisations are presented in Tables 4 to 10 for UNEP/MAP, IBSFC, ICES, UN CSD, Eurostat, OECD and FAO respectively.

Fisheries in the EEZs are, for the main species, regulated by quotas and a variety of other measures (for vessels, fleets, species, season). Advice on catch forecasts is being made consistent with the precautionary approach. There is a relationship between the ecosystem approach and the precautionary approach (pa) in fisheries, as used by FAO. The precautionary approach is meant to guarantee a sustainable fisheries for the present and future generations. This approach offers several possibilities to further explore state, performance and efficiency indicators.

Outline of possible performance indicators Table 1

Item	Driving forces	Pressures	State	Impact	Response
Ecosystem (habitats)	• Long-term trends of key physical parameters • Eutrophication, pollution • Upwelling indices • ….	• Climate change • Nutrients • Circulation patterns •	• Hydrographic regime • Chemical composition of water • Habitat extent and condition •	• Sea warming • Physical damage to seabed • Water pollution transmitted through food web •	• Changes in water dynamics • Changes in productivity • Changes in fish availability • ....
Ecosystem (biocoenosis, e.g. relation between living organisms)	• Intrinsic population growth rate (*) • Individual growth rate (*) • Individual fecundity (*) • Structure of trophic webs •	• Natural mortality of populations (*) • Productivity at various trophic levels • Energy flow in food webs •	• Biodiversity indices by area and by major taxa groups • Energy flow in key links of food web • Biomass (*) •	• Changes in geographical distribution (*) • Changes in fish mortality (*) • Additional sources of food (discards) •	• Changes in geographical distribution and migration (*) • Changes in growth, fecundity and age at first maturity (*) • ....
Fishing industry	• Fishing tradition • Alternative employment • Fishing capacity • Market demand • Loans, subsidies •	• Deployed fishing effort by region and by fishing gear • Gear loss • Waste • Economic needs •	• Fishing capacity (potential fishing effort) • Employment • Production (catch) in weight and in value •	• Fleet size adaptations • Change in fishing behaviour: effort, gear, zones • Changes in economic results •	• Social unrest • Adaptation of fishing effort • Highgrading of catch • Change of gear • Withdrawal from industry • ....
Aquaculture	• Market demand • Technological improvement • Need for water resources •	• Need for good environmental conditions of farm sites • Need for food stuff of marine origin •	• Fish production • Use of water • Food needs • Quality of effluent water •	• Water quality (effluents) • Use of territory • Supply of food stuff • Supply of fry •	• Adaptation of farming methods • Promotion of research • Diversification of supply • ....
Consumers and public opinion	• Market supply • Feeding behaviour • Buying power • Need for health protection •	• Demand for supply at reasonable prices • Demand for ecological and sanitary standards • Political pressure •	• Opinion (poll results) • Fish consumption indices • Consumption preferences •	• Changes in market supply and demand • Public awareness of marine problems •	• Adaptation of consumption habits • Reactions against poor quality or high prices • ....
Science	• Need for scientific support • Intellectual challenge • Research facilities (personnel, installations) •	• Need for basic research data • Need for research funds • Research results •	• Budget allocated to research • Number of research projects • Inventory of research facilities •	• Changes in budget actually used in research • Changes in geographical and thematic scope of research •	• Research enhancement • Adaptation of research programmes • ...
Decision-making	• International and internal commitments • Dissatisfaction with current producers • Public opinion	• Regulatory instruments • Information campaigns • Enforcement • Subsidies	• Number of actions subject to impact assessment • Number of species covered by management	• Increased understanding of problems • Political pressure • Social pressure	• Improved measures • Improved enforcement • Improved governance

(*) For key biota.

Source: Communication from the Commission to the Council and the European Parliament, 16 March 2001.

Table 2 **Indicators for fisheries within the DPSIR framework for marine waters and coastal zones as proposed by the IRF working group on indicators**

Source: IRF, 2000: http://eea.eionet.eu.int:8980/Public/irc/eionet-circle/irf/library?l=/summary_reports&vm=detailed&sb=Title

Common themes	Driving force	Pressure	State	Impact	Response
Fisheries	Fisheries technology Social-economic	Discards Total catch Bycatch Fleet characteristics Fishing intensity	Commercial species Fish-stock characteristics Seabed characteristics	Species and habitats Seabed disturbance	Precautionary measures Quota management Fishing equipment improvement Zoning Zone management Fishing effort Control and enforcement Fisheries restructuring

Table 3 **Potential core set of indicators for environmental integration in fisheries (F) and aquaculture (A) [1])**

Source: EEA, 2001b.

	Driving forces	**Type [1)]**	**Time frame [2)]**
1	Economic value [(2)] of fisheries vs implementation of precautionary approach	C	L
2	Employment	B	A
3	Landings	B	I/L
	Pressure		
4	Fishing mortality	A	L
5	Fleet size	B	L
6	Fishing effort (horsepower per day or categories per gear)	B	L
7	Ratio of fishing effort vs maximum yield	B	L
8	Percentage of stocks outside safe biological limits	A	I/L
9	Production (catch) (F and A)	B	I
10	Quality of effluent water (A)	B	I
11	Number and total size (ha) of fish farms (A)	B	I
	State		
12	Biomass of commercial fish species	A	L
13	Structure of fish population	A	L
14	Catch per unit effort	A	L
	Impact		
15	Physical damage to habitats and species (benthos changes)	A/B	L
16	Discards	A/B	L
17	Relative abundance of juveniles vs adults	A/B	L
18	Bird population changes (food changes)	A/B	L
19	Non-commercial fish-stock changes	A/B	L
20	Bycatch (unwanted) of mammals	A/B	L
	Response		
21	Percentage of fisheries reflecting environmental integration	C	L
22	Percentage of mariculture complying to Fish Farms Code of Conduct	C	L

[1)] Type of indicators	[2)] Time frame
Type A: 'What is happening to the environment and to humans?' — Descriptive Type B: 'Does it matter?' — Performance indicators Type C: 'Are we improving?' — Efficiency indicators Type D: 'Are we on the whole better off?' — Total welfare indicators	A = Available for 2002 *Environmental signals* report I = Intermediate, data available by 2003 L = Long term, data available

1) (A) is indicated where the indicator is relevant also, or only, for aquaculture.
2) Economic value is a function of the indicators production value, added value and employment.

List of potential indicators proposed by ICES Table 4

	Indicator	DPSIR
Fisheries	Biomass	State
	Fishing mortality	State
	Structure fish population	
	Physical damage to seabed	Pressure/state
	Fleet size	Pressure
	Employment	Driving force
	Production (catch)	Pressure
	Landings	Response
	Fishing effort per fishing gear	Response
Aquaculture	Fish production	State
	Food needs	State
	Quality of effluent water	State
	Number and total size of fish farms	

Source: EEA, 2001a.

List of fisheries/mariculture indicators developed for the Mediterranean Table 5

Theme: Economic activities and sustainability	Type
Number and average power of fishing boats	Pressure
Fishing production per broad species groups	State
Production of aquaculture	State

Source: Blue Plan, 2000.

Indicators suggested by the International Baltic Sea Fisheries Commission Table 6

Biological indicators
Spawning stock biomass (SSB): The part of the biomass of cod, herring and sprat taking part in the reproduction process, in tonnes. This is an important indicator of the biological health of a given stock. Scientific information is only available for the most important commercial stocks in the Baltic Sea.
Fishing mortality: The proportion of the average population removed annually by fishing.
Recruitment: The number of fish reaching the age where they enter the fisheries.

Economic indicators
Landings per country: Total amount of landings in tonnes of cod, salmon, herring, sprat.
Number of fishing vessels per country operating in the Baltic Sea.
Average engine power per country: Total kilowatt of the fleet, divided by the number of vessels.
Fish consumption per capita per country.

Social indicators
Number of full-time fishermen engaged in the Baltic Sea region, per country.

Source: Baltic 21, 2000.

Potential indicators based on UN Commission for Sustainable Development (UN CSD) Table 7

UN CSD working list of indicators of sustainable development
Environmental indicators Table 7.1

Chapters of Agenda 21	DSR	Indicator
Chapter 17 Protection of the oceans, all kinds of seas and coastal areas	State	Maximum sustainable yield (MSY) for fisheries MSY abundance/actual average abundance; or the deviation in stock of marine species from the MSY level

Source: UN CSD, 1996.

UN CSD core list of indicators of sustainable development
Environmental indicators Table 7.2

Theme	Sub-theme	Indicator
Oceans, seas and coast	Fisheries	Annual catch by major species

Source: UN CSD, 1999/2000.

Table 8 **List of potential indicators available from EU Commission: Eurostat**

Source: Eurostat, 2002.

Issue	Indicator	
Marine environment and coastal zones	Fishing pressure	Towards environmental pressure indicators for the EU (first edition 1999)
Statistics in focus Agriculture and fisheries Theme 5	Catches in the North-East Atlantic	Last issue date: 27.11.2001
	European aquaculture, 1999	Issue date: 16.10.2001
	Mediterranean fisheries	Last issue date: 9.10.2001
	EEA fishing fleet in 2000	Issue date: 17.9.2001
	Fisheries production, 1999	Issue date: 11.9.2001
	EEA fisheries in the North-West Atlantic	Last issue date: 10.9.2001
	Fisheries production in EU candidate countries	Issue date: 30.3.1999
	EEA foreign trade in fishery products	?

Table 9 **Potential indicators based on OECD**

Table 9.1 **Resources: Towards sustainable development - Environmental indicators**

Source: OECD, 1998.

Issue	Indicator area	Indicators
Fish resources	Fish catches and consumption: national	Trend in fish catches in marine and inland waters Fish consumption per capita
	Fish catches and consumption: global and regional	Trend in fish catches, 1980–95 Fish catches by major fishing areas World marine fish resource by phase of fishery development

Table 9.2 **Ten indicators for the environment**

Source: OECD, 2001.

Issue	Selected core indicators
Fish resources	• Intensity of use of fish resources
Biodiversity	• Threatened species

Table 9.3 **Core set of indicators for environmental performance reviews**

Source: OECD, 1993.

Issue	DPSIR	Indicators	Availability
Fish resources	Pressure	Fish catches	S
	State	Size of spawning stocks Overfished area	M M/L
	Response	Number of stocks regulated by quotas Expenditure for fish-stock monitoring	M M/L

Note: Availability: 'S' for indicators measurable in the short term; 'M' for indicators which require additional empirical work and data collection efforts and which are therefore only measurable in the medium term; and 'L' for indicators measurable only in the long term because they would need significant data development work.

Table 10 **Fisheries/aquaculture indicators developed by FAO**

Source: CD FAO, 2001.

- Trends in world fishing fleets
- Fisheries: statistics and trends
- Trends in capture fisheries production
- Trends in aquaculture fisheries production
- Trends in fish utilisation
- Trends in fish trade
- Trends in consumption

5. Compilation of candidate indicators

One could identify and assess environmental performance within fisheries by a huge number of potential indicators. Many countries have started developing fisheries indicators and so have some marine conventions. However, as there is no operational technology for implementation of routine measurements at the required scales of space and/or time, there are only a few pressure indicators (such as fishing gear expressed as number, and tonnage of the fishing fleet) that could be implemented European-wide and at the same time be reliable.

The ICES Advisory Committee on Fishery Management is reporting yearly its assessments of fisheries catch data. Landings, recruitment, fishing mortality and spawning stock biomass are amongst other parameters reported for the major demersal and pelagic fish stocks of ICES fishing areas covering the North Sea and the Atlantic Ocean, the Baltic, the Norwegian Sea and the Arctic Waters. The set of indicators suggested by ICES reflects what can be produced based on data available in fisheries statistics.

Safe biological limits are, since 1998, defined by the precautionary reference points (limits and targets) for fishing mortality and spawning stock biomass. The development of these benchmarks not only has value for direct advice on the catch quota, but the benchmarks also contribute to communication about the level of sustainable fisheries. These data are available for most commercial fish species within the North Sea (ICES, 1999).

In the Mediterranean, unreliable official fisheries statistics is a major problem for the development of indicators. This situation is directly linked to the fact that an important part of the production eludes from the traditional circuits for information gathering (auction, markets, etc.). Moreover, most statistical services are not tailored to deal with the problem with adequate sampling systems. As a result, according to each case, underestimation of catches (suspected to represent less than one-third of the reality), as well as overestimation of some productions, is detected (Papaconstantinou and Farrugio, 2000). With regard to the fleets, the official statistics do not describe their structure and capacity well, the discrepancy depending on heterogeneous factors such as the depth of the fishing ground, the type of activity, the economic level of fishermen, the shipbuilding, traditions, etc. For example, in the small scale fleets, registered figures can deviate as much as 50 % from the real ones, a fact that introduces important biases in the analyses (Papaconstantinou and Farrugio, 2000). Study of many biological fishery parameters in the Mediterranean region has been included in the objectives of an EU-funded project running from 1994 to 2001 (Medits). To this end, many research centres collaborated in studying the dynamics of the most important fish stocks as well as the fleet dynamics and interactions. However, catch and effort statistics remain the weak points. There is no sufficient coverage at the Mediterranean level: Spain and France keep records of fishing effort but not Italy and Greece.

Trying to choose the 'best' fisheries indicators following EEA's strategy, which is based on policy relevance and data availability at a pan-European level, is not an easy task. It was soon realised that it is not only unsatisfactory but also probably wrong in some cases to base the choice *only* on the data availability. Without having any 'measure of quality' regarding the context in which an indicator describes the actual environmental performance of each fishery, even the longest data series becomes insufficient. At the national level of Member States, progress has been made in developing fisheries indicators for sustainable fisheries in many countries. However, due to national differences in fisheries and inconsistency of reporting to the regional conventions, the reporting system is flexible and therefore not entirely useful. A system of indicators defining certain minimum requirements is needed.

