FISH
FISKESEKRETARIATET
THE FISHERIES SECRETARIAT

EU 2004

Institute for European Environmental Policy

Sustainable EU fisheries: Facing the Environmental Challenges

European Parliament, Brussels

8-9 November 2004

Conference Report

The Institute for European Environmental Policy (IEEP) is an independent institute with its own research programmes. Based in London and Brussels, the Institute's major focus is the development, implementation and evaluation of EU policies of environmental significance, including agriculture, fisheries, regional development and transport.

The Fisheries Secretariat (FISH) is a non-profit organisation dedicated to work towards more sustainable fisheries at an international level, with a focus on the European Union. The Stockholm-based Secretariat was set up in 2003 by three environmental NGOs: the Swedish Society for Nature Conservation, WWF Sweden and the Swedish Angler's Association.

Designed & printed by Seacourt on paper from a sustainable source

This report should be referenced as: N. Sporrong, C. Coffey, J. Brown and D. Reyntjens (eds) 2005. Sustainable EU fisheries: facing the environmental challenges. FISH/IEEP Conference report, European Parliament, Brussels, Belgium, 8-9 November 2004. ISBN 1 873906 49 8

Sustainable Fisheries: Facing the Environmental Challenges
European Parliament, Brussels 8-9 November 2004

Conference Report

Editors: Niki Sporrong, FISH; Clare Coffey, James Brown and Dirk Reyntjens, IEEP

Contributing authors: Mahfuzuddin Ahmed, WorldFish Center; James Brown, IEEP; Clare Coffey, IEEP; Emily Corcoran, UNEP-World Monitoring Centre; Anthony Cox, OECD; Dirk Reyntjens, IEEP; Saskia Richartz, IEEP; Niki Sporrong, FISH; Peter Tyedmers, School for Resource and Environmental Studies, Dalhousie University; Douglas Wilson, IFM

Thanks to the people who made the conference possible, in particular the Steering Committee, the speakers, the assistants and Members of the European Parliament, the moderator, chairs and rapporteurs.

The conference and this report were financially supported by the Fisheries Secretariat (FISH), the Esmée Fairbairn Foundation, the European Commission – DG Fisheries and English Nature.

ENGLISH NATURE

Esmée Fairbairn FOUNDATION

landbouw, natuur en voedselkwaliteit

CONTENTS

FOREWORD

Although fishing has direct effects on the environment – a substantial part of a natural resource is simply extracted from wild stock – the renewable nature of fish stocks means that impacts can be very limited. Unfortunately, the past hundred years have seen a global decline in stocks to levels of 10 per cent or less. The EU waters are no exception, with several stocks currently at all time lows, and fish farming increasingly being looked to as a way of compensating for this situation. Instead of making the most of a valuable renewable resource, we have contributed to its decline and undermined the possibility of future generations to benefit from fisheries.

At the Johannesburg Summit, world leaders made a commitment to restore fish stocks to healthy levels by 2015, where possible. Among other targets, we also agreed on the need for a global network of marine protected areas. We have gradually tried to translate this commitment into the EU Common Fisheries Policy, in particular through the 2002 CFP reforms. Subsequent measures, such as those prohibiting bottom trawling in certain areas to protect coral reefs and addressing cetacean by-catch, confirm the EU's commitment to environment and sustainable development. We are on the right track, but we still have a long way to go before reaching our targets.

A key question is how we can bridge the gap between what is needed to maintain fish stocks and the marine environment for now and the future, whilst minimising the short-term negative effects that this may have on the sector and dependent coastal communities. Fishing and fish farming are economic activities with a distinct socio-cultural dimension, and we should do all we can to support this dimension. The challenge is one of sustainability – ensuring that the future social and economic development of the fishing sector builds on rather than undermines the health of fish stocks and the marine environment.

To make progress in this field, we will need to shift our thinking towards win-win-win approaches, where social, economic and environmental objectives are achieved together. Environmental technology is a key area for progress, potentially reducing the fisheries sector's operating costs by ensuring more targeted fishing and farming effort. The result is a sector that is both cleaner and more competitive, and which can exploit consumer trends that favour sustainably caught products. Importantly, this could also stimulate the development of a strong European environmental maritime technologies sector.

The IEEP/FISH conference provided an occasion to reflect on these and other opportunities, looking at and beyond the horizon. Our challenge is – wherever suitable – to turn these opportunities into reality.

Mr Fernand Boden
Minister of Agriculture, Viticulture and Rural Development
Luxembourg

Mr Cees Veerman
Minister of Agriculture, Nature and Food Quality
The Netherlands

SUMMARY OF CONFERENCE CONCLUSIONS

On 8–9 November 2004, a high-level conference was held at the European Parliament, under the patronage of the Dutch Presidency of the EU Council. The event was organized by the Institute of European Environmental Policy (IEEP) and the Fisheries Secretariat (FISH). It was attended by over 100 representatives from the EU institutions, national fisheries and environment ministries and authorities, inter-governmental organisations, the fisheries sector, environmental and consumer organisations, and universities.

The high-level conference sought to re-examine the challenges facing sustainable development of the EU capture fisheries and aquaculture sector, taking a long-term, environmental perspective, and placing it within the pan-European and global contexts, in particular the WSSD targets on Fisheries, Oceans and Biodiversity. The aim was to propose new approaches, including a range of possible instruments, to ensure the transition of the EU fisheries sector to a sustainable industry. The resulting conference conclusions are intended to inform discussions within an enlarged EU, with a view to securing commitment to make strong progress in implementing the CFP reform and meeting international targets.

Recognising the complex and challenging nature of sustainable development of the fisheries and aquaculture sector, and the need for new approaches to tackling the issues, the conference focused on four broad themes: *production, consumption and trade, instruments* and *governance*. Detailed discussions on each issue resulted in the identification of a number of areas deserving continued or increased attention. The following key conclusions and recommendations reflect the discussions in the groups as well as in plenary.

Production

Production methods and processing of fish and fish products can have serious impacts on the environment and, consequently, also on people and livelihoods. Yet fish is a food source of high nutritional value. The challenge is to maximise the positive contribution of fisheries, whilst reducing negative impacts to acceptable levels. Using existing technologies, there is already great scope to redress the balance and some progress is being made by fisheries organisations, the processing industry and policy makers. Improvements in this area will generate potential benefits for the sector in terms of its sustainability, but also its profitability and competitiveness. Growing awareness of fisheries issues among European consumers will create further benefits for responsible fisheries.

There is an opportunity for EU Member States to work together to improve the environmental performance and resource efficiency of production, which should be secured through a ***series of targeted and complementary policies and measures***. The EU can stimulate innovation in the sector through research, funding, regulation and even voluntary agreements.

The unnecessary ***bycatch and subsequent discarding*** associated with fisheries is a key issue, affecting the image, productivity and efficiency of the sector. The capture of large numbers of juveniles, as well as the important 'mega-spawners', is a particular problem. Despite receiving political attention, progress in this area is inadequate. There is a need to re-examine the technical means for addressing these issues, including minimum landing sizes. When bycatch is unavoidable, systems requiring the landing and subsequent auction of bycatch should be considered. In this area there is particular scope to work with the catching sector to develop and implement a ***sectoral plan of action*** to significantly reduce the environmental and resource impacts associated with fishing.

Recreational fisheries are largely outside the scope of CFP management measures. Consideration should be given to improving information on the recreational sector, particularly in the Mediterranean, ensuring that ***recreational fisheries are fully accounted for within fisheries management*** measures. Any measures to protect stocks, such as time and area closures, should apply equally to all parts of the sector. The use of large-capacity (industrial-scale) gear could be restricted to licensed fishing activities, and particularly destructive fishing methods such as night-time spear fishing with light prohibited altogether.

As regards ***aquaculture production***, improvements should be secured in order to decrease the sector's dependence on wild-caught fish for feed, by developing high-protein vegetable alternatives. Greater efforts are also needed to address the issue of specimen escaping. The use of wild juveniles, such as young bluefin tuna or elvers, to stock farms needs to be properly identified and recorded within existing catch reporting systems.

Consumption and trade

Consumption is central to the sustainability debate, not just in terms of how much but also what is being consumed, how it is produced, and the product form and origin. The current levels and patterns of consumption have lead to increasing trade in fish products. Trade itself is associated with a number of environmental issues, including the generation of greenhouse gases and chemical pollution. Conversely, the highly traded nature of fish products means that trade-based measures are potentially a powerful tool for securing effective fisheries management.

There is a major opportunity to ***harness EU consumer power*** in order to support sustainable trade and consumption patterns. A growing number of initiatives in the EU Member States include labelling, the production of booklets, mainstream media articles and other public information campaigns. There is scope to learn from ongoing efforts in this area, potentially initiating an EU-wide project to identify and exchange good practice.

The provision of ***clear and targeted information*** is the basis for consumer choice. The EU's efforts in relation to traceability and standards for product labelling are an important start, but need now to be strengthened both to improve their application and, eventually, to provide more relevant and detailed information for consumers. There is scope to work with the production and processing sector, NGOs and consumer organisations, potentially using voluntary agreements backed up by the option of legal measures should voluntary efforts fail.

There is also a need for ***EU level action on product labelling***, and particularly eco- or organic labels. Organic labels for fish farming are currently unsatisfactory, as labels vary widely, creating an uneven playing field for producers as well as confusing consumers. There is a good deal of support for developing EU standards for labelling schemes, and the development of an EU 'ecolabel' also has some support.