Selection of indicators must be based on a broader perspective; policy relevant indicators are selected based on data requirements, not availability. So, the suggestions for the development of 29 indicators out of a total of 52 (see Table 11) is

based on the indicators' relevance for the illustration of the environmental performance of the actual fishery. In this way, this report will contribute to better and targeted data collection within the area of coverage in the future. The new Council Regulation (EC) No 1543/2000 (see Chapter 5.2) sets some minimum requirements for data collection at the European level.

Table 11 **Overview of 52 candidate indicators of which a potential core set of 29 indicators for environmental integration in fisheries (F) and aquaculture (A) has been selected**

Community regulation numbers as given below refer to Community policies already in force. Underlined: suggested name of indicator when it has been proposed under many different names. Only proposed 29 indicators for a core set have been numbered.

Candidates		Definition	Type	Comments	Community legislation
Driving forces					
Core indicators					
1	Fish consumption per capita	Indicator of consumer demand.	A	If data can be split on origin (sea, region, fishery, landing port, aquaculture) this would be a good indicator.	*Council Regulation (EEC) No 1382/91*
2	Average wage (F & A)/average national wage	An indicator of attractiveness for individuals to enter the industry and of attractiveness for investment.		May be misleading because of delayed adjustment. Low wages may actually drive fishing pressure up in situation where sunk investment and debt is high. Require comparison with pressure and state indicators.	
3	Market demand (F & A) Price — First sale value/cost	A simple indicator of consumer demand and its relationship to supply.	A/C/D	Directly related to 'economic value' in a deregulated market. Potential for 'ecological fish' comparable to ecologically propagated dairy products, data availability most likely poor. Unless some fisheries are identified and classified as non-destructive and 'environmentally friendly'. Meaningful in relation to specific fisheries species.	*Council Regulation (EEC) No 1382/91*
	First sale value/feed cost	Feed is the main operating cost.		Aggregated data difficult to interpret. Same as above.	
	First-hand value of catch per fisher	Earnings of fishery have a direct impact on fishermen since many are 'share fishermen', self-employed or artisanal fishermen. Economic health and gains are drivers related directly to investment in fisheries.		Interpretation is not straightforward. No clear connection between indicator and exerted pressure on stocks. It is evident that countries where value per fisher has increased and should increase their efforts have significantly reduced their fleet. Data concerning employment and socioeconomics are poor both in quality and quantity.	*EC Treaty, Article 38*
	Sales per employee vs per capita (GDP) (A)	Proxy for wages. Economic health and gains are drivers related directly to investment in aquaculture.		Interpretation not straightforward. See also previous comment on data.	
Additional indicators					
	Fishing tradition	Indication of 'urge' to enter the industry.	A	Expressed as number of fishermen in public 'trade records'. Difficult to compensate for technological development.	
	Economic needs Loans, subsidies (F & A) Total grants, subsidy, infrastructure investment and research funding/output value	Indication of attractiveness to enter the industry.	D	Vary within states and in time. Probably difficult to obtain reliable data. A linear relationship between provision of subsidy/infrastructure and fishing pressure unlikely. Data probably not readily available for non-EU countries.	*Commission Decision 92/448/EEC*

Candidates		Definition	Type	Comments	Community legislation
	Economic value of fisheries vs implementation of precautionary approach	?	C	Varies with external forces (e.g. mad cow disease) and supply and demand from other fisheries (fishmeal/oil – El Niòo).	*Council Regulation (EEC) No 1382/91* *Council Regulation (EC) No 3699/93*
	Employment and skills associated with fisheries and aquaculture Employed/number of qualified, skilled personnel	Indication of 'urge' to enter the industry.	B	Employment in fisheries and handling, transportation, retail? Difficult to measure environmental performance related to number of retail shops for e.g. fresh fish. If it refers to alternative employment? Should be classified as 'State'.	*Council Regulation (EEC) No 31/83* *Council Regulation (EC) No 3699/93* Community measures to encourage the creation of joint enterprises in the fisheries sector
	Landings Data set rather than indicator	See comments.	A/B	Direct measure of significant importance A data set to be employed for calculation of many indicators.	
	Fisheries technology	Indication of attractiveness to enter the industry.	B	Technological developments mostly to officiate fishing operations or make life easier for employees onboard and in the fish-processing industry.	*Council Regulation (EEC) No 2847/93*
	Technological improvement (A)	Indication of attractiveness to enter the industry.	B	Derived from a need to reduce losses due to accidents. Larger production units giving access to new sites. Driven mostly by economical considerations, not environment.	Action X of BAP: Research to provide enhanced knowledge related to aquaculture
	Need for water resources (A) Annual water exchange – Water allocated for aquaculture	Prerequisite for establishing an aquaculture enterprise.			Action VIII of BAP: Reduction of environmental impact
	Borrowing as a proportion of total value			Same as 'Total grants …'.	
	Landings of wild stocks (A)	Declining landings of capture fisheries will drive price up. Similar to price but more fundamental.		Price an easier and more direct driver which also encompasses increased demand. Does the price of wild captures affect prices in aquaculture? Maybe not a good indicator.	
Pressure					
Core indicators					
4	Gear loss	Ghost fishing is a problem in different scales. Probable 'pollution' pressure on the wider environment.	A	Reliable data hardly available. Ghost fishing can be a problem in different scales. Could probably be included by keeping record of new equipment being brought into use.	*Council Regulation (EEC) No 2847/93*
5	Fishing mortality	An expression of the proportion of the fish stock that is removed by fishing activity within one year.	A/C	F is specifying instant mortality rate caused by fishing. Prefer Z ((F+M)/F) as measure of proportion of a stock being harvested. However it should be noted that actual fishing mortality rates are exceeding target rates because of unreported catches, discarding and ghost fishing.	*Council Directive 83/515/EEC* Action VI of BAP: Monitoring & assessment of state of commercially important fish stocks
6	Percentage of stocks outside safe biological limits	Indicator of sustainable fisheries. Stocks where fishing pressure (mortality) exceeds sustainability (mortality > recruitment).	A	This is more like a political indicator. Several other factors other than fishing affect fish stocks, e.g. predation from marine mammals, natural temperature variations, etc. Difficult to identify the safe biological limits for more than a few stocks.	*Council Regulation (EEC) No 3252/87* *Council Directive 83/515/EEC* Action VI of BAP: Monitoring & assessment of state of commercially important fish stocks

Candidates		Definition	Type	Comments	Community legislation
7	Fleet size/fishing capacity Fleet characteristics Fishing pressure Total capacity (KW)	Indicator of the fishing effort related to fishing mortality. Excess capacity may lead to overfishing. Broad indicator of fishing pressure.	B	Extensive fleet data available that could be related to specific fisheries. Difficult to compensate for fishing in non-EU countries.	*Council Directive 83/515/EEC* *Council Regulation (EEC) No 2847/93* *Council Regulation (EC) No 3699/93* Action I of BAP: Overall reduction in fishing pressure to promote conservation and sustainable use of commercially exploited fish stocks
8	Fishing effort (horsepower/day or categories/gear) Deployed fishing effort by region and fishing gear Fishing intensity	See comments.	B	Fishing effort is generally a strong indicator for accessibility of fish resources. Impacted by e.g. weather conditions, but a central and necessary indicator. Together with catch a prerequisite for CPUE calculations.	*Council Regulation (EEC) No 31/83* *Council Regulation (EEC) No 2847/93* *Council Regulation (EC) No 3699/93* Action I of BAP: Overall reduction in fishing pressure to promote conservation and sustainable use of commercially exploited fish stocks
9	*Maximum sustainable yield (MSY)* Ratio of fishing effort vs maximum yield	An expression of the state of the fishery exploitation to its sustainable size.	B	MSY is a classical measuring instrument, but the reliability is questioned. A large amount of background data probably available for single stocks.	*Council Regulation (EEC) No 3252/87* *Council Regulation (EEC) No 2847/93*
10	Fish catches by major species/areas Production (catch) Production (catch) in weight and in value Inland fisheries Total catch	General pressure indicator.	B	Absolutely necessary. Extensive landing data available but the job in itself is very large, particularly if one wants to split on species, season, area, gear type, etc. The catches could be estimated using equations that incorporate the discarding fraction of the catch. These estimates are available for many areas. Ideally use all fish caught (landings + discards).	*Council Regulation (EEC) No 2847/93* Action I of BAP: Overall reduction in fishing pressure to promote conservation and sustainable use of commercially exploited fish stocks
11	Aquaculture production (A) Fish production (A) Total production Production (tonne and/or value/area) or volume of aquaculture system capacity	General pressure indicator. Measure of the pressure aquaculture exerts on the specific areas it occurs in. Depends on space available and assimilative capacity of a body of water .	A	Extensive data available. Trends in aquaculture maybe should be classified as 'State'. Poor for comparative purposes, since pressure/impact depends on coast length/water area/total water flushing. Better 'Response' indicator. Production/area, volume. Ideally the indicator for freshwater would be production per unit flux in different catchments. Data may be available from the water quality people. Some countries have identified 'suitable coastline' for aquaculture development. Proportion of this developed for major producers would be a useful related indicator/case study.	*Council Regulation (EEC) No 31/83*
	Capacity (KW/catch, quota or best scientific advice	More immediate measure of pressure on individual fisheries.		Isn't the same as EEAs catch per unit effort classified as 'State'?	
12	Production of non-indigenous species Indicator on introduction of alien species by mode of introduction	Indicator of potential for disease spread and ecological impact displacement of native species.		Risk rather than pressure.	*BAP* *Water Framework Directive*

Candidates		Definition	Type	Comments	Community legislation
	Imports/Exports of live animals	Escape, release of alien species and/or genotypes may have population, ecological and disease impacts		Incorporated in 12.	
13	Food conversion ratio Eco-efficiency of aquaculture	Standard industry performance measure. Also indicator of waste as above.		Data not available for many countries. Meaningful indicator can be developed if data of good quality are available. May be developed as case study.	
Additional indicators					
?	Total feed used minus total aquaculture production FAO — Food use/ output production and/or value	An indication of the waste produced and potential for organic enrichment/ eutrophication.		Data not available for many countries. Meaningful indicator can be developed if data of good quality are available. May be developed as case study.	
?	Sales of chemicals to aquaculture industry FAO – Chemical, antibiotics/tonne output	Indicator of likely release of chemicals to the environment.		Only available for some chemicals for some countries. Meaningful indicator can be developed if data of good quality are available. May be developed as case study.	
	Number of escapees per Km coast/ha inland water	An indication of the pressure on wild genotypes and possibly also potential for disease transfer.		How to define it? Data limited; underestimates. Escapees represent a risk of pressure.	
	Waste	Waste from fish processing	B	Suggested by DG Environment.	
	KW per tonne (of boats)	Indicator of the power of fleet in relation to its size.		Are a few powerful boats more or less pressure than a lot of less powerful boats? Maybe 'keep' fleet size/capacity.	
	Number of new vessels built, entering the fishery in the previous year – as a proportion of the whole fleet	Gives an indication of the change in size of the fleet and therefore the change in pressure exerted.		Same reservations as above. Can be added as 'Response' similar to 'Withdrawal from industry' and 'Fleet size adaptations' which should now be classified as 'Response'.	
	Catch per fishermen	Indication of the pressure exerted by each individual and of the technology and efficiency of fishing.		Covered in *Catch per Unit effort* where classified as 'State'. More a performance/efficiency indicator, or a state indicator than a pressure indicator. Difficult to interpret. If catch/fishermen is declining then overfishing. But CPUE a better measure of this. If catch per fishermen rising, either stock is getting healthier or technology improving or both.	
	Need for good environmental conditions of farm sites (A) See 'Driving forces'		?	This is a prerequisite for developing aquaculture. Not possible to quantify it so as to become an indicator.	Action IX of BAP: Limit introduction of new species and secure animal health Action VIII of BAP: Reduction of environmental impact *Council Directive 85/337/ EEC and amendment 97/ 11/EC*
	Need for food stuff of marine origin (A) See FAO – Food use/ output production and/or value	Indicator of fishing pressure on wild populations to support aquaculture.	?	As above.	*Council Regulation (EEC) No 3760/92 and amendment 1181/98/EC*
	Overfished area Intensity of use of fish resources	Indicator of the sustainability of fisheries.	A	Lack of reliable statistics in many areas. To be developed at a later stage when intensity of fishing grounds will be registered along with landings.	*Council Regulation (EEC) No 2847/93* Action I of BAP: Overall reduction in fishing pressure to promote conservation and sustainable use of commercially exploited fish stocks