As a form of trade, ***EU third country fishing access agreements*** present a number of environmental challenges. The environmental impacts arising from fishing under access agreements are likely to be at least equal to those that occur in EU waters. Negotiations should be opened only after an assessment of the status of stocks, which should consider the best available information. In developing agreements, the principle of the user pays should be applied, resulting in a significant increase in access fees for vessel owners.

Policy instruments

To date, the CFP has predominantly relied upon 'command and control' type instruments to regulate fisheries, as well as financial aid to the sector. Limited use has been made of other types of instruments, for example, to limit individual waste or set environmental standards to underpin consumer labels. There is a need for a ***more effective application of the instruments already in use***, but greater consideration can and should also be given to strengthening and broadening the range of policy instruments used.

Further use should be made of ***spatial instruments***, particularly by establishing a scientifically robust programme for an effective system of Marine Protected Areas as a fisheries management tool, recognizing that these can provide multiple ecosystem benefits. This initiative should be led by the relevant EU institutions and the Member States, but in close collaboration with Regional Conventions, non-governmental organisations and fishermen.

Improved control and enforcement of effort is necessary. This may require the more widespread use of days-at-sea restrictions and real time closures of fishing grounds. ***A higher involvement of fishermen*** in developing and improving technical measures is required.
Although a politically sensitive issue, there is considerable support for generating greater ***ownership of the resources*** to foster a stewardship and allow the EU to move towards more sustainable capture fisheries. There is a range of potential instruments that can be applied at different levels of geographical scale that will help achieve this. For instance, a distinction can be made between inshore and offshore fisheries. In inshore fisheries, community-based cooperative management arrangements may be a more appropriate mechanism to help achieve economic, social, and

environmental, sustainable development goals, while internationally traded ITQs may be an option for offshore fisheries. Serious consideration should be given to this issue within the EU management system. Lessons from the application of rights-based management in EU and other countries should help to demonstrate the potential benefits to fishermen and wider communities.

There is a potential to build on the CFP reform through the ***new European Fisheries Fund*** (EFF). Aid should be targeted at helping the sector overcome a period of structural change, supporting efforts that will make it more sustainable and competitive in the long term. In this regard, there should be a reduction in the overall level of subsidies to the sector, an increase in the conditions attached to their use, cross-compliance with other EU policies, better targeting of subsidies and a prohibition of subsidies likely to promote unsustainable practices, reflecting World Trade Organisation discussions. Continued commitment to the EU decision to halt subsidies for fleet renewal is particularly important. Environmental impact assessments need to be undertaken on the use of existing and future subsidies. There is also scope for coordination of national funding schemes, in support of measures aimed at managing international fisheries.

Governance

The State's role in governance is to develop the policy and regulatory frameworks, fix the overriding objectives, legitimate and balance stakeholders' interactions, and carry out enforcement. The Commission's 2001 White Paper on European Governance states five principles underpinning good governance: participation, openness, accountability, coherence and effectiveness. Improvements in governance are already occurring but more substantial changes are needed in areas of policy coherence, accountability of actors, information requirements, and the distribution of responsibilities.

The decision to establish a ***Commissioner for Fisheries and Maritime Affairs*** is welcomed as a sign of more coherent inter-institutional workings, in particular, between DG Fisheries and DG Environment. However, the capacity of both DGs and their interactions could be strengthened in order to facilitate further coherence in policy making.

The need for reinforced stakeholder participation, transparency and accountability is reflected in the ***development of Regional Advisory Councils*** (RACs), which the conference welcomed. A number of roles that RACs could usefully play, both now and should they be given additional powers in the future, were identified. In the short term, however, attention needs to be given to the composition of RACs and the extent of communication between RACs, stakeholders they represent and institutions they advise. Additional human and financial resources need to be dedicated to RACs to ensure their effective functioning.

With the application of an ecosystem-based approach to fisheries, there is a need for the collection and exchange of more ***comprehensive, accurate and verifiable information*** about, for example, the state of resources and their ecosystems, fishing operations, compliance with management measures, and origin of fish and fishery products (traceability). This may be achieved, *inter alia*, with wider use of Vessel Monitoring Systems (VMS) and on-board observer schemes which would also support the gathering of effort and catch data. Where information gaps remain, the precautionary principle and adaptive management strategies will need to be applied.

There is concern about the excessively top down approach to fisheries regulation in EU waters, particularly given the ecosystem-based approach and the consequent need for management at the local, national, and regional levels, as well as at population or ecosystem levels. Consideration should be given to ***devolving more responsibility***, with the Commission responsible for setting principles and objectives and elaborating the legislative framework for fisheries and environmental management, whilst making regional institutions progressively more responsible for adapting and 'fine tuning' management to the local realities.

1. INTRODUCTION

In 2002, at the Johannesburg World Summit on Sustainable Development, the EU committed itself to important global targets concerning fish stock recovery by 2015, the creation of a global network of marine protected areas (MPAs) and halting the decline in biodiversity by 2010. The EU's credibility as a global environmental leader was reinforced in December 2002 when – very much in the spirit of the WSSD – EU Fisheries Ministers agreed to major reforms of the Common Fisheries Policy (CFP). Despite the strength of the new CFP framework Regulation 2371/2002 and significant changes to the EU's subsidy regime, however, progress in relation to stock recovery and management has been disappointing and more urgency is needed.

On 8–9 November 2004, a high-level conference was held at the European Parliament, under the patronage of the Dutch Presidency of the EU Council. The event was organized by the Institute of European Environmental Policy (IEEP) and the Fisheries Secretariat (FISH). It was attended by over 100 representatives from the EU institutions, national fisheries and environment ministries and authorities, inter-governmental organisations, the fisheries sector, environmental and consumer organisations, and universities.

The high-level IEEP/FISH conference sought to re-examine the challenges facing sustainable development of the EU capture fisheries and aquaculture sector, taking a long-term, environmental perspective, and placing it within the pan-European and global contexts, in particular the WSSD targets on fisheries, oceans and biodiversity. The aim was to identify and propose new approaches to ensure the transition of the EU fisheries sector to a sustainable industry.

Recognising the complex and challenging nature of sustainable development of the fisheries and aquaculture sector, and the need for fresh ways to tackle the issues, the conference focused on four broad themes: *production, consumption and trade, instruments and governance*. Five briefings focusing on key issues were developed ahead of the conference, to set the scene for discussions and frame the debate in an objective manner: 1) State of Europe's regional seas, 2) Production of fish, 3) Consumption and trade, 4) Policy instruments, and 5) Governance. The topics were selected because they correspond to key aspects of fisheries policy and management. They also broadly correspond to the European Environment Agency's (EEA) 'DPSIR'[1] framework that is used to describe the interactions between the environment and society.

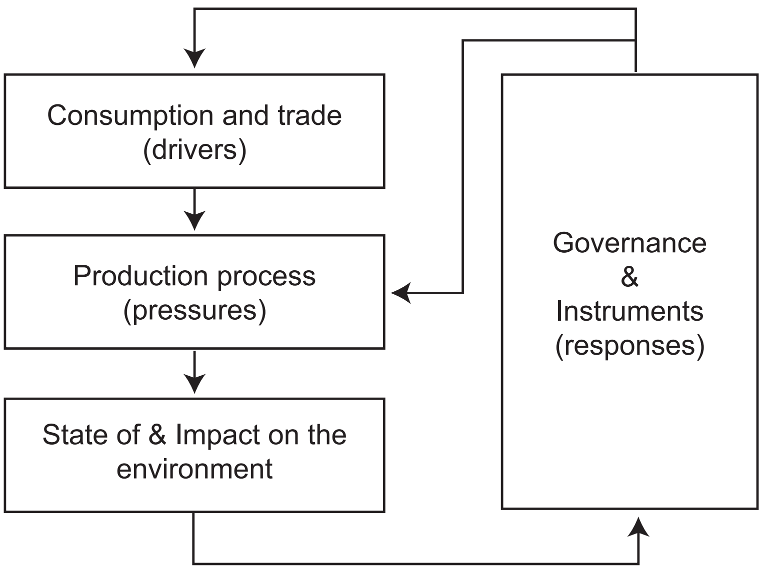

Figure 1. Schematic representation of the DPSIR framework used for the conference.

The primary *driving forces* are considered to be population growth and the needs and actions of individuals. These affect the overall levels of consumption and trade of fish products, be it for direct human consumption or indirectly as inputs, for instance fish meal for livestock feeds.

Consumption and trade of fisheries products are among the drivers leading to pressures being exerted on the marine environment by production processes (capture fisheries, aquaculture and processing). These production processes tend to be environmentally, and often economically, inefficient. They are accompanied by wastage and some degradation of marine living natural resources. It is, however, clear that there are other sources of pressures on the marine environment, such as pollution and climate

1 DPSIR stands for Driving forces, Pressures, States, Impacts and Responses.

change. When looking at the *state* of the marine environment, there is therefore a need to place capture fisheries and aquaculture within the broader context of the pressures exerted by human activities.

The *responses* of human society to all of these changes have been enacted through both governance structures and processes, and fisheries management instruments. A basic management framework for these shared resources was created in the second half of the last century, and a substantial reform of these systems has only recently begun. The instruments used today are still largely of the 'command and control' type, although some other instrument types are also used.

Detailed discussions on each of these headings resulted in the identification of a number of areas deserving continued or increased attention by policy-makers and others. Reflecting these and plenary discussions, this conference report is intended to inform fisheries discussions within an enlarged EU, with a view to securing commitment to make strong progress in implementing the 'new' CFP and in the process, meeting international targets.

The conference itself and the resulting report is financially supported by the European Commission (DG FISH), the Esmée Fairbairn Foundation, the Fisheries Secretariat (FISH) and English Nature.

2 THE STATE OF EUROPE'S REGIONAL SEAS – ARE WE MEETING CONSERVATION TARGETS?

Written by Saskia Richartz (IEEP) and Emily Corcoran (UNEP-WCMC)

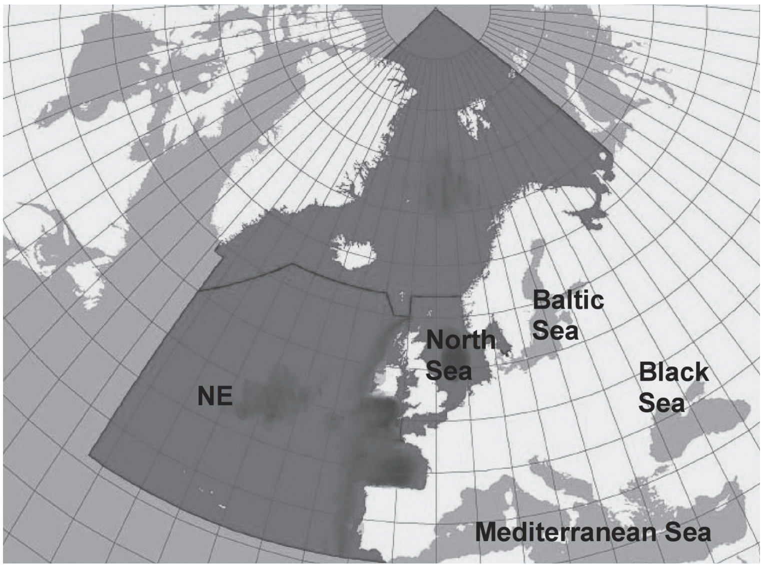

Figure 2. Europe's regional seas. Source: Adapted from OSPAR (2000) Quality Status Report for the North-East Atlantic.

2.1 INTRODUCTION

The two-thirds of the Earth's surface that make up the marine environment essentially provide the planet's powerhouse, and constitute an essential source of resources. While reporting on the state of the marine environment has improved in recent years,[2] our information about marine ecosystems is still patchy in space and time. Moreover, our application of data and policies is often sectoral, and thus do not provide for multi-species and multi-use management. Together with outdated misconceptions of a limitless marine environment, this causes significant problems in assessment and management of our marine resources.

All fisheries fundamentally depend on the marine ecosystem, its health and ability to replenish. Therefore, the state of the marine environment has to be the foundation of any discussion about the state of the [marine] fishing sector. This chapter therefore aims to identify the key threats to Europe's regional seas, notably the North-East Atlantic[3], the North Sea, the Baltic Sea, the Mediterranean Sea and the Black Sea.

Reflecting the EEA's 'DPSIR' model, environmental drivers (D) and pressures (P) have been identified and ranked according to their regional importance, using existing literature[4]. This is presented before the backdrop of an assessment of the state (S) and diversity of Europe's seas. To conclude, we discuss the role of fishing in driving environmental decline in the marine environment (I), and identify some of the existing political responses (R) to key marine threats.

2.2 POLICY CONTEXT

The importance of Europe's seas has been recognised at the highest political level, and within a number of Regional Seas Conventions, notably the:

- OSPAR Convention for the protection of the marine environment of the North-East Atlantic (including the North Sea);
- HELCOM Convention for the protection of the marine environment of the Baltic Sea;

2 A useful database on marine reporting is available on http://www.giwa.net/areas/regions_and_network.phtml
3 For the purpose of this briefing, the North-East Atlantic will be considered in terms of the wider Atlantic and the Celtic seas as defined by OSPAR Regions V and III. To avoid excessive length, only limited attention is given to the Bay of Biscay and the Iberian Sea.
4 Rankings reflect the urgency and dominance of pressures/drivers on the environmental state of each regional sea. For the purpose of this briefing we have based the rankings on publications by OSPAR and the Black Sea Commission. For the Mediterranean, no formal ranking of pressures and drivers could be found, so our assessment is based on a general literature review and educated judgment.

- Barcelona Convention for the protection of the marine environment and the coastal region of the Mediterranean; and
- Convention for the protection of the Black Sea against pollution.

In addition, European Heads of State and Governments have signed up to a raft of commitments for the protection of the marine environment, in Europe and internationally. This includes the commitments adopted at the World Summit on Sustainable Development (WSSD, Plan of Implementation), notably:

- by 2004, to have established a regular process for global reporting and assessment of the state of the marine environment;
- by 2006, to have made every effort to achieve substantial progress to protect the marine environment from land-based activities;
- by 2010, to have significantly reduced the rate of biodiversity loss;
- by 2010, to have encouraged the application of the ecosystem approach in marine management;
- by 2012, to have developed marine protected areas consistent with international law and based on scientific information, including representative networks and time/area closures for the protection of nursery grounds and periods;
- by 2012, to have facilitated proper coastal land use and watershed planning;
- by 2015 at the latest, to have maintained or restored [fish] stocks to levels that can produce the maximum sustainable yield;
- to develop national, regional and international programmes for halting the loss of marine biodiversity, including in coral reefs and wetlands;
- to maintain the productivity and biodiversity of important and vulnerable marine and coastal areas, including in areas within and beyond national jurisdiction; and
- to enhance maritime safety and protection of the marine environment from pollution by actions at all levels.

Most if not all of the WSSD targets build on international conventions. The Convention on Biological Diversity (CBD) is arguably most comprehensive in its reference to marine protection. It requires *'[t]he establishment and maintenance of marine and coastal protected areas that are effectively managed, ecologically based and contribute to a global network of marine and coastal protected areas, building upon national and regional systems, including a range of levels of protection, where human activities are managed, particularly through national legislation, regional programmes and policies, traditional and cultural practices and international agreements, to maintain the structure and functioning of the full range of marine and coastal ecosystems, in order to provide benefits to both present and future generations'* [Decision VII/5, paragraph 18]. *This has been further backed by the commitment 'to effectively conserve at least 10% of the world's ecological regions by 2010'* [Decision VII/30 Parties].

Further commitments, especially on species protection are also included in the CBD, as well as in the Convention on Migratory Species (CMS), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the Ramsar Convention.

At EU level, the Sixth Environmental Action Programme identified the need *'to promote sustainable use of the seas and conserve marine ecosystems'* (Decision 1600/2002/EC). The European Commission has subsequently set out its commitment to developing a more strategic approach to marine management in the Communication 'Towards a strategy to protect and conserve the marine environment' (COM(2002)539final). In this, the Commission calls for an ambitious and pragmatic approach to marine management, with *'a coherent set of measures founded on the application of an ecosystem based approach […]'.*

The above targets are further complemented and strengthened by certain regional commitments, often under the regional conventions. These commitments are often more ambitious and/or timetables are more pressing than at international level. The EU, for instance, has not merely committed to 'significantly reducing' the rate of biodiversity loss by 2010, but to halting it[5]. Under OSPAR and HELCOM, coastal states are committed to having identified marine

5 EU Sustainable Development Strategy, Gothenburg (COM(2001)264).

protected areas (MPAs) by 2006, and to having completed a joint network of well-managed MPAs by 2010, two years before the international deadline[6]. In the field of water pollution, the Baltic States have pledged to achieve the cessation of inputs of hazardous substances by 2020, with the ultimate aim of achieving concentrations in the environment near background levels for naturally occurring substances and close to zero for man-made synthetic substances.

2.3 THE DIVERSITY OF EUROPEAN REGIONAL SEAS

Europe's seas, from the enclosed Black Sea to the open ocean of the North-East Atlantic, comprise a diverse mix of ecosystems, spanning several biogeographical regions. As elsewhere, knowledge of marine diversity is confined largely to the continental shelves and slopes; very little is known about deep sea habitats.

Compared to tropical regions, Europe's temperate waters are relatively species poor. This is thought to reflect a global latitudinal diversity decline, resulting in fewer but bigger species near the poles, a phenomenon well understood in evolutionary and ecological terms.

The largest expanse of international waters in Europe is in the North-East Atlantic, although the Mediterranean and Baltic Seas also comprise waters outside national jurisdiction. By far the largest part of Europe's seas, however, is under the national jurisdictions of coastal states, and resources are nationally managed, with the exception of EU fisheries. The latter are regulated and managed by the European Community under the Common Fisheries Policy, except where powers have been delegated back to the Member States, such as in inshore waters.

Europe's marine environments display a stark mismatch between their limited carrying capacity and the excessive human footprint[7].