Candidates		Definition	Type	Comments	Community legislation
	Number and total size (ha) of fish farms (A) See: Production (tonne and/or value/area) or volume of aquaculture system capacity		B	The area of fish farms is not a valid parameter. Difficult to compensate for varying depth of net pens in cage cultures. In Norway aquaculture is regulated through feed quotas – a much better measure.	*Council Regulation (EEC) No 31/83* *Council Directive 97/11/EEC*
State					
Core indicators					
14	Quality of effluent water (A) General aquaculture system water quality (N, P, BOD, COD, ammonia, chemicals' pesticide concentrations, residues) in areas of intensive aquaculture activity compared with water quality standards Also in 'Impact'	Impact of aquaculture on the aquatic system: exceedance of environmental quality standards.	B	Organic load from aquaculture, eutrophication. A direct link to 'external factors, with probably a lot of different data sets available from e.g. environmental monitoring. Also 'Impact'. Case study.	Action X of BAP: Research to provide enhanced knowledge related to aquaculture Action VIII of BAP: Reduction of environmental impact *Council Directive 85/337/EEC and amendment 97/11/EC*
	Chemicals' pesticide concentrations, residues in areas of intensive aquaculture activity relative to EU/national standards Also in 'Impact'	Intensive aquaculture uses a range of chemicals which are released to coastal and inland waters, some of which are harmful above certain concentrations.		Incorporated to the indicator above.	*Council Directive 92/32/EEC* *Water Framework Directive*
15	Biodiversity indicators near farms compared with away from farms Also in 'Impact'	Impact of aquaculture on surrounding environment.		Also 'Impact'. Case study. For example area of seabed dominated by opportunist, pollution tolerant species.	*BAP* *Water Framework Directive* *Habitats Directive*
16	Metrics of community structure Diversity of fish catch Biomass of commercial fish species Non-commercial fish-stock changes Structure of fish population	An estimation of the number and/or biomass of the species in the catches; state of the ecosystem.	A/B	It measures the state of an ecosystem, but experimental survey data are needed other than those available from fisheries statistics. Community size spectra could provide the linkage with fishing pressure. Uncertainty in community structure due to environmental factors other than fisheries impact. Could be extended to non-commercial species of fish.	*Council Regulation (EEC) No 3252/87* Action V of BAP: Research to provide enhanced knowledge related to biodiversity Action VI of BAP: Monitoring & assessment of state of commercially important fish stocks
17	Fish-stock characteristics Relative abundance of juveniles vs adults Recruitment as proportion of spawning stock biomass (SSB)	Structure of fish stocks in a given area. Indication of information on fishing mortality (F), natural mortality (M), recruitment, and stock size. Indicates the rate at which the stock is replacing itself.	A/B	Data from surveys exist for some species/stocks. Recruitment highly variable/cyclical from year to year and affected by temperature and other oceanographic and ecological variations.	*Council Regulation (EEC) No 3252/87* Action I of BAP: Overall reduction in fishing pressure to promote conservation and sustainable use of commercially exploited fish stocks Action VI of BAP: Monitoring & assessment of state of commercially important fish stocks
18	Catch per unit effort Catch per unit effort measured as total catch/fleet power (KW)	Catches (landings)/fishing effort; a useful tool for the management of fisheries. CPUE declines as stock is overfished	A	It can be calculated using the fishing effort/landings data. It is difficult to accurately estimate CPUE for the Mediterranean countries because effort data are very limited, especially for small-scale fishery. Apply to stock rather than country. CPUE may not decline in decreasing stock situations if technology increases catchability. If CPUE is declining despite advances in technology then this provides a significant warning.	*Council Regulation (EEC) No 2847/93*

Candidates		Definition	Type	Comments	Community legislation
19	Spawning stock biomass Size of spawning stock	Indicator of the state of a stock.	A/B	A very relevant indicator. Data availability should also be appropriate for most exploited stocks.	Action VI of BAP: Monitoring & assessment of state of commercially important fish stocks
	SSB compared to SSB lim See 'State', fish stocks outside safe biological limits	Compares the current state of the stock with a 'danger sign'; indication of the risks of over-exploitation.		Probable development but rather difficult. Might be developed to generate an indicator of stock risk/vulnerability or health. Examine variation and trend in SSB to generate probability of SSB_lim being breached.	
?	Ratio of catch of species low in the food chain to those high in the food chain	Indicator of the state of the fishery ecosystem and the degree of 'fishing down the food chain'.		Changes can occur for climatic reasons. Probably erratic from year to year but less than recruitment.	
Additional indicators					
	Disease incidence (A)	Disease likely to increase as water quality decreases; high levels of disease may impact wild stocks.		Not so clear; also reservation on data availability and quality.	
	Wild salmon SSB or wild salmon catch (A)	Escapees and disease may impact wild stock.		Not so clear; also reservation on data availability and quality. Relating this state indicator to aquaculture impacts very difficult and contentious; significant proportion of unrecorded salmon catch.	
	Use of water (A) See 'Driving forces'		?	Suggested by Environment DG. Unclear definition.	
	Food needs (A) See 'Pressure'		D	Probably only relevant in developing countries/regions. Not relevant to EU area. We have included market demand as a 'Driving forces' indicator.	Action X of BAP: Research to provide enhanced knowledge related to aquaculture
Impact					
Core indicators					
	Total catch See EEAs 'Pressure' Trends in fish catches	General indicator of impact.			
	Catch as proportion of spawning stock biomass See EEAs 'Pressure' Stocks outside safe biological limits	Tighter impact indicator for individual fisheries.			
20	Physical damage to habitats and species (benthos changes) Seabed disturbance Species and habitats Area trawled	Area of seabed directly affected by fishing activities. Indicator of habitat modification.	A/B	Indicator of different gear use. Time consuming to document, but survey data probably exist. A direct measure of impact, and as such important.	Action III of BAP: Technical measures with the objective to reduce impact of non-target species and habitats Action V of BAP: Research to provide enhanced knowledge related to biodiversity Action VII of BAP: Monitoring of other organisms and habitats
21	Discards Discards (pressure) Non-target species catches Discards + marine mammals deaths + turtle deaths + seabird deaths	Indicates the effects of fishing on the wider environment. Expressed as a proportion of the catch when refers to non-target species.	A/B	Discard is a major problem in many fisheries. However, reliable and unbiased data hardly available. To record one needs inspectors onboard the fleet, which will hardly be economically possible. Discard is in several fisheries prohibited. Yet, some data exist from experiments in fisheries that could exhibit some trends. Case study.	Strongly put forward by environmentalists Action V of BAP: Research to provide enhanced knowledge related to biodiversity Action VII of BAP: Monitoring of other organisms and habitats

Candidates		Definition	Type	Comments	Community legislation
22	Bycatch Bird, turtles, mammal population changes (food changes) Non-target species catches Discards + marine mammals deaths + turtle deaths + seabird deaths	Indicates the effects of fishing on the wider environment.	A/B	Only very limited amount of data, e.g. herring/puffin in Røst (Norway) is one of few good data series. Vulnerable indicator (e.g. birds are vulnerable to other impact factors like e.g. oil spills). Too difficult to handle as it is an indirect indicator. Case study.	Of major importance to CBD and other directives Action III of BAP: Technical measures with the objective to reduce impact of non-target species and habitats Action V of BAP: Research to provide enhanced knowledge related to biodiversity Action VII of BAP: Monitoring of other organisms and habitats
23	Food quality of fish (F and A)	See comments.	B	Are quality standards exceeded? There are times and places where contaminants present in the coastal zone mainly may be bioaccumulated in fish food. The consumers need to be certain that seafood remains clean and safe to eat, and that routine monitoring is sufficient to detect contamination problems when they arise.	*Commission Regulation (EEC) No 3703/85* Action X of BAP: Research to provide enhanced knowledge related to aquaculture Action VIII of BAP: Reduction of environmental impact: refers to aquaculture Strongly emphasised in the Green Paper
Additional indicators					
	Kittewake index	Indicates the effects of fishing on the wider environment, specifically seabirds.		Not clear. Case study.	
?	Disease frequency in wild populations of farmed species	Indicator of possible spread of disease from farmed to wild populations.		Unproven link with aquaculture. Care required in interpretation. Data uncertain. Can be developed as case study.	
?	Frequency of farmed genotypes in wild populations			Data uncertain, evolving technology. Can be developed as case study.	
	Use of territory (A) See 'Driving forces'		C	Conflict between aquaculture, some fisheries and other interests. Difficult to assess the reliability of this indicator. What is the direct implication of increased area occupied by aquaculture, measured as environmental performance?	Action X of BAP: Research to provide enhanced knowledge related to aquaculture Action IX of BAP: Limit introduction of new species and secure animal health
	Supply of food stuff (A) See 'Pressure'		C	The aquaculture industry's demand for fish meal/oil is, among other demands, stimulating industrial fishery in some regions. However, it is difficult to trace the demand back to a specific fishery. Tentatively	
	Supply of fry (A)	Indicator of the impact of aquaculture on wild stocks.	A		
Response					
Core indicators					
24	Quota management Number of stocks regulated by quotas Catch/quota?	Regulation measurement for fisheries management. Total allowable catch (TAC) per area and season. An indicator of effectiveness of measures to manage effort in line with stocks.	C	Number of stocks regulated by quotas is only one example of several management tools. A better indicator would be quota size, or directly landings (as included above). Included (in modified form). Interpretation problematic. May indicate effective management response to reduce effort and catch. However, under quota catch may occur when quota has been set too high, i.e. poor management response. Not so clear.	*Council Regulation (EEC) No 3252/87*

Candidates		Definition	Type	Comments	Community legislation
25	Zone management Fishing effort control and enforcement	Regulation measurement for fisheries management. Total allowable catch (TAC) per area and season. An indicator of effectiveness of measures to manage effort in line with stocks.	C	As above, included.	*Commission Decision 92/448/EEC* Action I of BAP: Overall reduction in fishing pressure to promote conservation and sustainable use of commercially exploited fish stocks
26	Fisheries restructuring Specific policy measures assessed against policy objectives and corresponding pressure and state indicators (e.g. fleet capacity/target or recommended capacity)?	Indicator of fishery industry response to successful management. An indication of how much money (and therefore effort) each country is putting into balancing fleet capacity with resource availability. Impact of major policy initiatives summarised by marking key inventions on trend graph of key state and pressure indicators.	D	Should rather be a result of management decisions (and as such an indicator of implementation of a policy towards wanted goals). An index of success could be generated based on relative movement toward policy objective. This indicator could then be used as a summary of response effectiveness for selected key fisheries. Not so clear.	*Council Regulation (EEC) No 31/83* *Council Regulation (EC) No 3699/93*
27	Percentage of fisheries reflecting environmental integration International fisheries agreements	Indicator of fisheries industry response to successful management. Membership and participation in international fisheries organisations is an indication of countries' commitment to the management and control of fisheries.	C/D	Provided clear-cut definitions and unambiguous tools for measuring performance. Included (after redefining). It is only an indication of effectiveness of management. Data easily obtainable.	*Council Regulation (EEC) No 2847/93*
28	Percentage of aquaculture complying to Fish Farms Code of Conduct Proportion of farms subject to EIA and/or consents and/or environmental management plan Proportion of farms in QA or certification schemes Proportion of product sold under QA, certification, eco-schemes	 Indication of how many farms have been evaluated to assess their potential impact on the environment. Indication of the industry's interest in reducing environmental impact of aquaculture. Indication of the industry's interest in reducing environmental impact of aquaculture.	C/D	Provided that codes of conduct are established for different types of aquaculture (both fish and invertebrates). Data difficult and/or inadequate.	Action VIII of BAP: Reduction of environmental impact
29	National legislation with specific provision for environmental management of aquaculture Aquaculture regulation	Indicator of national awareness and determination to manage aquaculture sustainably.		Require significant work to extract data.	
Additional indicators					
	High grading of catch	Can be an indicator of environmental performance in fishing activity.		Optimal use of catch is not indicative of environmental performance in fishing activity itself.	

Candidates		Definition	Type	Comments	Community legislation
	Change of gear Fishing equipment improvement Expenditure on capacity reduction compared with expenditure on fleet renewal/rebuilding/improving	Indicator of shift to optimal CPUs. Indication of how much money (and therefore effort) each country is putting into balancing fleet capacity with resource availability.		Improvement is synonym with larger catch at lower effort (CPUE). Also in 'Impact'. Data variable and generally poor, but this is critical management information. Interpretation difficult: more money spent may indicate either big effort (= good management?) or otherwise poor management requiring costly response. Needs to be used in conjunction with 'Pressure' and 'State' indicators.	
	Withdrawal from industry Expenditure on capacity reduction compared with expenditure on fleet renewal/rebuilding/improving	Indicator of fisheries industry response to successful management.		? As above.	*Council Regulation (EC) No 3699/93*
	Precautionary measures	Managerial tool.		Politics — not indicator .	
	Adaptation of farming methods (A)	Can be an indicator of financial and environmental performance in fishing activity.	?	Unspecific	Action X of BAP: Research to provide enhanced knowledge related to aquaculture Action IX of BAP: Limit introduction of new species and secure animal health
	Expenditure for fishstock monitoring Expenditure on fisheries monitoring, control and surveillance per fishermen or per tonne of fish landed or per value	Indication of how much money (and therefore effort) each country is putting into ensuing management measures are followed.	B	Nationally or EU funded? Economic terms are not a good measure. Rather use a measure for effort, like e.g. days at sea for research vessels, area covered by monitoring surveys.	*Council Regulation (EEC) No 3252/87* Action VI of BAP: Monitoring & assessment of state of commercially important fish stocks
	Marine Stewardship Council indicators	Comprehensive set of sustainability performance indicators for fisheries management systems.		???	
	Promotion of research methods (A) Expenditure on regulation and monitoring per tonne of produced fish and or value	Indication of how much money (and therefore effort) each country is putting into ensuring management measures are followed.	B	As above. Data may be difficult and/or inadequate.	*Council Regulation (EEC) No 3252/87* Action X of BAP: Research to provide enhanced knowledge related to aquaculture

Type A: 'What is happening to the environment and to humans?' Descriptive
Type B: 'Does it matter?' — Performance indicators
Type C: 'Are we improving?' — Efficiency indicators
Type D: 'Are we on the whole better off?' — Total welfare indicators

6. Storyline and proposal for a core set of indicators answering policy questions for fisheries and aquaculture

6.1. Storyline

The storyline for the proposed core set of indicators links the indicators and relate them to the main policy objectives.