2.4 EUROPE'S REGIONAL SEAS

2.4.1 Pressures and Drivers on the Marine Environment and Their Impacts

High population densities and levels of industrialisation in Europe significantly increase environmental pressures. Enclosed and semi-enclosed seas, such as the Black, Baltic and Mediterranean seas, are particularly at risk. That said, some of Europe's northern coastlines are the most heavily populated and developed, leading to severe impacts also in the Atlantic and North Sea. Some of the key threats are:[8]

Fishing and mariculture – overfishing is a common problem worldwide, and Europe's regional seas are no exception. There are four key concerns as regards fishing and mariculture. Firstly, several important commercial fish stocks have reached critically low levels and research presented in ICES shows clearly that biomasses of fish at high trophic levels today are a small fraction of what they were 100 years ago. Subsidy-driven overcapitalisation has led to the 'fishing down' of marine food webs, with mean trophic levels of catches now significantly lower than 50 years ago. Secondly, the bycatch of non-target fish species and other marine creatures puts significant pressure on the system as a whole. This is further increased by high discard rates and associated increases in nutrient load. Thirdly, commercial fishing activities are also responsible for the damage to sensitive habitats, such as cold water coral reefs and sea grass beds. In addition to marine fisheries, mariculture also has environmental implications, mainly associated with high nutrient and chemical inputs, as well as with the intentional or non-intentional introduction of non-native, genetically modified and/or diseased species. Together these phenomena indicate worrying changes in ecosystem function and resilience[9].

6 OSPAR Recommendation 2003/3, and at the 2002 Fifth International Conference on the North Sea; Joint OSPAR/HELCOM Declaration (June 2003).
7 The WWF defines ecological footprint as '[comparing] renewable natural resource consumption with nature's biologically productive capacity. A country's footprint is the total area required to produce the food and fibres that country consumes, sustain its energy consumption, and give space for its infra-structure'. European countries are ranked as indicated on http://www.nationmaster.com/graph-T/env_eco_foo/EUR
8 The information is largely based on the EEA's indicator-based assessment of Europe's water (2003), as well as a series of State of the Environment Reports for Europe's Regional Seas (see References).
9 See www.seaaroundus.org for detailed numerical and mapping of data.

Pollution can have multiple causes including inputs of chemical or organic substances and solid wastes. Eighty per cent of all pollution in the marine environment is thought to come from land-based activities (CSMP, 2001; UNEP/GPA, 2002). Compared to many other areas of the world, some of Europe's seas have received significant discharges of nuclear material, notably as a result of the Chernobyl accident and nuclear reprocessing on the French and UK Atlantic and Irish Sea coasts. Despite some improvements, 10 per cent of Europe's coastal bathing waters do not meet non-mandatory or, in the case of the EU, mandatory thresholds for physical, chemical and microbiological parameters (EEA, 2003).

Eutrophication is caused by excessive inputs of nutrients, notably nitrogen and phosphorous. Inputs can be as run-off from agricultural land, as atmospheric deposition of NO_x (including ship emissions), or from municipal and industrial sewage. Toxic algal blooms can be a consequence.

Shipping – it is estimated that approximately 30,000 ships with tonnage at or above 250 gross registered tonnes (or roughly half of the world fleet) operate in European waters in a given year. Operational and accidental oil spills are one of the key pressures associated with marine transport. Litter and atmospheric pollution are also a concern. In 2000, for instance, emissions from European shipping sources accounted for roughly 2.6 million tonnes of SO_2 and 3.6 million tonnes of NO_x. Despite this, it is considered the most environmentally friendly mode of transport, if all measures and legislation are enforced (NERA, 2004).

Coastal development and tourism – the drivers for coastal erosion and decline are multiple, and many are industrial and/or tourism related. In the EU, some 25 per cent of the coast is subject to erosion (EEA, 1999) and 86 per cent of Europe's coastlines are at high or moderate risk due to unsustainable management (UNEP, 1997; EEA, 1999).

Aggregate extraction and dredging include coastal sand and gravel extraction, navigation channel dredging, and mineral mining. Annually, 43 million m^3 of sand and gravel are extracted from the North-East Atlantic and the North Sea.

Invasive aquatic species – about 660 non-indigenous marine species have been introduced and have established themselves in European coastal waters (EEA, 2003). The rate of introduction is now thought to be decreasing for all European seas, except for the North-East Atlantic.

Climate change – species distribution and abundance are usually dependent on natural, long-term climate fluctuations. However, these natural patterns are increasingly affected or superseded by man-made climate change.

2.4.2 The North-East Atlantic

The wider Atlantic is characterised by open ocean and deep seas, reaching a depth of 5,800 metres. The Azores Archipelago forms the only land mass in the wider Atlantic. Cold water originating from the Nordic seas, Labrador seas, and the Mediterranean Sea forms the North Atlantic deep water, which drives the global thermohaline circulation. This cold water mass is key in driving regional production and influencing global climate patterns.

In addition to open ocean, the North-East Atlantic also comprises the continental shelf region around Ireland and the Bay of Biscay, and the partly enclosed Irish Sea. The biological and hydrological conditions in these continental waters are markedly different from those of the wider Atlantic. The Irish Sea is characterised by strong tides and fast exchanges of water, the Bay of Biscay is influenced by strong up-welling of cold water along parts of the coast, and the Gulf Stream exerts a strong influence.

The Atlantic region exhibits a distinct north-south biodiversity gradient, with benthic and pelagic biodiversity increasing towards the south (OSPAR, 2000). The highly productive continental shelf and shelf edge represent important feeding grounds for fish, birds and marine mammals, as well as rich commercial fishing grounds. Biodiversity hotspots are also found in the deep sea, notably around carbonate mounds, seamounts, hot vents and the Mid-Atlantic Ridge. These underwater elevations are associated with high endemism, and may serve as stepping stones and places of refuge for more mobile marine species. Extensive cold water coral reefs appear to be widely distributed in the deep sea of the North-East Atlantic, particularly at the shelf break. Deep-water species are characteristically slow growing and late maturing, and thus particularly sensitive to exploitation and damage.

The catchment area of the North-East Atlantic covers 700,000 km^2, significantly less than other marine catchments in Europe. Moreover, the catchment has much lower population densities overall, with high densities concentrated only around the Irish Sea. As a consequence, the Irish Sea is affected by industrialisation and urbanisation along both the English and Irish coasts.

2.4.2.1 Drivers and Pressures in the North-East Atlantic

Drivers and pressures are ranked loosely in order of importance, based on the OSPAR Quality Status Report for the wider Atlantic and Celtic Seas. That said, this area is extremely heterogeneous, which means that ranking is very difficult.

Fishing and mariculture – total annual catches in the North-East Atlantic are estimated to be around 10.5 million tonnes (NEAFC). For the Celtic Seas, the average annual landings for 1990–1995 amounted to 926,000 tonnes. The main fisheries target redfish, herring, mackerel, blue whiting, and, more recently, deep-sea species. The fishing for deep-sea fish raises particular concerns with regards to impacts on non-target species and the physical damage to benthic habitats. In the Bay of Biscay, mixed species fisheries with low selectivity catch significant quantities of juvenile fish. Discard rates in bottom trawl fisheries, for instance, can be as high as 59 per cent. Mariculture, in particular salmon farming, has increased in the last two decades, with activities concentrated in coastal waters of Scotland and Ireland.

Pollution in the wider Atlantic results mostly from direct inputs from shipping, mainly associated with exchanges of ballast waters, permitted and unregulated discharges of waste water and biodegradable material, discharges from offshore installations, atmospheric deposition, and, around the Azores, municipal discharges. In the Irish Sea, most pollution originates from land-based sources. That said, gas and oil industries, an important economic sector in the region, and shipping also contribute significantly to pollution levels.

Climate change is projected to bring about a surface air temperature increase of around 1.5 degree, a sea level rise of 0.5 metres and a general increase in storminess and rainfall (OSPAR, 1999). It has been suggested that global climate change may have an effect on oceanic currents, such as the Gulf Stream. If this was the case, a complete breakdown or shift of Atlantic systems may be the result. Evidence and predictions are still insufficient. Increased seawater temperatures also appear to be responsible for the appearance of tropical fish along the Iberian coast and the south-eastern shelf of Biscay.

Costal development and tourism – the Azores have a growing tourism industry, which causes the local population to triple seasonally (OSPAR, 2000) and results in increases in cruise ship traffic and demands on ports. The Bay of Biscay and the Irish Sea basin are also significantly affected by coastal development. Coastal erosion is also a problem in this region.

2.4.2.2 State of the North-East Atlantic

Due to the vastness and great depth of the North-East Atlantic, its environmental state is even more difficult to assess than that of other regions. It is clear, however, that stocks of cod, hake, saithe, whiting, plaice and sole are now outside safe biological limits due to unsustainable harvesting (ICES, 1999). Over 70 per cent of the commercial fish stocks are over-fished (EEA, 2001). For 40 of the 60 commercial stocks the fishing pressure is believed to be unsustainable, at least in some areas (OSPAR, 1999). Rates of bycatch of harbour porpoise in certain fisheries are also thought to be unsustainable. Intensive trawling for *Nephrops* in Irish waters has lead to disturbance of the benthos, including the destruction of burrows and burrow openings of the *Nephrops* themselves. Little is known about the state of an estimated 1,000 un-exploited fish species, including sharks, rays and skates.

Physical damage from fishing activities to benthic communities in the shallow coastal waters, as well as to cold water coral reefs, deep sea sponge aggregations, hydrothermal vents and communities around carbonate mounds, has been documented and is thought to be widespread. The full extent of the damage and its consequences are still unknown. The threat to cold water coral reefs, however, is considered so pressing that an *ad hoc* Committee has been set up within the context of the International Coral Reef Initiative (ICRI) – a voluntary, informal, international partnership between governments, international organisations and non-governmental organisations. Moreover, in 2003, the European Community adopted a permanent trawling ban around the Darwin Mounds, an area of sand volcanoes north-west of Scotland that feature some of the best coral communities known in Community waters (Council Regulation 1475/2003).

The impacts of pollution on the wider Atlantic are quite different to those on the semi-enclosed Irish Sea or the continental shelf area of the Bay of Biscay. The wider Atlantic, in relation to its surface area and volume, has a relatively short coastline and is dominated by oceanic currents that maintain a constant through flow of relatively unpolluted waters. As a result, eutrophication and chemical pollution are of lesser significance here than, for example, in the Irish Sea. By contrast, the Irish Sea receives water from a large, highly industrialised and heavily populated catchment area. Major ports and industrial facilities and dense maritime traffic take a heavy toll. In the last 30 years, there have been 18 accidents in the North-East Atlantic, with each spilling over 5,000 tonnes of oil. Even so, compared to other semi-enclosed seas, the Irish Sea is only moderately affected by eutrophication and water pollution due to its highly dynamic hydrology. Salmon farming causes localised pollution, in particular along the coasts of Ireland and Scotland. Although the Bay of Biscay is generally relatively unaffected by pollution, toxic algal blooms are widespread, with incidences of acute shellfish toxicity caused by amnesic toxins, diarrhetic toxins and paralytic toxins.

The Irish Sea Pilot has examined some of the multi-use-multi-impact pressures on the Irish Sea basin, with the principle aim of developing a strategy for marine nature conservation that could be applied to all UK waters, and with international collaboration also in adjacent waters. The work has included a scooping study on marine spatial planning.

2.4.2.3 Are key targets being met in the North-East Atlantic?

- ↓ At least 60 per cent of fish stocks have to be restored to levels that can meet maximum sustainable yields.
- ↓ Biodiversity trends are unclear, although some are thought to be declining (eg sharks). Information is primarily available for the coastal zones.
- ↓ Despite due reference in policy statements and EU legislation, no significant progress has been made towards applying an ecosystem-based approach. Potential EU legislation on the marine environment could represent the biggest step towards more integrated management. OSPAR is aiming to prepare a concept and methodology for the application of the ecosystem-based approach by 2005, and a full set of management measures consistent with it by 2010.
- → A regular process for reporting on the state of the environment is still missing, although some progress has been made within OSPAR and ICES to provide regular assessments. The OSPAR Commission has adopted a Joint Assessment and Monitoring Programme (JAMP), and published its first assessment in 2000.
- → Progress in addressing land-based pollution has slowed down.
- → The first set of marine protected areas has been agreed under the EU's Natura 2000 scheme. However, these are primarily located in the coastal zone, with progress lacking for offshore areas. It does not look as though regional targets will be met.
- ↑ Following a number of accidents, the legal framework for safety at sea has been tightened.
- ↑ Good progress has been made in finalising a list of threatened or declining species and habitats under OSPAR, with the aim to develop measures for halting their decline. In the EU, progress in developing an action plan for halting biodiversity loss is moderate to slow; although commitments have been made to implement Natura 2000 in the marine environment by 2008.

2.4.3 The North Sea

The waters of the North Sea consist of a mixture of North Atlantic waters, received mainly from the north and through the English Channel, and of freshwater input from a catchment area that includes 18 European States. The North Sea is comparatively young and characterised by large, shallow areas of tidal mud flats in the south, notably the Wadden Sea. It is deeper in the north and east. The North Sea is one of the most productive sea areas in the world (EEA, 1999), with fish biomass estimated at 10 million tonnes (EEA, 2002).

The North Sea hosts around 230 species of fish, 31 species of breeding seabirds, 16 cetaceans and 3 species of seal. The inter-tidal flats of the Wadden Sea contain few species, but are extremely productive, with up to 10 million birds feeding in the region each year. The catchment area of the North Sea (850,000 km^2) is one of the most densely populated areas in the European Union (EEA, 1999). As a result, the region faces a considerable human footprint, with significant consequences for its marine life.

2.4.3.1 Drivers and Pressures in the North Sea

Drivers and pressures are ranked loosely in order of importance, based on the OSPAR Quality Status Report for the North Sea.

Fishing and mariculture – the North Sea is one of the world's most important fishing grounds. The combined landings of different species in 1999 amounted to 2.3 million tonnes (EEA, 2002). Thirty to forty per cent of the biomass of the commercial species is removed each year. The total fishing effort for 1995 was estimated at 2.25 million hours (OSPAR, 2000). Other marine living resources, such as kelp and mearl, are also exploited. Bycatch is a major concern, with around 7,000 small cetaceans caught every year. Moreover, 500,000 tonnes of fish per year are discarded in the beam trawl and roundfish fisheries alone. Mariculture is expected to stabilise rather than grow, primarily due to environmental legislation restricting methods of production and increases in production cost.

Pollution – discharges from 475 offshore installations amount to 16,000–17,000 tonnes of oil per year (EEA, 2002). Overall, discharges of oil could be as high as 210,000 tonnes per year. Dumping of munitions at sea, including chemical weapons, took place after World War I and II. Considerable efforts have been made to reduce discharges of sewage, industrial effluents and agricultural run-off.

Eutrophication is most evident in estuaries and fjords, as well as in the Wadden Sea, the German Bight, Kattegat and eastern Skagerrak. Major rivers, such as the Rhine, Elbe, Weser, Ems and Thames, contribute to the nutrient loading of the North Sea. Since 1985, a significant reduction in the total input of phosphorus has been recorded, but there has been no discernible reduction in the overall nitrogen input (OSPAR, 2000).

Shipping – the North Sea is one of the most frequently traversed sea areas of the world, with around 270,000 ships entering the main 50 ports in 1996 (EEA, 2002). Two of the world's largest ports are situated on the North Sea coast. The loss of cargo bears particular dangers, as 50 per cent of goods transported by sea are classified as hazardous (OSPAR, 1999). In 1994, eleven per cent of accidents worldwide (11 in total), which entailed water pollution, occurred in the North Sea. In just one of these accidents, 84,700 tonnes of crude oil and 1,600 tonnes of other types of oil were spilt.

Waste and litter – an estimated 70,000 m^3 of litter are received by the North Sea per year, with a total of 8,600 tonnes in the Dutch sector alone (OSPAR, 1999). Of this, 95 per cent consists of non-degradable plastics, most of it generated on passenger ferries.

Invasive aquatic species – more than 80 species have been introduced by sea currents, ship ballast water, the importation of fish and shellfish, mariculture and on the hulls of ships.

Climate change – since 1988, mean sea temperatures during winter and spring have been higher than during the three previous decades. The predicted sea level rise is 60 cm in the next century (OSPAR, 1999).

Coastal development and tourism – the number of overnight stays and of berths in marinas is increasing, but measures have been taken to reduce recreational pressure. Plans for offshore wind parks are under development.

Aggregate extraction and dredging – most of the extraction of sand and gravel takes place in the southern part of the North Sea, with around 40 million m^3 in 1996 (OSPAR, 1999). Under OSPAR, derogations for the dumping of disused offshore installation can be given for footings of steel installations weighing more than 10,000 tonnes and for concrete installations.

2.4.3.2 State of the North Sea

Around a quarter of coastal areas in the North Sea are at risk from erosion (EEA, 1999). Hence, coastal defence work and land reclamation are commonly undertaken, often with severe consequences for inter-tidal and transitional brackish habitats. Only two estuaries in the Wadden Sea have retained near natural character, and 32,000 hectares have been lost from the German Wadden Sea alone.

Contamination levels are above those of the North Atlantic, with synthetic organic compounds such as PCBs, DDT, PAHs and TBT particularly widespread in the southern North Sea (EEA, 1999). Although overall pollution levels are static or decreasing, high levels of the anti-fouling compound tributyltin (TBT) have led to shell thickening and imposex in molluscs, and PAHs have been linked to increased rates of liver tumours in flatfish. While the input of certain organic pollutants has been reduced, a corresponding decrease in dissolved concentrations is not always evident (OSPAR, 1999). Severe population declines in the harbour seal, caused by epidemic virus infections, are thought to be a symptom of the animals' weakened immune system – a result of high body concentrations of toxins. PCBs are thought to impair their reproductive success, adding to the population decline.

While the diversity of offshore benthic communities in general is very high, this is not so in areas of direct industrial impact, such as offshore oil fields. Persistent effects can occur up to 200 metres away from the source and, in the case of faunal communities, may extend up to 3 km (OSPAR, 1999). Elevated levels of hydrocarbons can be found up to 8 km away from the source, with sediment levels of some hydrocarbons exceeding the environmentally acceptable limits in almost all areas where recording takes place. Despite relatively constant declines elsewhere, high oiling rates of birds occur along the Danish west coast. Levels of cadmium, mercury and copper are above minimum acceptable levels in some locations, particularly the Wadden Sea and some Nordic fjords (OSPAR, 1999).

Benthic biomass in muddy areas of the German Bight is thought to have tripled during the past decade (EEA, 2002), at least partly due to increased nutrient levels. Dense mats of green algae and severe toxic blooms of a new species of algae (*Chattonella* sp.) occurred in 1998, 2000 and 2001, killing fish and other organisms (EEA, 1999).