State and impact
Fishing and aquaculture are two of the most important uses of the living resources in the seas and inland waters. As well as providing a healthy and enjoyable source of food they create much-needed jobs in coastal areas and promote the social and economic well-being of the European Union's fishing regions. Fisheries include the catch of fish and also the catch of mussels, shrimps and other shellfish, squids and, in some cases, whales. However, fishing has an impact on the ecosystem because the target species are overfished and not only the target species are being caught. The unwanted bycatch of fisheries includes other fish, marine mammals, seabirds, turtles, corals, etc. The bycatch is usually dumped into the sea. Gear-related damage is also inflicted on benthic habitats and communities There are too many fishing vessels causing fishing overcapacity in European waters, which has led to overfishing of fish stocks, too much discard, and uneconomic, unsustainable exploitation of the fish resources.

Aquaculture of fish and shellfish is providing an additional food source and an additional income for coastal human communities. Environmental impacts associated with aquaculture are deterioration of quality of effluent water leading to eutrophication, local smothering of the seabed, transfer of disease agents, and impacts on biodiversity by the introduction of exotic species.

Driving forces and pressures
Despite the EU being the world's third largest fishing power, the market demand for fish exceeds production. The imbalance between imports and exports resulted in a deficit of over EUR 6.5 billion in 1995. On the other hand the EU has facilitated the transition towards a better balance between vessels and fish stocks by instigating a decline in fleet capacity, which was too large for the available fish and had become uneconomic. However, there is still too much capacity in the fishing fleet.

The socioeconomic importance of fisheries and aquaculture as a source of employment in areas where there are often few alternatives is highly significant. Fisheries, aquaculture and their related activities on the production side (processing, packing, transportation and marketing) and on the service side (shipyards, fishing gear manufacturing, chandlers and maintenance) form the backbone of many remote coastal areas throughout the Community.

The sector is regulated by means of Community expenditure. The main instruments are:

1) structural assistance by providing funds to address structural, economic and social problems in order to reduce inequalities between different regions and social groups through:
   - Financial Instrument for Fisheries Guidance (FIFG),
   - European Regional Development Fund (ERDF),
   - European Agricultural Guidance and Guarantee Fund (EAGGF), and
   - European Social Fund (ESF);

2) the PESCA initiative (from 1994 to 1999) to help the fisheries sector make a successful transition by diversifying activities away from fishing and contributing to the diversification of coastal regions by developing new employment opportunities;

3) fisheries agreements with third countries; and

4) management: aid to research and control.

Main policy objectives

- The objective of the current **common fisheries policy (CFP)**, is 'to provide for rational and responsible exploitation of living aquatic resources and of aquaculture, while recognising the interest of the fisheries in its long-term development and its economic and social conditions and the interest of the consumers taking into account the biological constraints with due respect to the marine ecosystem'.

- European Council conclusions on the **strategy for sustainable development** (European Council, 2001): 'The review of the common fisheries policy in 2002 should, on the basis of a broad political debate, address the overall fishing pressure by adapting the EU fishing effort to the level of available resources, taking into account the social impact and the need to avoid overfishing'.

- The **Green Paper** on the future common fisheries policy (European Commission, 2001c) (ecosystem approach) identifies four main objectives: '(i) improving conservation and the protection of marine ecosystems, (ii) increasing the involvement of stakeholders in decision-making, (iii) securing an economically viable and self-sufficient fisheries sector and (iv) promoting sustainable fisheries beyond Community waters'.

- One of the actions foreseen in the **sixth environmental action programme (EAP)** (European Commission, 2001d) is the development of a thematic strategy for the protection and conservation of the marine environment (marine strategy). Therefore, the overarching objectives of the communication on a European marine strategy with the aim to protect the marine ecosystem are (i) sustainable and healthy European seas and their ecosystems and (ii) sustainable exploitation of renewable marine resources of these seas.

Responses

Governments and regulatory bodies respond to the pressures, impacts and effects that fisheries and aquaculture exert on the environment by attempting to control these influences. In both cases, control can take the form of attempting to reduce the pressure exerted (e.g. fishing capacity/the amount of aquaculture production allowed) or lessen the impact the activity has (e.g. the amount of catch/discharges allowed). Whilst controls on the driving force (e.g. capping prices, sales or salaries) are not often considered, greater consideration is being given to employing the power of market forces to effect such control — through more informed use of fiscal and taxation policy, and much reduced and more sensitive use of subsidy as a tool of control.

Whatever the control method used, responses are very difficult to compare between different types of fishery or aquaculture operation and between areas and years. This is because a whole range of responses are usually used together; for example, a combination of TACs, gear controls, closed areas and vessel restrictions are used throughout Europe to control fisheries. It is possible that in the future it may be possible to construct a composite indicator reflecting the nature of such responses, but this will necessarily require considerable focused research.

A currently available indicator of the response of individual countries to effect reduction in fisheries impacts on the environment is their level of participation in international organisations whose aim is to manage international fisheries cooperatively.

The response each country makes to the impacts that aquaculture has on the environment can be assessed by reviewing the different regulatory measures in place e.g. use of environmental impact assessments, control of discharges, registration of farms, etc. The level of response can then be scored based on use of all methods and cross-country comparisons can be made.

6.2. Proposed core set of indicators

Core indicators are numbered according to Table 11, but titles of indicators have been simplified.

Table 12

Generic question type	Policy question (take text from directives, etc.)	Core set of indicators
1. Is the environmental performance of the fisheries sector improving? (P, S, I)	Is capture fisheries sustainable?	6. Status of marine fish stocks 16. Metrics of community structure 17. Fish-stock characteristics 19. Spawning stock biomass
	Is aquaculture sustainable?	11. Aquaculture production per coastal area
	What is the impact of fisheries on non-target species and habitats?	20. Physical damage to habitats and species 21. Discards 22. Bycatch
	Is the environmental impact of aquaculture a burden?	12. Indicator on introduction of alien species by mode of introduction 14. Quality of effluent water 15. Biodiversity indicators near farms compared with away from farms
	Is monitoring of contamination reflecting the environmental performance of the industry?	23. Quality of fish for human consumption (F & A)
2. Is the efficiency of fisheries and aquaculture improving? (S, P)	Is the fishing effort matched with available resources? Has the need to limit fishing effort been met? Has the fishing industry been modernised towards effectiveness? Is the eco-efficiency of aquaculture plants improving?	4. Gear loss 5. Fishing mortality 7. Fishing capacity of fleets 8. Fishing effort 9. Maximum sustainable yield/ fishing effort 18. Catch per unit effort 13. Eco-efficiency of aquaculture
3. How is the size and shape of the sector developing (including technological advances)? (D, S)	Does production (fisheries and aquaculture) meet the market needs?	1. Fish consumption per capita 10. Catches by major species and areas
	Does Community aid help the sector to restructure?	2. Average wage (F & A)/average national wage 3. Market demand (F & A) or first sale value (F &A)/cost
4. What is the progress in economic integration? (R)	Does Community aid help the sector to restructure?	26. Fisheries restructuring
5. What is the progress in management integration? (R)	How is restricting catches aiding management of fisheries?	24. Quota management 25. Zone management
	Is the industry complying to the integration of environmental considerations in policy-making?	27. Percentage of fisheries reflecting environmental integration 28. Percentage of aquaculture complying to Fish Farms Code of Conduct 29. National legislation with specific provision for environmental management of aquaculture

7. Data availability

A major constraint on the use of the recommended indicators is the availability of essential data. Some indicators have to be supported by research data, gathered through research projects and surveys, while other indicators need support from data regarding commercial landings and/or voluntarily reporting by fishermen and stakeholders.

ICES maintains large archives of data, and is a prime data source for the majority of the indicators. For other indicators, national institutions have to be consulted regarding fisheries on geographically isolated fish stocks, e.g. Norwegian spring spawning herring, which are being managed solely by Norwegian authorities. In the present work, most emphasis is put on identification of international institutions (ICES, FAO, Eurostat, Fisheries DG) possessing data for relevant indicators. This is done on purpose, realising the pilot-scale of this work. To fully assess specific fisheries or regions, the institutions supplying data to the international bodies have to be consulted, to secure adequate resolution of the data sets.

7.1. FAO

FAO has the most comprehensive data sets on fisheries and aquaculture for marine and inland waters at global level. EEA has access to these data through the Memorandum of Understanding between EEA and FAO. EEA has permission to publish European FAO data in its data warehouse on the web.

FAO/FIDI (Fishery Information, Data and Statistics Unit) http://www.fao.org/fi/struct/fidi.asp#FIDS identifies its data sources as such:

'Building up data on world fisheries requires a truly international effort. International classifications and standardised data submission procedures have to be maintained in order to ensure that the collected statistics are comparable across countries so as to allow for summation and analyses at regional and global level. Fisheries statistics are usually obtained from national reporting offices and, wherever possible, verified from other sources. Estimates are produced when data are lacking or are considered unreliable. The statistics are stored in databases and disseminated through publications and electronic media. Aggregated data are also available through the FAO Internet site.'

7.2. ICES

ICES-ACFM reports contain timely assessments of North-East Atlantic fish stocks including the Baltic Sea and of landings. They can be downloaded from the web: http://www.ices.dk/committe/acfm/acfm.htm. The **data used for these assessments of stocks and landings** are published in tables in the ACFM working group reports, which can be downloaded as well from that web page in PDF format (which can be transferred into Word or Excel).

The **ICES Marine Data Centre** can be accessed via the web as well: http://www.ices.dk/hl/ICES_Marine_Data_Centre.htm. It contains data on catches from industry from 1973 to 1999, but there is no database on stock assessment data for the moment. The published working group tables contain the analysed and assessed data that can be used by EEA. Caution has to be taken, because working group assessments might be changed by ACMF and therefore the ACMF statement is the final one.

For **mariculture data**, the ICES Mariculture Committee is responsible. The Annual (science) reports give the overview, what data is collected by ICES: http://www.ices.dk/pubs/annualrep/annrep.htm. Data are only available from the working group reports under that committee.

For **data on ecosystem effects of fishing**, a new body, called ACE, is being established beside ACMF and ACME. For the moment, data are available from the reports of the working group on ecosystem effects of fishing under ACME. Five reports from 2000, 1998, 1996, 1994 and 1992 have been produced so far, but only the latest one for 2000 is available via the web: http://www.ices.dk/committe/acme/acme_wgroups.htm.

For **deep-sea fishing**, only a limited amount of species is assessed. This is a problem, because nothing is known about the status of the stocks of other species and the fisheries on these stocks is increasing. The available data can be found in the report of the ACFM working group WGDEEP: http://www.ices.dk/committe/acfm/acfm.htm

7.3. Eurostat

Eurostat data are derived from submissions by the national authorities under the terms of EU legislation on fishery statistics and from submissions by the national authorities to other international bodies (notably FAO).

7.4. Directorate-General for Fisheries

The European Commission's Directorate-General for Fisheries (Fisheries DG) possesses data submitted by the national authorities under the terms of EU legislation on fishery statistics as well as data resulting from research projects on various fisheries related issues funded by the Directorate, i.e. Medits.

8. Data sets for the suggested indicators

Indicator description sheets are given in the following pages and are linked to available data sets. These sheets describe the indicator, data source, data holder, contact names, information on access to the data, the format of the data and a brief description of their characteristics. Sheets have been developed for each of the proposed indicators. These sheets will form the basis for future development of indicator fact sheets and their publication at the EEA web site. At present four fact sheets have been developed for the *Environmental signals 2002* report.

The European Environment Agency intends to cooperate with and build upon the data collection and indicator development by international organisations in the production of its fact sheets in order to avoid duplication and overlap. This scoping study is a significant first step in the collaboration process.

Mediterranean fisheries exhibit peculiarities in their management. Data on small-scale fisheries are not registered or are very difficult to obtain. The lack of a central scientific body (equivalent to ICES and universally accepted) makes the search for data a difficult and time-consuming process. For most of the cases data are available on a country basis and are accessed through individual national research centres and statistical services.

Table 13 **Overview of data sheets and related indicators of proposed core set**

Data sheet	Table	Indicator
Employment in the fishery sector	14	3. First sale value (F)/cost or First-hand value of catch per fisher
Employment in the aquaculture sector	15	3. First sale value (A)/cost or Sales per employee vs per capita GDP
Wages (F & A)	16	2. Average wage (F & A)/average national wage
Value of catch	17	3. First sale value (F)/cost or First-hand value of catch per fisher
Value of aquaculture production	18	3. First sale value (A)/cost or Sales per employee vs per capita GDP
Gross domestic product per capita	19	3. First-hand value of catch per fisher or Sales per employee vs per capita GDP
Fish consumption per capita	20	1. Fish consumption per capita
Manufacture and import of fishing equipment	21	4. Gear loss
Fishing mortality	22	5. Fishing mortality 9. Maximum sustainable yield/fishing effort 6. Status of marine stocks (stocks outside safe biological limits) 17. Fish-stock characteristics
Fleet size	23	7. Fishing capacity
Fishing effort	24	8. Fishing effort 18. Catch per unit effort (CPUE)
Maximum sustainable yield	25	9. Maximum sustainable yield/fishing effort
Landings	26	10. Fish catches by major species and areas 19. Spawning stock biomass 18. Catch per unit effort 9. Maximum sustainable yield/fishing effort
Fish production by species — Annual production by major species	27	11. Aquaculture production per coastal area (and fish production by species — Annual production by major species for aquaculture)
Introduction of aquatic species	28	12. Introduction of alien species by mode of introduction
Monitoring data from fish farms	29	14. Quality of effluent water
Abundance and biomass of the catches (from experimental surveys)	30	16. Metrics of community structure

Data sheet	Table	Indicator
Fish-stock characteristics	31	17. Fish-stock characteristics 9. Maximum sustainable yield/fishing effort 24. Quota management
Spawning stock biomass (SSB)	32	19. Size of spawning stock 9. Maximum sustainable yield/fishing effort 17. Fish-stock characteristics
Recruitment	33	9. Maximum sustainable yield/fishing effort 17. Fish-stock characteristics
Habitat alteration • Trends in abundance of macro- and mega- benthos • Mortality of key species (megafauna) • Benthic community structure	34	20. Physical damage to habitats/species
Discards	35	21. Discards 10. Catches by major species and areas 20. Physical damage to habitats and species
Bycatch (mammals, birds and turtles)	36	22. Trends in bycatch (mammals, birds and turtles)
Quality of fish	37	23. Quality of fish (fisheries and aquaculture)
Quota management	38	24. Quota management
Number of fishing vessels and fishermen participating in different fisheries	39	25. Zone management or Fishing effort control and enforcement
Number and size of vessels entering and leaving the fishery	40	26. Fisheries restructuring
Research and monitoring effort data	41	26. Fisheries restructuring or Expenditure for fish-stock monitoring
Effort data for relevant fisheries	42	27. Percentage of fisheries reflecting environmental integration
International fisheries organisations	43	27. Percentage of fisheries reflecting environmental integration 29. National legislation with specific provision for environmental management of aquaculture
Monitoring results from aquaculture sites	44	28. Percentage of aquaculture complying to Fish Farms Code of Conduct 15. Biodiversity indicators near farms compared with away from farms
Country legislation on regulation and monitoring	45	29. National legislation with specific provision for environmental management of aquaculture 28. Percentage of aquaculture complying to Fish Farms Code of Conduct

Table 14	**Data set: Employment in the fishery sector**

Used for indicators: 3. **First sale value (F)/cost** or **First-hand value of catch per fisher**	
Data retrieval:	
Holding body: Eurostat New Cronos database (through FAO) (except Iceland: Icelandic Ministry of Fisheries)	
Contact name: David Cross	**Contact details:** david.cross@cec.eu.int
Reference: Eurostat New Cronos database, Agriculture and fisheries (Theme: Theme 5), 'Employment in the fishery sector', last update available: 29.1.2002 Eurostat: http://europa:eu.int/comm/eurostat *Icelandic Fisheries in Figures*, Ministry of Fisheries	
Accessibility: Subscription required	
Format: HTML tables	
Reason for choosing data holder/Procedure for collecting data: FAO data have excellent geographical and temporal coverage. Data-collecting practices are well-established.	
Data description:	
Definitions: Statistics of full-time employees in the fisheries sector	
Units: Number of employees	
Geo coverage: FAO coverage	
Time series: 1970–99	
Quality: FAO quality	
Next update: Annual	
Previous use:	
Additional information:	
Actions: Ministry of Agriculture with Eurostat	**Comments:** See Table 11

Table 15	**Data set: Employment in the aquaculture sector**

Used for indicators: 3. **First sale value (A)/cost** or **Sales per employee vs per capita GDP**	
Data retrieval:	
Holding body: Eurostat New Cronos database (through FAO) (except Iceland: OECD; and Norway: Directorate of Fisheries)	
Contact name: David Cross	**Contact details:** david.cross@cec.eu.int
Reference: Eurostat New Cronos database, Agriculture and fisheries (Theme: Theme 5), 'Employment in the fishery sector', last update available: 29.1.2002 Eurostat: http://europa:eu.int/comm/eurostat Review of fisheries in OECD countries policies and summary statistics, OECD Norwegian fisheries, Directorate of Fisheries, Norway http://www.ssb.no/english/subjects/10/05/fiskeoppdrett_en/tab-2001-08-22-02-en.html	
Accessibility: Subscription required	
Format: HTML tables	
Reason for choosing data holder/Procedure for collecting data: FAO data have excellent geographical and temporal coverage. Data-collecting practices are well-established.	
Data description:	
Definitions: Statistics of full-time employees in the fisheries sector	
Units: Number of employees	
Geo coverage: FAO coverage	
Time series: 1970–99	
Quality: FAO quality	
Next update: Annual	
Previous use:	
Additional information:	
Actions: Ministry of Agriculture with Eurostat	**Comments:** See Table 11

Data set: Wages (F & A)	Table 16

Used for indicators: **2. Average wage (F & A)/average national wage**	
Data retrieval:	
Holding body: Eurostat New Cronos database National statistical offices	
Contact name: David Cross Per case	**Contact details:** david.cross@cec.eu.int Per case
Reference: Eurostat New Cronos database Eurostat: http://europa:eu.int/comm/eurostat	
Accessibility: Subscription required	
Format: HTML tables	
Reason for choosing data holder/Procedure for collecting data: Data with excellent geographical and temporal coverage. Data-collecting practices are well-established.	
Data description:	
Definitions: Statistics of wages in fisheries aquaculture	
Units: USD	
Geo coverage: EEA coverage	
Time series: 1970–99	
Quality: EEA quality	
Next update: Annual	
Previous use:	
Additional information:	
Actions: Ministry of Agriculture with Eurostat	**Comments:** See Table 11

Data set: Value of catch	Table 17

Used for indicators: **3. First sale value (F)/cost** or **First-hand value of catch per fisher**	
Data retrieval:	
Holding body: EU and EFTA countries: EU concerted action project EU candidate countries and new independent States: FAO	
Contact name: Anon	**Contact details:**
Reference: Anon. (2000), 'Economic performance of selected European fishing fleets', *Annual Report 2000*, EU concerted action (FAIR PL97-3541), 'Promotion of common methods for economic assessment of EU fisheries' FAO, FAO fishery country profiles, http://www.fao.org/fi/fcp/fcp.asp	
Accessibility: Published data	
Format: Tables	
Reason for choosing data holder/Procedure for collecting data: FAO data have excellent geographical and temporal coverage. Data-collecting practices are well-established.	
Data description:	
Definitions: First-hand sales value of commercial fish catch from seagoing vessels	
Units: USD	
Geo coverage: FAO coverage	
Time series: EU & EFTA: 1994–99 Limited data for rest of Europe	
Quality: FAO quality	
Next update: EU tries to make collection annually FAO data collected on infrequent basis when fishery country profiles are updated	
Previous use:	
Additional information:	
Actions:	**Comments:** See Table 11

Table 18	Data set: Value of aquaculture production

Used for indicators: **3. First sale value (A)/cost** or **Sales per employee vs per capita GDP**	
Data retrieval:	
Holding body: FAO/FIDI (Fishery Information, Data and Statistics Unit)	
Contact name: Richard Grainger, Chief of FIDI Jose Luis Cort, Senior Fisheries Information Officer Richard Pepe, Fishery Information Officer	**Contact details:** richard.grainger@fao.org jose.cort@fao.org richard.pepe@fao.org
Reference: FAO/FIDI: http://www.org/fi/struct/fidi.asp#FIDS	
Accessibility: Downloadable statistical databases	
Format: Downloadable statistical databases Fishstat Plus	
Reason for choosing data holder/Procedure for collecting data: FAO data have excellent geographical and temporal coverage. Data-collecting practices are well-established.	
Data description:	
Definitions: Value of aquaculture production, by country	
Units: USD	
Geo coverage: FAO coverage	
Time series: 1984–2000	
Quality: FAO quality	
Next update: Annual	
Previous use:	
Additional information:	
Actions:	**Comments:** See Table 11

Table 19	Data set: Gross domestic product per capita

Used for indicators: **3. First-hand value of catch per fisher** or **Sales per employee vs per capita GDP**	
Data retrieval:	
Holding body: Eurostat New Cronos database	
Contact name: David Cross	**Contact details:** david.cross@cec.eu.int
Reference: Eurostat New Cronos database, Economy and finance (Theme: Theme 2), National accounts — Aggregates; GDP and main aggregates; GDP and main components, last update available: 9.11.2001 Eurostat: http://europa:eu.int/comm/eurostat	
Accessibility: Subscription required	
Format: HTML tables	
Reason for choosing data holder/Procedure for collecting data: World Bank data with global geographical and temporal coverage. Data-collecting practices are well-established.	
Data description:	
Definitions: Gross domestic product per member of the population, by country	
Units: USD	
Geo coverage: Pan-European coverage	
Time series:	
Quality: EEA quality	
Next update: Annual	
Previous use:	
Additional information:	
Actions: MoU with Eurostat	**Comments:** See Table 11

Data set: Fish consumption per capita	Table 20

Used for indicators: **1. Fish consumption per capita**	
Data retrieval:	
Holding body: FAO/FIDI (Fishery Information, Data and Statistics Unit)	
Contact name: Richard Grainger, Chief of FIDI Jose Luis Cort, Senior Fisheries Information Officer Richard Pepe, Fishery Information Officer FAO/FAOSTAT	Contact details: richard.grainger@fao.org jose.cort@fao.org richard.pepe@fao.org gabriella.laurenti@fao.org
Reference: FAO fisheries circular — Fish and fishery products — World apparent consumption statistics based on food balance sheets, FAO/FIDI: http://www.org/fi/struct/fidi.asp#FIDS FAO/FAOSTAT: http://apps.fao.org	
Accessibility: Bulletin obtained through FAO Data accessible from FAO online database. No payment is required unless downloads greater than 500 records per query are needed, where an annual subscription of approximately USD 1 500 is payable.	
Format: Bulletin Data available in HTML tables or CSV files	
Reason for choosing data holder/Procedure for collecting data: FAO data have excellent geographical and temporal coverage. Data-collecting practices are well-established.	
Data description:	
Definitions: Statistics of total and per caput fish supply in live weight. Annual statistics of supply/utilisation accounts (SUAs) for eight groups of primary fishery commodities and nine groups of processed products. The SUAs contain estimates of supplies from different sources matched against estimates of different forms of utilisation of each product.	
Units: Kg	
Geo coverage: FAO coverage	
Time series: 1961–97	
Quality: FAO quality	
Next update: Annual	
Previous use:	
Additional information:	
Actions:	**Comments:** See Table 11

Data set: Manufacture and import of fishing equipment	Table 21

Used for indicators: 4. Gear loss	
Data retrieval:	
Holding body: National customs/importing bodies. Central bureau of statistics within each Member State. Could probably select special groups as indicators of different fisheries. Must consult import/export and trade statistics at Member State level.	
Contact name:	**Contact details:**
Reference: Unknown	
Accessibility:	
Format:	
Reason for choosing data holder/Procedure for collecting data: Data on national manufacture and import/export of fishing tools (gill nets trawl accessories, etc.) indicates average lifespan of the different types of gear. Difficulties arise when splitting on loss and disposal of outworn equipment.	
Data description:	
Definitions: Single units/gross tonnages	
Units: Pieces, tonnes, kilos, etc.	
Geo coverage: National (each Member State)	
Time series: Unknown	
Quality: Unknown (best available?) for the actual indicator	
Next update:	
Previous use: Taxation and calculation of custom tax	
Additional information:	
Actions:	**Comments**: See Table 11

Table 22	Data set: Fishing mortality

Used for indicators: **5. Fishing mortality** **9. Maximum sustainable yield/fishing effort** **6. Status of marine stocks (stocks outside safe biological limits)** **17. Fish-stock characteristics**	
Data retrieval:	
Holding body: International Council for the Exploration of the Sea (ICES): Working groups Advisory Committee on Fishery Management (ACFM) **For Mediterranean:** Fisheries DG, 'International bottom trawl survey in the Mediterranean', Medits project 'Stock assessment in the Mediterranean', SAMED project National institutions and publications also cover Mediterranean compiled in GFCM	
Contact name: ICES Medits: Dr Papaconstantinou Dr A. Souplet Dr G. Sola Dr G. Relini SAMED: Dr Papaconstantinou	**Contact details:** ices.info@ices.dk pap@ncmr.gr arnauld.souplet@ifremer.fr, gildesola@ma.ieo.es biolmar@unige.it pap@ncmr.gr
Reference: http://www.ices.dk/committe/acfm/acfm.htm http://europa.eu.int/comm/dgs/fisheries/index_en.htm ftp://cucafera.icm.csic.es	
Accessibility: Permission from holding bodies is needed before the data set can be obtained and used	
Format: Data scattered: available through fishery commissions and national institution bulletins and publications or from current scientific literature.	
Reason for choosing data holder/Procedure for collecting data: ICES produces data with good geographical and temporal coverage. Data are collected using well-established methods and are quality checked. Fisheries DG (Medits and SAMED projects) and GFCM (for national projects) are the only holders of Mediterranean fisheries data.	
Data description:	
Definition: Fishing mortality (F) is an expression of the proportion of the fish stock that is removed by fishing activity within one year	
Units: It is an exponential value not directly converted to percentage. Ranges from 0–1 but sometimes can exceed 1	
Geo coverage: ICES fishing areas Mediterranean fishing areas	
Time series: 1960–2000 Limited time series, annual 1994	
Quality: There are known quality problems with reported data, so ICES frequently uses supplementary information when analysing the status of fish stocks. Data mainly from experimental fishing surveys and are scattered. There will be quality problems with the existing data, due to different sampling methodologies and gear used by each institute.	
Next update: Annual update Unknown, usually annually	
Previous use: ICES fish-stock data have been used in EEA *State of the environment* reports.	
Additional information:	
Actions: Contact ICES to retrieve data Locate and contact data for Mediterranean (Fisheries DG — GFCM)	**Comments:** See Table 11 **Medits:** Holds raw data **SAMED**: Assesses these data