At various times during the past decade, stocks of cod, haddock, whiting, saithe, plaice and herring have dropped to, or below, the lowest previously recorded level (EEA, 2002). In 1999, ICES regarded eight of the fourteen most important commercial fish stocks as being outside or close to safe biological limits; the status of the remaining six was unclear. North Sea mackerel stocks collapsed in the early 1970s, and have still not recovered. Recent analyses of catch compositions show that catches of juveniles may account for up to 80 per cent in many areas and for several species – clearly an unsustainable practice. Seventy per cent of two-year old cod die before sexual maturity, 80 per cent of these as a result of fishing. In addition, annual recruitment of cod is thought to be low as a result of two decades of above average water temperatures, attributed to global climate change.

Studies show that the Dutch beam trawl fleet, which represents 80 per cent of the total beam trawl effort in the North Sea, trawls about 600,000 km^2 of the North Sea (OSPAR, 2000). Seventy per cent is trawled less than once a year, about 10 per cent more than once per year, and some areas over 400 times a year.

Wild salmon are thought to be at risk from interbreeding with non-native aquaculture escapees, with escaped salmon making up more than half of the individuals in a number of Norwegian rivers. Sea trout are significantly affected by an increase in fish lice, also attributed to fish farms.

Overall, the North Sea is affected by extreme human interference, with above average levels of regional industrialisation and urbanisation, as well as intensive exploitation of its high productivity and richness in natural resources. That said, significant improvements have been made in the past decades, particularly with respect to reducing the input of heavy metals, TBT and some organic substances.

2.4.3.3 Are key targets being met in the North Sea?

- ↓ Around 70 per cent of fish stocks have to be restored to levels that can sustain maximum sustainable yields.
- ↓ Biodiversity trends are thought to be declining, with significant declines in benthic habitats.
- ↓ Despite due reference in policy statements and EU legislation, no significant progress has been made towards applying an ecosystem-based approach. Potential EU legislation on the marine environment could represent the biggest step towards more integrated management. OSPAR is aiming to prepare a concept and methodology for the application of the ecosystem-based approach by 2005, and a full set of management measures consistent with it by 2010.
- → Progress in addressing land-based pollution has slowed down.

➔ The first set of marine protected areas have been proposed under the EU's Natura 2000 scheme. It does not look as though regional targets will be met.
↑ Following a number of accidents, the legal framework for safety at sea has been tightened.
↑ Good progress has been made in finalising a list of threatened or declining species and habitats under OSPAR, with the aim to develop measures for halting their decline. In the EU, progress in relation to developing an action plan for halting biodiversity loss is moderate to slow; although commitments have been made to implement Natura 2000 in the marine environment by 2008.
↑ State of the environment reports are compiled under various regional processes, most notably the Trilateral Wadden Sea Cooperation and OSPAR. Compared to other regions a series of environmental reports are available, with the first main publication in 1993.

2.4.4 The Baltic Sea

The Baltic Sea is the largest brackish water area in the world and consists of several sub-basins. The transition area (the Belt Sea and Kattegat) to the North Sea is narrow and shallow with a sill depth of 18 metres. In other areas, the sea reaches a maximum depth of 459 metres. At irregular intervals, often several years apart, major inflows supply large volumes of highly saline and oxygen-rich water to the Baltic Sea. Only these inflows are able to renew the stagnant bottom water of its deep basins. Otherwise, marked stratification prevents the exchange of oxygen and nutrients between the oxygen poor lower layers and surface waters. It has been estimated that it takes up to 35 years for the water in the Baltic to be entirely replenished by the North Sea. The catchment area, spanning an area four times the size of the Baltic Sea itself, is one of the most heavily developed in the world.

The species composition of the Baltic Sea reflects its brackish character, with freshwater, brackish and marine species. There are around 100 species of fish, including freshwater fish such as pike and perch, and a number of species of marine mammals, including seals and cetaceans, in the Baltic. Around 9 million birds of some 30 species are thought to overwinter in the Baltic (OSPAR, 1999). The highest biodiversity is found in the south-west of the region (840 benthic species), with a stark gradient to the north-east (only one or two benthic species). Overall, the Baltic is comparatively species poor, most likely due to its relative young age in evolutionary terms. Moreover, due to the geographical and hydrochemical characteristics, many of its species are at the limit of their distribution range. Large areas of the seabed appear lifeless, due to the prevailing lack of oxygen in deep waters.

That said, the saline inflows of 2002/2003 have caused major changes to the hydrographic conditions in the deep basins of the Baltic Proper. The deep-water (between 80 and 90m; max. depth 105m) salinity in the Bornholm Basin and south-eastern Baltic Proper increased by about 6 per cent, and oxygen levels rose significantly. However, some areas are still badly affected by hydrogen sulphide, a related phenomenon, and particularly severe oxygen depletion occurred in the late summer and autumn of 2002.

2.4.4.1 Drivers and Pressures in the Baltic Sea

Drivers and pressures are ranked loosely in order of importance, based on the Baltic Marine Environment Report (1999-2000) (HELCOM, 2003).

Eutrophication – excessive nutrients from fertiliser use and sewage, coupled with the physical and chemical nature of the Baltic Sea and its topography, are responsible for the eutrophication observed. Agricultural run-off and natural leaching cause most of the total nutrient load (EEA, 1999).

Pollution is mainly caused by pesticides, waste disposal, sewage, waste combustion, oil production and transport. A total of 132 pollution hotspots have been identified under HELCOM. Despite reductions of almost 90 per cent, concentrations of PCBs, DDT, HCH and HCB are still several times higher than in the open North Sea and Atlantic Ocean (EEA, 1999), as are organo-chlorine levels. Cadmium levels in organisms are increasing, despite reductions of levels in water. In 2001, some 2,700 tonnes of oil were spilt during a single accident at sea, killing 2,000 birds in just three days – 20 per cent of the population. Shipping accidents are, however, not the main source of oil pollution. Illegal discharges account for 10 per cent of the total input, while around 80 per cent of oil and oil residues come from installations along the coast, rivers and atmospheric deposits. The levels of radioactivity in the Baltic Sea water, sediments and biota have been declining since the Chernobyl accident in 1986, which resulted in significant fallout over the area.

Fishing and mariculture – fishing is mainly for marine species, but includes some freshwater fish. Cod, herring, sprat and salmon are the only species regulated by quotas, with cod being the most important commercial species overall. Total cod landings in 2000 were estimated at 66,000 tonnes (OSPAR, 1999), lower than in most previous years. Overfishing and bottom trawling are threats to the marine environment, with cod, salmon and eel all unsustainably fished. Relatively little mariculture is undertaken in the Baltic Sea, due to naturally unfavourable conditions. However, fish produced in hatcheries to compensate for hydrological power installations now account for more than 90 per cent of the region's salmon population.

Shipping – an estimated 500 million tonnes of cargo are transported across the Baltic Sea annually.

Invasive aquatic species – there are thought to be around 100 introduced species in the Baltic Sea; since 1990, ten new species have been introduced, including the zebra mussel (*Dreissena polymorpha*).

Aggregate extraction and dredging – dredging, the dumping of dredged materials and damming are all causes for concern, mainly for benthic communities.

2.4.4.2 State of the Baltic Sea

Eighty-three per cent of all biotopes of the Baltic Sea area are considered heavily endangered (15 per cent) or endangered (68 per cent) (HELCOM Baltic Sea Red List, 1998). Especially biotopes of coastal lake ecosystems, of pelagic waters and of coastal/terrestrial ecosystems are rated 'heavily endangered'; most of the benthic and of the pelagic biotopes are classified as 'endangered'.

Bladder wrack, a once common species in the Baltic, underwent dramatic declines in the 1970s, probably due to increased competition from fast growing algae, which thrive on the increased nutrient levels. It is thought that this and other eutrophication-induced community changes have decreased the suitability and availability of important foraging habitats. In addition, the loss of bladder wrack habitat and other marine mega flora has resulted in a decrease in shelter for many key species, including cod.

Worryingly, eutrophication now affects almost all areas of the Baltic Sea. While some reductions in nutrient levels were observed in the mid-1990s, this trend seems not to have continued (EEA, 2002). As a consequence, Baltic waters are highly turbid, with the mean water transparency decreasing by 2.5 metres in the second half of the last century (EEA, 2002). Moreover, the EEA reports that the frequency and spatial extent of toxic algal blooms is increasing. In 1997, the Baltic experienced the most extensive blooms ever recorded. The cyanobacterial blooms in 2003 were less intensive than in 2002 and 2001, but cod and other fish species still showed diminished reproductive success, with eggs dying in anoxic waters caused by the decay of excessive algal growth.

The Baltic population of harbour porpoise, which likely represents a genetically distinct population, has seen dramatic declines and may have become extinct in the Baltic Proper. The harbour seal has also decreased significantly, and only a few hundred now remain in the southern Baltic Sea (EEA, 2002). A similar trend has been noted for the otter and the grey seal, which are thought to suffer from high levels of PCB poisoning. Large numbers of female seals have been found to be infertile. The white-tailed eagle, on the other hand, is thought to be slowly recovering from the effects of pesticide pollution in the 1960s and 1970s.

In 1999, ICES regarded three (the Eastern cod stock and the salmon stocks of the main basin and the gulfs of Bothnia and Finland) of the thirteen most important commercial fish stocks to be outside or close to safe biological limits, while the status of five stocks was unclear. Only the western cod stock, the eastern herring stock and sprat were thought to be within safe biological limits. Efforts made by HELCOM and the International Baltic Sea Fishery Commission (IBSFC) to protect and restore wild salmon populations have started to bear fruit. Estimates indicate that wild salmon production increased over the period 1995-2001. However, yields of juvenile wild salmon in certain rivers are sill alarmingly low, particularly in smaller forest rivers around the Bothnian Bay and Estonia.

Bycatch rates are also a cause for concern. Up to 17 per cent of the wintering populations of long-tailed ducks and velvet scoters in the Gulf of Gdansk and eiders in the Kiel Bight are killed annually in fishing nets.

2.4.4.3 *Are key targets being met in the Baltic Sea?*

- ↓ Despite due reference in policy statements and EU legislation, no significant progress has been made towards applying an ecosystem-based approach. Potential EU legislation on the marine environment could represent the biggest step towards more integrated management. HELCOM is aiming to prepare a concept and methodology for the application of an ecosystem-based approach by 2005, and a full set of management measures consistent with it by 2010.
- ↓ Steady increases in the breeding success of top predators, such as the white-tailed eagle and the three seal species, are a positive sign. However, poisoning by heavy metals, or PCBs in particular, still remains a serious threat, with reproductive success faltering in some species.
- ↓ Invasive species are an increasing threat. Major improvements are still needed to meet the 2010 target.
- ➔ Around 23 per cent of the fish stocks have to be restored to levels that can sustain maximum sustainable yields. Overall this is a comparatively small number, and trends of recovery can be seen in some species.
- ➔ Although some good progress has been made in addressing land-based sources of pollution, this has not yet given the anticipated results. The Baltic region does not seem to be on track as regards meeting the target of achieving a cessation of inputs of hazardous substances by 2020, with the ultimate aim of reaching concentrations in the environment near background values for naturally occurring substances and close to zero for man-made synthetic substances.
- ↑ The first set of marine protected areas has been proposed under the EU's Natura 2000 scheme. These add to a suite of Baltic Sea Protected Areas (BSPAs) designated under HELCOM in 1994. Progress, although sluggish, is arguably better than in other European regional seas.
- ↑ Following a number of accidents, the legal framework for safety at sea has been tightened.
- ↑ The Baltic Agenda 21 process, initiated in 1996, has encouraged significant progress towards sustainable development; but important warning signals remain[10].
- ↑ A series of environmental reports are available, with the first main publication in 1986.

2.4.5 The Mediterranean Sea

The Mediterranean Sea is Europe's largest semi-enclosed sea. It is characterised by a narrow continental shelf (except in the Adriatic Sea), limited water exchange, high evaporation, high salinity and low nutrient levels. It receives fluvial input from four main sources: the Ebro, the Rhône, the Po and the Nile. Nutrient and biodiversity gradients both decrease from west to east.

The Mediterranean Sea links northern Europe to parts of the Middle-East and North Africa. There are 21 coastal states of diverse cultural, geographical and political backgrounds. Seven of these are Members of the European Union, with a further three aiming to join the Union in the near future. All but one coastal state are signatories to the Barcelona Convention – Mediterranean's Regional Seas Convention – and to the UNEP Mediterranean Action Plan. The European Community is also a signatory in its own right.

2.4.5.1 *Drivers and Pressures in the Mediterranean*

[Note that to the authors' knowledge, there have not been any previous attempts to rank environmental pressures according to their overall level of impact. Thus the following is based on educated judgment.]

Fishing and mariculture plays an important economic, social and cultural role in the Mediterranean. In the EU alone, Mediterranean fisheries provide employment for more than 100,000 fishermen working on board some 40,000 vessels. Approximately 90 per cent of fishing activity in the Mediterranean can be described as coastal, exerting pressures not only on the target fish stocks, but also benthic habitats and non-target species. Of the 600 known fish species, more than 100 are fished. The catch in mixed demersal fisheries can contain up to 50 species of fish in one haul. The multi-species nature of the Mediterranean fisheries has significant implications for marine food webs and for the sustainable

10 Baltic 21 Prime Ministers report (2004) http://www.baltic21.org/attachments/report_no_1_2004__5_year_report_to_prime_ministers.pdf

management of fisheries. The rate of accidental catch of turtles, mammals and birds in the Western Mediterranean increased between 1999–2000 by 90, 130 and 140 per cent respectively. Mariculture has been increasing by about 185 per cent in a decade, predominantly of shell fish (eg mussels) but including fin fish (mostly sea bream and sea bass, but more recently tuna). Increases are driven by strong market demand, and are also subsidised and promoted in some areas as an alternative to capture fisheries (Europe's Environment, 2003). Increases in intensive aquaculture have resulted in localised increases in eutrophication, and contribute to increased demand for fishmeal-based feed pellets, which in turn increases the incentives to fish wild stocks.

Invasive aquatic species enter the Mediterranean Sea through three pathways: (i) the Suez Canal; (ii) ballast discharge and hull fouling; and (iii) as escapees from aquaculture installations.

Coastal development and tourism are major and increasing pressures in the Mediterranean region, notably focused in the north-west. In 2001, the combined population of all Mediterranean coastal states was estimated to be 450 million. By 2025, the expected number of tourists is thought to rise to 235–353 million annually.

Shipping – an estimated 220,000 vessels of more than 100 tonnes cross the Mediterranean each year, equal to about 30 per cent of the total merchant shipping in the world and 20 per cent of oil shipping.

Eutrophication – the Mediterranean is one of the most oligotrophic seas in the world. However, there are significant nutrient inputs from agriculture, sewage and industrial effluents. This leads to local eutrophication, particularly near the north and west coasts of the Adriatic Sea. Eutrophication can result in toxic algal blooms and microbial contamination, leading to paralytic shellfish poisoning and other public health risks.

Pollution – although not considered a key threat in the Mediterranean as a whole, oil pollution is still a major concern, notably due to higher than average (European) levels of transportation. Transport is by tanker or pipeline. Since 1970, there have been 17 spills above 5,000 tonnes, the last of which was in 1992 (ITOPF, 2003). Between 1987 and 1996, 22,223 tonnes of oil are thought to have entered the Mediterranean Sea as a result of shipping incidents (EEA, 1999). Ten billion tonnes of industrial and urban waste (including sewage), of which only a very small proportion receives even primary treatment before discharge, are dumped annually in the Mediterranean. In the whole basin, 90 per cent of the municipal waste is still untreated.

Waste and litter – it is thought that Mediterranean coastal areas generate 30 to 45 million tonnes of household waste each year. That said, microbiological pollution and eutrophication have decreased greatly in the coastal waters of EU Member States. Increasing pressure from the tourism industry for cleaner beaches and the adoption of the EU Bathing Water Directive are thought to have helped. Non-EU countries are lagging behind EU standards. Plastic debris comprises 75 per cent of the coastal litter in the region.

2.4.5.2 State of the Mediterranean Sea

The Mediterranean supports around 10,000–12,000 marine species, of which 28 per cent are endemic to the region (EEA, 2002). Overall, this represents around 9 per cent of world seas' species richness (EEA, 1999). Included are 86 species of shark and ray (IUCN, 2004)[11], of which 29 appear on the IUCN Red List and two are considered critically endangered. The Mediterranean is also home to 3 species of turtle, 33 breeding species of water birds and 22 species of cetacean. Many species, such as the monk seal, the great white shark, and the Dalmatian pelican, as well as coastal habitats such as the *Posidonia* beds, are considered to be at particular risk. It is thought that already lost *Posidonia* beds, for instance, could only be recovered over a period of 3,000 years (EEA, 2002), if loss was halted today.

The status of a few key fish stocks is reported on annually by the General Commission for Fisheries in the Mediterranean (GCFM). In 2002, blue fin tuna, swordfish, hake and red mullet were considered overfished, as were regional stocks of anchovy, bream, horse mackerel and pilchard (EEA, 2004). Whilst most commercial demersal fish populations are considered to be out side safe biological limits (EEA, 2004), increases have been noted in the catches of certain pelagic species. This is thought to be due in part to the removal of predatory fish through overfishing, but also due to the

11 IUCN Centre of Mediterranean Cooperation www.iucn.org/places/medoffice/Noticias/sanmarino.htm

increase in nutrients entering the marine system, stimulating primary production. Further declines have been noted in *Corallium rubrum* (red coral), the date mussel (*Lithophaga lithophaga*) and some other invertebrate species. Invasive species, such as *Caulerpa taxifola*, have caused significant disruptions, for example in *Posidonia* habitats.

Eutrophication has resulted in massive phytoplankton blooms, mainly in the Adriatic, Gulf of Lion and the northern Aegean. In places, toxic algal blooms have had an impact. Centres of industrial activity and large commercial harbours represent hotspots of toxic, persistent and bio-accumulative pollutants such as TBT (EEA, 2002). Mass fatalities amongst seals and dolphins, such as those in 1987 and 1990, are thought to be a consequence. Microbial contamination levels can also be high, however the extent of the damage, not least to human health, still has to be determined (EEA, 1999). The overall concentrations of DDT and PCBs in the Mediterranean basin are reported to be much lower than the permissible limits in seafood for consumption (EEA, 1999). Data on coastal erosion on a basin scale is still missing.