Data set: Fleet size	Table 23

Used for indicators: **7. Fishing capacity**	
Data retrieval:	
Holding body: FAO/FIDI (Fishery Information, Data and Statistics Unit) Eurostat Fisheries DG Blue Plan, Mediterranean exclusively: receives data from FAO	
Contact name: Richard Grainger, Chief of FIDI Jose Luis Cort, Senior Fisheries Information Officer Richard Pepe, Fishery Information Officer Narain Pratap, Senior Officer Statistical Division David Cross	**Contact details:** richard.grainger@fao.org jose.cort@fao.org richard.pepe@fao.org pratap.narain@fao.org david.cross@cec.eu.int
Reference: FAO *Bulletin of Fishery Statistics* – Fishery fleet Eurostat: http://europa:eu.int/comm/eurostat Fisheries DG: http://europa.eu.int/comm/dgs/fisheries/index_en.html Blue Plan: http://planbleu.org	
Accessibility: Bulletin: An array of tables of fishery fleet statistics Eurostat: PDF file download Fisheries DG: PDF file download Blue Plan: PDF file, download	
Format: An array of tables of fishery fleet statistics The rest are PDF files	
Reason for choosing data holder/Procedure for collecting data: FAO data have excellent geographical and temporal coverage. Data-collecting practices are well-established. Eurostat and Fisheries DG have better time series but only cover EU and EFTA countries (see 'Geo coverage').	
Data description:	
Definitions: Annual statistics by country on the number and total tonnage of fish catching, processing and support vessels utilised in commercial, subsistence and artisanal fisheries by size of vessel measured in gross register tonnes or gross tonnes and by type of vessel according to length overall. Data collected directly from each country directly through a questionnaire and explanatory notes. For non-reporting countries and countries submitting incomplete data, other sources are used such as national publications, international fishery magazines, FAO fishery country profiles, FAO projects and Lloyd's Register of Shipping. However, the latter excludes vessels under 100 GRT. Problems in obtaining the information prevent release of timely statistics. To properly use the data one must consult the many notes included in the relevant publications.	
Units: Number of vessels, total tonnage, power (not FAO)	
Geo coverage: FAO coverage Eurostat: EU and EFTA countries Fisheries DG: EU	
Time series: FAO: 1970,1975,1980,1985 and annual for the seven most recent years Eurostat: annual 2000, in details, 1998 & 1999 summary Fisheries DG: annual, 1989–98	
Quality: FAO does not quality check data. For non-reporting countries and countries submitting incomplete data, other sources are used such as national publications, international fishery magazines, FAO fishery country profiles, FAO projects and Lloyd's Register of Shipping. However, the latter excludes vessels under 100 GRT.	
Next update: Annual	
Previous use: Eurostat: *Statistics in focus*	
Additional information:	
Actions:	**Comments:** See Table 11

Table 24 **Data set: Fishing effort**

Used for indicators: **8. Fishing effort** **18. Catch per unit effort (CPUE)** **9. Maximum sustainable yield/fishing effort**	
Data retrieval:	
Holding body: International Council for the Exploration of the Sea (ICES) : Working groups Advisory Committee on Fishery Management (ACFM) National statistical offices	
Contact name: ICES Per case	**Contact details:** ices.info@ices.dk Per case
Reference: http://www.ices.dk/committe/acfm/acfm.htm http://europa.eu.int/comm/dgs/fisheries/index_en.htm	
Accessibility: Permission from ICES is needed before the data set can be obtained and used Permission from holding bodies is needed before the data set can be obtained and used	
Format: Data available through fishery commissions and national statistical bulletins and publications	
Reason for choosing data holder/Procedure for collecting data: ICES produces data with good geographical and temporal coverage. Data are collected using well-established methods and are quality checked. Institutions are the only projects holding aggregated information on these aspects of Mediterranean fisheries.	
Data description:	
Definitions:	
Units: Horse power per day	
Geo coverage: ICES fishing areas Mediterranean fishing areas	
Time series: 1960–2000 Limited time series for Mediterranean	
Quality: ICES quality Information for the Mediterranean exists at an experimental level. However there is an ongoing project to satellite monitor fishing vessels activity.	
Next update: Annual Not regularly reported	
Previous use:	
Additional information:	
Actions: Contact ICES to retrieve data Locate and contact national statistical offices for data on Mediterranean Sea	**Comments:** Available for the Mediterranean region through Directive COM 1543/2000

Indicator: Maximum sustainable yield	Table 25

See required data sets: Annual catch, fishing effort, fishing mortality, biomass, stock size and age	
Data retrieval:	
Holding body: ICES through advisory committees For Mediterranean: Fisheries DG (SAMED and Medits) and national institutions	
Contact name: Per case guidance through: ICES Fisheries DG (Medits & SAMED)	**Contact details:** Per case ices.info@ices.dk pap@ncmr.gr
References:: http://www.ices.dk/committe/acfm/acfm.htm http://europa.eu.int/comm/dgs/fisheries/index_en.htm	
Accessibility: Personal contacts per case	
Format: Publications and bulletins	
Reason for choosing data holder/Procedure for collecting data: Only sources available	
Data description:	
Definitions: An expression of the state of the fishery exploitation to its sustainable size. To develop it data required for annual catch, fishing effort, fishing mortality rates, biomass estimates and stock size and age. Effort and mortality estimates and other biological information used to develop these indicators are almost always performed by national marine resource institutes or universities. Not many countries maintain data on fishing effort by national fleets; fewer still standardise effort levels by different fleets to an annual total. Unless size and age composition are collected and/or estimated from properly sampled catches in ports, fishing mortality rates will not be estimated which in any case require trained fisheries scientists. Regular standardised fisheries surveys also required for direct biomass estimates.	
Units: %	
Geo coverage: European seas	
Time series: Per case	
Quality: ICES quality Data mainly from experimental fishing surveys and are scattered. There will be quality problems with the existing data, due to different sampling methodologies and gear used by each institute.	
Next update: Per case	
Previous use:	
Additional information:	
Actions: Locate and contact sources per case	**Comments:** See Table 11

Table 26	Data Set: Landings

Landings and catches sometimes intermix. However when landings are reported data can be derived for catches. See comments.

Used for indicators: **10. Fish catches by major species and areas** **19. Spawning stock biomass** **18. Catch per unit effort** **9. Maximum sustainable yield/fishing effort**	
Data retrieval:	
Holding body: FAO/FIDI (Fishery Information, Data and Statistics Unit) FAO/FAOSTAT ICES (International Council for the Exploration of the Sea) Eurostat (Blue Plan, Mediterranean exclusively: data from FAO)	
Contact name: Richard Grainger, Chief of FIDI Jose Luis Cort, Senior Fisheries Information Officer Richard Pepe, Fishery Information Officer Narain Pratap, Senior Officer Statistical Division ICES David Cross	**Contact details:** richard.grainger@fao.org jose.cort@fao.org richard.pepe@fao.org pratap.narain@fao.org ices.info@ices.dk david.cross@cec.eu.int
Reference: FAO/FIDI: http://www.org/fi/struct/fidi.asp#FIDS FAO/FAOSTAT: http://apps.fao.org ICES http://www.ices.dk/fish/statlant.htm Eurostat: http://europa:eu.int/comm/eurostat *Statistics in focus* Blue Plan: http://planbleu.org	
Accessibility: Downloadable statistical databases Data accessible from FAO online database. No payment is required unless downloads greater than 500 records per query are needed, where an annual subscription of approximately USD 1 500 is payable Downloadable PDF bulletin	
Format: Downloadable statistical databases Fishstat Plus Data available in HTML tables or CSV files Downloadable PDF bulletin Downloadable PDF file	
Reason for choosing data holder/Procedure for collecting data: FAO data have excellent geographical and temporal coverage. Data are regularly updated and easily accessible. Data-collecting practices are well-established. ICES produces data with good geographical and temporal coverage. Data are collected using well-established methods and are quality checked. Fishstat Plus comes together with data retrieval, graphical and analytical software. This product provides more detailed data than those contained in the FAOSTAT online database.	
Data description:	
Definitions: Data for annual catches landed by country of capture, species or a higher taxonomic level and FAO major fishing areas. Weights are of whole animal (live weight) and coverage includes harvest by commercial, artisanal and subsistence fisheries. Regional databases cover data of annual production in quantity by country and by species for the Eastern Central Atlantic (CECAF) and the Mediterranean (GFCM).	
Units: Tonnes (live weight equivalent)	
Geo coverage: FAO coverage	
Time series: 1973–98 1961–98	
Quality: FAO does not quality check data. There are known comparability problems. There is concern with respect to the quality of some of the reported catch data. Scientists from member countries participating in ICES stock assessment working groups have been aware of this and have frequently used supplementary information when analysing the status of the stocks. Based on these analyses, management advice is formulated and provided by ICES to the various national governments, the EU and the fishery commissions. Several countries still report their catches by large groupings, therefore the figures given for any species in a particularly statistical division are likely to be underestimated. When examining the statistics for a given species, it should always be kept in mind that an unknown proportion of the catches for that particular species and division might well have been reported under the generic, family or order names of that very species, or even more roughly as 'marine fishes unspecified'.	
Next update: Data are updated on annual basis and are generally two years behind	
Previous use:	
Additional information:	
Action:	**Comments:** See Table 11

Data set: Fish production by species — Annual production by major species	Table 27

Used for indicators: 11. **Aquaculture production per coastal area (and fish production by species — Annual production by major species for aquaculture)**	
Data retrieval:	
Holding body: FAO/FIDI (Fishery Information, Data and Statistics Unit) (Blue Plan) Eurostat	
Contact name: Richard Grainger, Chief of FIDI Jose Luis Cort, Senior Fisheries Information Officer Richard Pepe, Fishery Information Officer Narain Pratap, Senior Officer Statistical Division David Cross	**Contact details:** richard.grainger@fao.org jose.cort@fao.org richard.pepe@fao.org pratap.narain@fao.org david.cross@cec.eu.int
Reference: FAO/FIDI: http://www.org/fi/struct/fidi.asp#FIDS Blue Plan: http://planbleu.org Eurostat: http://europa:eu.int/comm/eurostat *European aquaculture, 1999*	
Accessibility: as before Downloadable PDFs	
Format: Downloadable statistical databases Fishstat Plus PDF bulletin	
Reason for choosing data holder/Procedure for collecting data: FAO data have excellent geographical and temporal coverage. Data are regularly updated and easily accessible. Data-collecting practices are well established. Fishstat Plus comes together with data retrieval, graphical and analytical software.	
Data description:	
Definitions: Aquaculture is the farming of aquatic organisms including fish, molluscs, crustaceans and aquatic plants. Data for annual catches (inland and marine waters) landed by country, species or a higher taxonomic level and FAO areas. Weights are of whole animal (live weight). Regional databases cover data of annual production in quantity by country and by species for the Eastern Central Atlantic (CECAF) and the Mediterranean (GFCM).	
Units: Tonnes (live weight)	
Geo coverage: FAO coverage	
Time series: 1984–98	
Quality: FAO does not quality check data. There are known comparability problems. Several countries still report their aquaculture production by large groups of species. In these circumstances the data presented by individual species items are likely to be underestimated. Therefore, when the statistics are examined for a particular species, it should be noted that an unknown proportion of the production for that species might have been reported by the national office under the generic, family or order name of the species, or even more roughly as 'fish, unspecified'. Consequently, species-item totals frequently underestimate the real production of the individual species.	
Next update: Data are updated on an annual basis and are generally two years behind	
Previous use:	
Additional information:	
Actions:	**Comments:**

Table 28	**Data set: Introduction of aquatic species**

Used for indicator: 12. Introduction of alien species by mode of introduction	
Data retrieval:	
Holding body: FAO — Database on Introductions of Aquatic Species (DIAS) ICES – ACME (Advisory Committee on the Marine Environment) National institutions and Member State ministries	
Contact name: D. Bartley ICES Per case	**Contact details:** devin.bartley@fao.org ices.info@ices.dk Per case
Reference: FAO/DIAS: http://www.fao.org/fi/statist/fisoft/dias/index.htm ICES-ACME http://www.ices.dk/committe/acme/acme.htm	
Accessibility: Downloadable information	
Format: Tables and reports (PDF)	
Reason for choosing data holder/Procedure for collecting data: FAO data have good geographical and temporal coverage. Data are easily accessible. Data-collecting practices are well-established. ICES produces data with good geographical and temporal coverage. Data are collected using well-established methods and are quality checked.	
Data description:	
Definitions: A number of non-indigenous species are introduced for aquaculture purposes	
Units: Number of species	
Geo coverage: FAO and ICES	
Time series: Up to 1998	
Quality: FAO does not quality check data. Data cover only aquatic species (not marine) and temporal coverage up to 1998.	
Next update: Unknown	
Previous use:	
Additional information:	
Actions:	**Comments:** See Table 11

Data set: Monitoring data from fish farms	Table 29

Used for indicators: **14. Quality of effluent water**	
Data retrieval:	
Holding body: National environmental agencies, Environment DG/Fisheries DG through EU-funded projects. In Norway: regional environmental authorities at province (*fylke*) level. Norway consists of 19 provinces, of which approximately 12 host aquaculture and possess data. A common database, managed by regional and central (*SFT*) environmental authorities, SESAM, contains the information.	
Contact name: Ian Davies/Aberdeen	**Contact details:** ICES Working Group on Environmental Impacts of Mariculture (EIM)
Reference: GESAMPT, 1996. Monitoring the ecological effects of coastal aquaculture wastes. Report No 57 EU QLRT-99-31779 MERAMED: Development of monitoring guidelines and modelling tools for environmental effects from Mediterranean aquaculture EU QLRT-99-31305 BIOFAQS: Biofiltration and aquaculture: An evaluation of hard substrate deployment performance within mariculture developments EU QLRT-99-31151 AQCESS: Aquaculture and coastal, economic and social sustainability	
Accessibility: Uncertain. Probably some restrictions on public use	
Format: Variable	
Reason for choosing data holder/Procedure for collecting data:	
Data description:	
Definitions: Monitoring programmes of fish farms are designed individually dependent of size of farm and quality of production site. Parameters like sediment total organic contents, bottom water oxygen contents and biodiversity changes are typically included. A 'Norwegian standard' manual for environmental monitoring of fish farms has recently been issued.	
Units: Relative organic contents are normally reported on weight/weight basis, oxygen saturation measured as percentage saturation or weight/volume ratio. Biodiversity measured qualitatively or quantitatively.	
Geo coverage: Restricted to specific production sites	
Time series: Exist for some sites. Up to 10–15 years with probably irregular intervals	
Quality: Variable but generally good, as accreditation is demanded (at least in some provinces)	
Next update: Continuous. Basically annually or bi-annually based on approved production plans	
Previous use: Enforcement of management actions (production adjustments and location of farms)	
Additional information:	
Actions: From EEA to include relative parameters in the Water Framework Directive	**Comments**: Absolutely necessary parameters for water quality assessment in mariculture sites

Table 30	**Data set: Abundance and biomass of the catches (from experimental surveys)**

Used for indicators: **16. Metrics of community structure**	
Data retrieval:	
Holding body: International Council for the Exploration of the Sea (ICES) — Working groups Advisory Committee on Fishery Management (ACFM) National institutions and publications should cover Mediterranean Also EU Fisheries DG (Medits)	
Contact name: ICES per case Mediterranean per case Medits (see previous sets)	**Contact details:**: ices.info@ices.dk Mediterranean per case pap@ncmr.gr
Accessibility: Permission from the holding bodies is needed before the data set can be obtained and used	
Format: PDF Data scattered through national institutes. Probably database format	
Reason for choosing data holder/Procedure for collecting data: ICES coverage Only sources available	
Data description:	
It measures the state of an ecosystem, but experimental survey data are needed other than those available from fisheries statistics. Community-size spectra could provide the linkage with fishing pressure.	
Units: Estimated number and/or biomass of the species in the catches	
Geo coverage: ICES fishing grounds Mediterranean	
Time series: Extensive coverage in ICES (per case) Mediterranean countries: Medits since 1994	
Quality: ICES quality Data mainly from experimental fishing surveys and are scattered. Sample sizes needed to quantify some major community properties.	
Next update: Annual	
Previous use:	
Additional information:	
Actions: Contact ICES to retrieve data Locate and contact data on Mediterranean basis (Fisheries DG — SAMED)	**Comments:** See Table 11 Uncertainty in community structure due to environmental factors other than fisheries impact

Data set: Fish-stock characteristics	Table 31

Used for indicators: **17. Fish-stock characteristics** **9. Maximum sustainable yield/fishing effort** **24. Quota management**	
Data retrieval:	
Holding body: International Council for the Exploration of the Sea (ICES) — Working groups Advisory Committee on Fishery Management (ACFM) National institutions and publications should cover Mediterranean Also EU Fisheries DG (SAMED project)	
Contact name: ICES SAMED: Dr Papaconstantinou	**Contact details:** ices.info@ices.dk pap@ncmr.gr
Reference: http://www.ices.dk/committe/acfm/acfm.htm http://europa.eu.int/comm/dgs/fisheries/index_en.htm	
Accessibility: Data through permission	
Format: ICES**:** PDF format from web Data available through fishery commissions and national institution bulletins and publications or from current scientific literature	
Reason for choosing data holder/Procedure for collecting data: ICES quality SAMED and national institutions record information on the Mediterranean.	
Data description:	
Definitions: Structure of fish stocks in a given area, includes information on fishing mortality (F), natural mortality (M), recruitment and stock size.	
Units: Number of fish per year class	
Geo coverage: ICES fishing areas Mediterranean fishing areas	
Time series: Per case Limited data series	
Quality: ICES Data mainly from experimental fishing surveys and are scattered. There will be quality problems with the existing data, due to different sampling methodologies and gears used by each institute.	
Next update: Annual Unknown	
Previous use: Annual quota recommendation	
Additional information:	
Actions: Contact ICES to retrieve data Locate and contact data on Mediterranean basis (Fisheries DG — SAMED)	**Comments:**

Table 32	Data set: Spawning stock biomass (SSB)

Used for indicators: **19. Size of spawning stock** **9. Maximum sustainable yield/fishing effort** **17. Fish-stock characteristics**	
Data retrieval:	
Holding body: International Council for the Exploration of the Sea (ICES) — Working groups Advisory Committee on Fishery Management (ACME) For Mediterranean: Fisheries DG (Medits and SAMED projects) National institutions and publications also cover Mediterranean compiled in GFCM	
Contact name: ICES Medits: Dr Papaconstantinou Dr A. Souplet Dr G. Sola Dr G. Relini SAMED: Dr Papaconstantinou	**Contact details:** ices.info@ices.dk pap@ncmr.gr arnauld.souplet@ifremer.fr, gildesola@ma.ieo.es biolmar@unige.it pap@ncmr.gr
Reference: http://www.ices.dk/committe/acfm/acfm.htm http://europa.eu.int/comm/dgs/fisheries/index_en.htm ftp://cucafera.icm.csic.es	
Accessibility: Permission from authors is needed before the data set can be obtained and used	
Format: Data scattered: available through fishery commissions and national institution bulletins and publications or from current scientific literature	
Reason for choosing data holder/Procedure for collecting data: ICES produces data with good geographical and temporal coverage. Data are collected using well-established methods and are quality checked. Fisheries DG (Medits and SAMED projects) and GFCM (for national projects) are the only holders of Mediterranean fisheries data.	
Data description:	
Definitions: Spawning stock biomass is the total weight of all sexual mature individuals in the population that will spawn in a given year. SSB values are produced by scientific surveys for the most important fishery stocks.	
Units: Estimated weight of fish in tonnes	
Geo coverage: ICES fishing areas Mediterranean fishing areas	
Time series: 1960–2000 Limited time series for Medits since 1994	
Quality: There are known quality problems with reported data, so ICES frequently uses supplementary information when analysing the status of fish stocks. Data mainly from experimental fishing surveys and are scattered. There will be quality problems with the existing data, due to different sampling methodologies and gear used by each institute.	
Next update: Annual update Unknown, usually annually	
Previous use: ICES fish-stock data have been used in EEA *State of the environment* reports	
Additional information:	
Actions: Contact ICES to retrieve data Locate and contact data for Mediterranean (Fisheries DG — GFCM)	**Comments:** See Table 11 **Medits:** Holds raw data **SAMED**: Assesses these data

Data set: Recruitment	Table 33

Used for indicators: **9. Maximum sustainable yield/fishing effort** **17. Fish-stock characteristics**	
Data retrieval:	
Holding body: International Council for the Exploration of the Sea (ICES): Working groups Advisory Committee on Fishery Management (ACFM) For Mediterranean: Fisheries DG (Medits and SAMED projects) National institutions and publications also cover Mediterranean compiled in GFCM	
Contact name: ICES Medits: Dr Papaconstantinou Dr A. Souplet Dr G. Sola Dr G. Relini SAMED: Dr Papaconstantinou	**Contact details:** ices.info@ices.dk pap@ncmr.gr arnauld.souplet@ifremer.fr, gildesola@ma.ieo.es biolmar@unige.it pap@ncmr.gr
Reference: http://www.ices.dk/committe/acfm/acfm.htm http://europa.eu.int/comm/dgs/fisheries/index_en.htm ftp://cucafera.icm.csic.es	
Accessibility: Permission from authors is needed before the data set can be obtained and used	
Format: Data scattered: available through fishery commissions and national institution bulletins and publications or from current scientific literature	
Reason for choosing data holder/Procedure for collecting data: ICES produces data with good geographical and temporal coverage. Data are collected using well-established methods and are quality checked. Fisheries DG (Medits and SAMED projects) and GFCM (for national projects) are the only holders of Mediterranean fisheries data.	
Data description:	
Definitions: Recruitment (R) is the number of new fish produced each year. Normally assessed as the number of a specific age, normally one to two years old, being added to the stock in a given year.	
Units: Estimated number of fish	
Geo coverage: ICES fishing areas Mediterranean fishing areas	
Time series: 1960–2000 Limited time series for Medits since 1994	
Quality: There are known quality problems with reported data, so ICES frequently uses supplementary information when analysing the status of fish stocks. Data mainly from experimental fishing surveys and are scattered. There will be quality problems with the existing data, due to different sampling methodologies and gear used by each institute.	
Next update: Annual update Unknown, usually annually	
Previous use: ICES fish-stock data have been used in EEA *State of the environment* reports	
Additional information:	
Actions: Contact ICES to retrieve data Locate and contact data for Mediterranean (Fisheries DG — GFCM)	**Comments:** See Table 11 **Medits:** Holds raw data **SAMED**: Assesses these data

Table 34	**Data set: Habitat alteration** • **Trends in abundance of macro- and mega- benthos** • **Mortality of key species (megafauna)** • **Benthic community structure**

Used for indicators: **20. Physical damage to habitats/species**	
Data retrieval:	
Holding body: ICES Working Group o Ecosystem Effects o Fishing Activities Benthos Ecology Working Group Fisheries DG funded projects National environmental organisations	
Contact name: Per case	**Contact details**: Per case
Reference: http://www.ices.dk/committe/acme/acme.htm http://europa.eu.int/comm/dgs/fisheries/index_en.htm	
Accessibility: Projects' reports, workshops reports, publications, personal contacts	
Format: PDF downloadable Reports and publications and workshops: non-specified: descriptive and in tables	
Reason for choosing data holder/Procedure for collecting data: Nothing available from national statistics	
Data description: Habitat alteration (assessed by side scan sonar offshore), by video in seagrasses, coralligenous beds: qualitative or semi-quantitative measure Macro benthic community structure: trends in species variety and abundance, community diversity (H): assessed via research Mortality of key species among molluscs, echinoderms encountered in the discards. Changes in abundance of selected megafauna species from the discards and ratio of broken to intact individuals	
Definitions: Physical damage to habitats/species refers mostly to damage caused by trawling and purse-seiners. The parameters to be monitored include: habitat alteration; changes in benthic community structure (abundance of dominant species included); mortality and physical damage of key species per area (to be defined among big mollusca, echinoderms).	
Units: %	
Geo coverage: Much is already available from research in the Baltic, North Sea, Celtic Seas, and Mediterranean (Spain, Italy, Greece)	
Time series: In the North Sea changes in benthic communities Elsewhere, only sporadic data	
Quality:	
Next update:	
Previous use:	
Additional information:	
Actions: Funding of research at both national or international level to assess regularly (i.e. once a year) the state of benthic ecosystem depending on the gear and biotope	**Comments**: Possibly include in discards assessment studies measurements of selected megafaunal species (mortality rate, physical damage)

Data set: Discards	Table 35

Used for indicators: **21. Discards** **10. Catches by major species and areas** **20. Physical damage to habitats and species**	
Data retrieval:	
Holding body: International Council for the Exploration of the Sea (ICES) — Working groups Advisory Committee on Fishery Management (ACFM) Study Group on Discard and Bycatch Information National institutions and publications should cover Mediterranean; Also EU Fisheries DG (Discards project)	
Contact name: ICES Discards	**Contact details:** ices.info@ices.dk amachias@imbc.gr
Reference: http://www.ices.dk/committe/acfm/acfm.htm National institutions http://europa.eu.int/comm/dgs/fisheries/index_en.htm	
Accessibility: Data through permission	
Format: ICES: PDF format from web Data available through fishery commissions and national institution bulletins and publications or from current scientific literature	
Reason for choosing data holder/Procedure for collecting data: ICES quality but see 'Quality' Only available sources for Mediterranean	
Data description:	
Definitions: Discards include fish that are undersized, over-quota, over a bycatch limit, unlicensed and due to high grading. It also includes data on invertebrates (caught mainly by trawlers): molluscs-cephalopoda, echinoderms, and crustacea that could be potentially used as food Data are collected and/or estimated: sampling of fish catches by commercial vessels by on-board scientists or crew Simulated commercial fishing Interviewing people in the fishing industry Modelling	
Units: Number, abundance and biomass (tonnes) per category	
Geo coverage: ICES fishing areas Mediterranean Sea	
Time series: ICES: not certain Limited time series — unknown	
Quality: ICES does not deal with issue systematically in terms of working groups and committees since it feels the inadequacy with data available questionable both in accuracy and credibility. Data mainly from experimental fishing surveys and are scattered. There will be quality problems with the existing data, due to different sampling methodologies and gears used by each institute.	
Next update:	
Previous use:	
Additional information:	
Actions: Contact ICES to retrieve data Locate and contact data on Mediterranean basis (Fisheries DG — Discards) Discards recording should be enforced through a directive	**Comments:** For general comments see Table 11 Comprehensive figures for the EU do not exist Discards should include data on invertebrates as in directives related to CBD, Habitats

Table 36	**Data set: Bycatch (mammals, birds and turtles)**

Used for indicators: **22. Trends in bycatch (mammals, birds and turtles)**	
Data retrieval:	
Holding body: International Council for the Exploration of the Sea (ICES): Working groups – Mammals and birds Mammals in Mediterranean**:** Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS) Data available through fishery commissions and national institution bulletins and publications or from current scientific literature Latter applies for birds Turtles are also covered by Mediterranean action plan (UNEP), Regional Activity Centre for Specially Protected Areas (SPA/RAC)	
Contact name: ICES ACCOBAMS UNEP	**Contact details:** ices.info@ices.dk mcvanklaveren@gouv.mc mwatts@unepmap.gr
References: http://www.ices.dk/committe/acfm/acfm.htm http://www.wcmc.org.uk/cms/acc_updt.htm http://www.unepmap.org	
Accessibility: ICES library: public domain Personal communication data difficult to access	
Format: Publications of working group on marine mammal population dynamics and in summary form in the report of our advisory committee on marine environment	
Reason for choosing data holder/Procedure for collecting data: ÉCES quality ACCOBAMS and UNEP/MAP only sources available	
Data description:	
Definitions: Observed captures of marine mammals	
Units: Number of animals	
Geo coverage: ICES fishing areas Mediterranean and Black Sea	
Time series: Per case	
Quality: ICES quality see above	
Next update: Per case	
Previous use:	
Additional information:	
Actions: Contact ICES locate and contact Mediterranean sources indicator to be incorporated into future directives	**Comments:** Indicator among priorities of major directives: CBD, Bonn and action plans

Data set: Quality of fish	Table 37

Used for indicators: 23. Quality of fish (fisheries and aquaculture)	
Data retrieval:	
Holding body: National research and monitoring projects. Data might also be obtained through questionnaires directly to wholesalers of fish	
Contact name: Per case — Member States	**Contact details**: Per case
Reference: Per case	
Accessibility: Permission required from institutes or holders of aggregated data	
Format: Uncertain: probably database format	
Reason for choosing data holder/Procedure for collecting data: The only holders of such data	
Data description:	
Definitions: Quality of fish and invertebrates caught or cultured expressed in the absence of harmful (or potentially harmful) for human consumption substances such as bacteria (coliforms), PAHs, heavy metals, etc.	
Units:	
Geo coverage: European coverage	
Time series: Uncertain	
Quality: Uncertain; depending on the quality of data reported from different institutions	
Next update: Per case	
Previous use:	
Additional information:	
Actions: Locate and contact national data holders Monitoring and recording should be enforced through a directive	**Comments:**

Data set: Quota management	Table 38

Used for indicators: 24. Quota management	
Data retrieval:	
Holding body: Fisheries DG National statistical offices cover Mediterranean	
Contact name: DG Fisheries Mediterranean	**Contact details:** http://europa.eu.int/comm/dgs/fisheries/index_en.htm Per case
Accessibility: Free downloadable data	
Format: PDF files	
Reason for choosing data holder/Procedure for collecting data: Fisheries DG is the main body responsible for comprehensively setting quotas for the ICES covered fishing area For the Mediterranean individual countries set own regulations such as closed areas and closed seasons, distance from shore, selective gear	
Data description:	
Definitions: Regulation measurement for fisheries management. Total allowable catch (TAC) per area and season	
Units: Weight of fish, tonnes	
Geo coverage: ICES fishing grounds Mediterranean Sea	
Time series: Not certain	
Quality: Fisheries DG control	
Next update: Annual	
Previous use:	
Additional information:	
Actions: Contact national statistical offices	**Comments:**

Table 39	**Data set: Number of fishing vessels and fishermen participating in different fisheries**

Used for indicators: 25. Zone management or **Fishing effort control and enforcement**	
Data retrieval: Electronic via Internet or oral (by request)	
Holding body: Norway: Fisheries Directorate, trade recordings EU: statistical bulletin http://www.europa.eu.int/comm/fisheries/doc_et_publ/statistic/stat_en.htm	
Contact name: Per case — Member States	**Contact details:** Per case (area, topic, period to be specified)
Reference:	
Accessibility: Public	
Format: Electronic, PDF file(s)	
Reason for choosing data holder/Procedure for collecting data: Number (and size) of vessels and number of fishermen participating in fisheries is a direct measure of effort. However, several of the fisheries are regulated by TACs, which are normally taken before the end of the year. In this way, number and size of participating vessels is a measure of intensity in the fishery, and can be used for splitting on different types of gear.	
Data description:	
Definitions:	
Units: Man-years, number of full- and part-time employed fishermen	
Geo coverage: National	
Time series: Continuous (EU data from 1996)	
Quality: Best available	
Next update: Annually updated	
Previous use:	
Additional information:	
Actions:	**Comments:**

Table 40	**Data set: Number and size of vessels entering and leaving the fishery**

Used for indicators: 26. Fisheries restructuring	
Data retrieval:	
Holding body: Norway: Fisheries Directorate ships register. Probably aggregated data available at EU or FAO level per year. For specific fisheries, data might be available with finer resolution than a year, e.g. the Lofoten fishery for Arctic cod or other short-term fisheries going on repeatedly (annually, semi-annually, bi-annually, etc.).	
Contact name: Per case	**Contact details:** Per case
Reference:	
Accessibility: Public	
Format: Spreadsheet or database formats	
Reason for choosing data holder/Procedure for collecting data: Number and size of vessels is a direct measure for the development within the fishing fleet (potential effort). TAC is distributed on groups of vessels, and thus is a direct measure of effort within the different groups (sizes and type of gear).	
Data description:	
Definitions:	
Units: Numbers of vessels within specified categories (overall length, engine power or type of gear in use)	
Geo coverage: Should be available at Member State level = covering all EU waters	
Time series: Probably variable	
Quality: Best available	
Next update: Continuous	
Previous use: Allowing vessels to participate in different types of fishery	
Additional information:	
Actions:	**Comments:**

Data set: Research and monitoring effort data	Table 41

Used for indicators: 26. Fisheries restructuring or **Expenditure for fish-stock monitoring**	
Data retrieval:	
Holding body: To be compiled from several bodies	
Contact name: Several	**Contact details:**
Reference:	
Accessibility: Should be relatively straightforward	
Format: Variable	
Reason for choosing data holder/Procedure for collecting data:	
Data description:	
Definitions:	
Units: Number of cruise-days/weeks, number of trawl hauls performed by research vessels or other measures of effort	
Geo coverage: Probably all Member State EEZs are covered, but with varying intensity	
Time series: Variable, but probably long within each institution	
Quality: Probably good quality data, but difficult to compare effort of one vessel to effort by another, operating in different areas and having different equipment, manning, range, etc.	
Next update: Continuous	
Previous use: Advisory basis for ICES TAC recommendations (and several research projects on relevant topics)	
Additional information:	
Actions:	**Comments:**

Data set: Effort data for relevant fisheries	Table 42

Used for indicators: 27. Percentage of fisheries reflecting environmental integration	
Data retrieval:	
Holding body: Central fisheries statistics services at Member State level	
Contact name: Per case	**Contact details:** Unknown
Reference:	
Accessibility: Public (in some cases probably anonymous names on boats)	
Format: Some Member States regulate specific fisheries by effort control (number of days allowed at sea for different types of vessels). Information has to be obtained from the local regulatory bodies for this type of managed fisheries	
Reason for choosing data holder/Procedure for collecting data: Also fisheries not managed by effort regulations can be evaluated based on effort measures. Days at sea and number of trawl hauls are normally recorded by larger vessels (dairy keeping). For Norwegian vessels, dairies are collected and data recorded by the Fisheries Directorate. Data can be obtained from this source with some time lag.	
Data description:	
Definitions:	
Units: Several: days at sea, hauls per day, etc.	
Geo coverage: All EU EEZs	
Time series: Continuous for larger vessels	
Quality: Best available. Difficult to intercallibrate and to compare from vessel group to vessel group, and from country to country, and even from fishery to fishery	
Next update	
Previous use:	
Additional information:	
Actions:	**Comments:**

Table 43	Data set: International fisheries organisations

Used for indicators: **27. Percentage of fisheries reflecting environmental integration** **29. National legislation with specific provision for environmental management of aquaculture**	
Data retrieval:	
Holding body: GFCM, EIFAC, ICES, NASCO, NEAFC, ICCAT	
Contact name: Per case EIFAC: European Inland Fisheries Advisory Commission GFCM: General Fisheries Commission for the Mediterranean IBSFC: International Baltic Sea Fishery Commission ICES: International Council for the Exploration of the Sea NEAFC: North-east Atlantic Fisheries Commission NASCO: North Atlantic Salmon Conservation Organisation ICCAT: International Convention for the Conservation of Atlantic Tunas	**Contact details**: See references
Reference: GFCM: http://www.fao.org/fi/body/rfb/gfcm/gfcm_home.htm EIFAC: http://www.fao.org/fi/body/eifac/eifac.asp IBSFC: http://www.ibsfc.org NASCO: http://www.nasco.int/ NEAFC: http://www.neafc.org ICCAT: http://www.iccat.es	
Accessibility: Public	
Format: Web pages	
Reason for choosing data holder/Procedure for collecting data:	
Data description:	
Definitions: General information regarding membership, area of operation, species covered and activities	
Units:	
Geo coverage: All Europe, associated areas and beyond	
Time series:	
Quality:	
Next update	
Previous use:	
Additional information:	
Actions:	**Comments:** Not a data set per se. Web sites with useful information for the development of indicators

Data set: Monitoring results from aquaculture sites	Table 44

Used for indicators: **28. Percentage of aquaculture complying to Fish Farms Code of Conduct** **15. Biodiversity indicators near farms compared with away from farms**	
Data retrieval:	
Holding body: Regional environmental authorities at Member State level National institutes EU projects (in particular under the Water Framework Directive)	
Contact name: Per case	**Contact details:** Per case
Reference:	
Accessibility: Probably restricted or limited to anonymous data covering a specific geographical area or group of aquaculture enterprises e.g. all salmon-producing enterprises within a specified area (county, province, watershed, etc.)	
Format: Highly variable as Code of Conduct varies from Member State to Member State and type of aquaculture production (concept, species, sites)	
Reason for choosing data holder/Procedure for collecting data:	
Data description:	
Definitions: Variable, but most frequently analysed parameters comprise nutrients in water, organic carbon in sediments, macrofauna biodiversity at production sites and oxygen contents in recipient water	
Units: Variable	
Geo coverage: Variable	
Time series: Variable	
Quality: Varying, but generally good as demands are made for institutions being allowed to undertake investigations. Quality would improve when Water Framework Directive implemented.	
Next update: Irregular	
Previous use: Monitoring environmental performance	
Additional information:	
Actions:	**Comments**: Another data set which could enlighten this indicator is the used amount of feed (where applicable) or the awarded feed quota (relevant for Norwegian salmon production). Data on the latter are available through the fisheries department (at national level).

Table 45	Data set: Country Legislation on Regulation and Monitoring

Used for indicators: **29. National legislation with specific provision for environmental management of aquaculture** **28. Percentage of aquaculture complying to Fish Farms Code of Conduct**	
Data retrieval:	
Holding body: Environmental authorities at Member State level (central and local) Maraqua workshops	
Contact name: Per case	**Contact details:** Per case
Reference: http://www.biol.napier.ac.uk/maraqua/	
Accessibility: Public	
Format: Variable	
Reason for choosing data holder/Procedure for collecting data: Holders of data on national level Maraqua workshops bring together representatives of European countries and shared information and knowledge on in-country legislation on regulation and monitoring	
Data description:	
Definitions: Types of regulation and monitoring in force	
Units:	
Geo coverage:	
Time series:	
Quality:	
Next update:	
Previous use:	
Additional information:	
Actions:	**Comments**: Not a data set per se. National legislation prerequisites for establishment of aquaculture sites

9. Abbreviations

ACF	Advisory Committee on Fishery
ACFM	Advisory Committee on Fishery Management (ICES)
ACME	Advisory Committee on the Marine Environment (ICES)
ACMF	Advisory Committee on Fishery Management (ICES)
ACP	African, Caribbean and Pacific countries
CAP	Common agricultural policy
CBD	Convention on Biological Diversity
CFP	Common fisheries policy
CPUE	Catch per unit effort
DPSIR	Driving forces–pressure–state–impact–response framework
EEA	European Environment Agency
EEZ	Exclusive economic zone
EIA	Environmental impact assessment
EIFAC	European Inland Fisheries Advisory Commission
Eurostat	European Statistical Office (part of the European Commission)
FAO	UN Food and Agriculture Organisation
FIFG	Financial Instrument for Fisheries Guidance
GFCM	General Fisheries Commission for the Mediterranean
Helcom	Helsinki Commission, Baltic Marine Environment Protection Commission
IBSFC	International Baltic Sea Fisheries Commission (ICES)
ICCAT	International Commission on the Conservation of the Atlantic Tunas
ICES	International Council for the Exploration of the Sea
IRF	Inter-Regional Forum (EEA)
MAGP	Multi-annual guidance programme
NEAFC	North-East Atlantic Fisheries Commission
NASCO	North Atlantic Salmon Conservation

OECD	Organisation for Economic Cooperation and Development
OSPAR Convention	Convention on the protection of the marine environment of the North-East Atlantic
Quotas	Individual transferable quotas
SBL	Safe biological limit
SDRS	Sustainable development reference system
STECF	Scientific, Technical and Economic Fisheries Committee of the EU
TACs	Total allowable catches
UNCLOS	United Nations Convention on the Law of the Sea

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