2.4.5.3 Are key targets being met in the Mediterranean?

- ↓ A regular process for reporting on the state of the environment is still missing, and is made difficult by the problematic and diverse political circumstances in the coastal states. The lack of reliable data is a major concern.
- ↓ Detailed information on the status of fish stocks is missing, but indications are that trends are similar to those of other regions. Many of the stocks that have been assessed are overfished.
- ↓ Some of the EU's most critically endangered species occur in the Mediterranean. High rates of endemism mean that this region is particularly vulnerable in terms of biodiversity loss.
- ↓ Land-based pollution is still a key concern in the Mediterranean basin, despite some recent improvements. The main problems relate to poor or missing waste water treatment and agricultural run-off.
- ↓ Despite due reference in EU legislation, no significant progress has been made towards applying an ecosystem-based approach in EU waters in the Mediterranean. In non-EU coastal states, the lack of progress is even greater. The recent Strategic Action Plan for the conservation of coastal and marine biodiversity in the Mediterranean region (SAP-Bio, 2003) states that it has been devised taking 'holistic and ecosystem approaches' into account. Its implementation presents an opportunity to make significant progress.
- → Under the Barcelona Convention signatories have signed up to a Protocol concerning the Specially Protected Areas and Biodiversity in the Mediterranean (1995). This and the subsequent development of a Strategic Action Plan for the conservation of coastal and marine biodiversity in the Mediterranean region (SAP-BIO, 2003) is a first step towards developing a regional programme for halting the loss of biodiversity.
- → Following a number of accidents, the EU legal framework for safety at sea has been tightened. As early as 1976, coastal states signed up to a Protocol under the Barcelona Convention concerning co-operation in combating pollution in cases of emergency (Emergency Protocol). In 2002, this was revised and opened for signature, now called Prevention and Emergency Protocol. Real progress in enhancing maritime safety is unclear.
- ↑ There are now more than 47 Specially Protected Areas in the Mediterranean Sea, which have been protected under the UNEP Protocol (Barcelona Convention). However, many coastal states still lack specific legislation for the establishment of MPAs (EEA, 2002). Progress in protecting marine sites under Natura 2000 and the Bern Convention's Emerald network are disappointing, however.

2.4.6 The Black Sea

The catchment area of the Black Sea is five times the size of the actual sea area, covering 2 million km^2, 22 countries (including some of the new EU Member States) and 160 million inhabitants. It is the largest European catchment area. The Black Sea is entirely land-locked, with the exception of a small opening to the Mediterranean Sea. It reaches an impressive maximum depth of 2,212 metres. Almost 90 per cent of the water is anoxic and contains (naturally) high levels of hydrogen sulphide. Moreover, most of the coastal waters are eutrophic, with the Sea of Azov exhibiting the highest nutrient loading. This is not least caused by inflows of the Danube, Dneper and Dnester. The climate of the Black Sea region is subtropical, similar to that of the Mediterranean.

The coasts of the Black Sea are densely populated, with a permanent population of 16 million and on average 4 million visitors during the summer months. However, coastal wetlands still play an important role, covering around 10,000 km^2.

The biology of the Black Sea reflects its geography and morphology. The life-supporting layer of water is extremely thin compared with other marine systems. Deep-sea pelagic and benthic organisms are thus largely absent. This creates a fragile and naturally changing species composition, with 3,774 identified species in total – about three times less than the Mediterranean Sea. This includes around 1,620 species of fungi, algae and higher plants, 1,983 identified species of invertebrates, 168 species of fish and 4 species of mammal. Macro-zooplankton alone comprises around 800 species.

Despite the lower diversity, the abundance of species, total biomass and productivity of the Black Sea is much higher than that of the Mediterranean. Moreover, many species, including fish, use the region for feeding and resting during their migration, or for over-wintering. It has been estimated that as many as 25 million waterfowl find refuge in the Black Sea basin each year. Most habitats are based on sandy substrata in shallow regions, or mud in areas below 10 metres.

2.4.6.1 Drivers and pressures in the Black Sea

Top four drivers and pressures are ranked loosely in order of importance, based on information from the Black Sea Commission (2002).

Eutrophication caused by agricultural inputs, industrial effluents and poorly treated sewage is one of the key threats. The yearly nutrient input from human activities is thought to amount to 647,000 tonnes of nitrogen and 50,500 tonnes of phosphorous (Black Sea Commission, 2002). More than half of the nitrogen input is received by air. Recently, good progress has been made in most coastal states to address the main sources of nutrients.

Pollution – some 170,000 tonnes of oil products are discarded annually with sewage. In addition, riverine inputs and oil spills at sea also contribute significant amounts. Forty-nine point source 'hot-spots' for pollution have been identified, mostly near municipal wastewater treatment plants, port treatment facilities and oil terminals. Information on many pollutants is scarce. However, heavy metals such as cadmium, mercury, and lead are not thought to be a widespread problem, with elevated levels only evident near pollution 'hot spots'. Levels of persistent organic pollutants, such as PCBs, are comparatively low. DDT and similar pesticides occur at levels that indicate continued inappropriate or illegal handling of these chemicals. Radionuclide pollution is thought to have reduced gradually following the Chernobyl accident, almost reaching pre-Chernobyl levels (Black Sea Commission, 2002). Background levels are, however, twice those of the Mediterranean Sea.

Fishing and mariculture – bottom trawling has become more widespread, especially along the Bulgarian coast, causing destruction in natural mussel beds and a shift in benthic fauna. Resuspension of sediments, siltation and habitat alteration are other areas of concern. Overfishing in estuaries, particularly of the Dnieper and Dniester, has been reduced recently. However, illegal fishing may be on the increase. Fish farming is a more recent development and impacts are as yet unclear. Mussel farming, on the other hand, is common in all coastal states, except for Georgia and Turkey.

Invasive aquatic species – of 41 introduced species, 34 per cent have been imported for aquaculture purposes and 66 per cent have entered the Black Sea in ballast water or as fouling organisms on ship hulls. The number of alien species is increasing, with devastating effects on the native marine ecosystem, particularly in the Sea of Azov. The introduction of the comb jellyfish (*Mnemiopsis leidyi*), for instance, has – together with high fishing pressure – caused the collapse of the anchovy fisheries. Particularly problematic is the lack of legislation and technology to control the introduction of invasive aquatic species via, for example, ballast water.

Water management/regulation – the damming of important contributories, such as the Dnieper and Don, has led to the loss of spawning areas for anadromous species such as the sturgeon. Moreover, the drastic reduction in annual influx of freshwater, along with the extraction of cooling water for coastal installations, has resulted in hydro-chemical and biochemical changes, most evident in salinity levels and community structure. Water extraction also causes the death of several thousands tonnes of fish in water intake devices.

Shipping – a twofold increase in marine transport has been observed (Black Sea Commission, 2002). The transport of petroleum and oil products via Georgia across the Black Sea is steadily increasing, and is projected to reach over 20 million tonnes.

2.4.6.2 State of the Black Sea

The Black Sea is naturally vulnerable to disturbances. As a result of eutrophication, primary production in the Black Sea has increased and the number of species has declined. Depending on meteorological, hydrothermal and hydrobiological conditions, oxygen deficiency and related mass mortality have become an annual event in certain parts of the Black Sea.

Since the 1970s, anoxic zones have expanded more than tenfold to cover around 40,000 km^2 in 1990, almost 10 per cent of the sea surface area. This has dramatically changed the species composition, particularly in the north-western parts of the Black Sea, and has led to an increased occurrence of algal blooms. Macro-zoobenthic species on the Romanian shelf decreased from 70 to just 14 species between 1961 and 1994. While eelgrass biomass has decreased tenfold in the last two decades, the total biomass of one group of zooplankton increased from 260 tonnes in the 1960s, to 3,000,000 in the early 1980s and 17,000,000 today. During a similar time frame, an estimated 100 to 200 tonnes of living organisms per km^2 died of anoxia – a total of around 60 million tonnes of benthic organisms, including 5,000 tonnes of fish (EEA, 2002). Despite more recent improvements, future projections indicate that the Black Sea will remain the worst affected area for eutrophication in Europe. In addition, inappropriate water management, notably the extraction of cooling water, causes increasing salinity.

Pollution from the land-based municipal and industrial sectors has recently started to decline (Black Sea Commission, 2002), as has the number of accidental oil spills. Overall, the condition of bathing waters of coastal states have also been improving. However, microbial pollution in the Black Sea is still severe in many areas (CEC, 2004 draft).

Most fish stocks, already affected by pollution, have been overexploited. Species composition and average fish size have changed, with increasingly smaller fish now dominating. Fish species such as mackerel, bonito and horse mackerel in the Black Sea and pike, perch, roach and bream in the Sea of Azov have practically disappeared, with only 5 of 26 commercial species remaining in 1980 (EEA, 1999). There are, however, early signs of a slow recovery for certain stocks of small pelagic fish (Black Sea Commission, 2002). The trawling-related resuspension of sediments, siltation and habitat alteration are thought to have caused a 70 per cent decline in species diversity in trawled areas (EEA, 1999). The status of mammal populations has not been adequately assessed, although there are indications that the number of dolphins may have declined from around 1 million in the 1950s, to between 60,000 to 100,000 individuals in the 1980s (Black Sea Commission).

2.4.6.3 Are key targets being met in the Black Sea?

- ↓ Overall biodiversity trends are unclear, and are in many ways influenced by the evolutionary and hydrological conditions in the Black Sea. On the whole, however, biodiversity seems to be declining.
- ↓ Some stocks have come close to biological extinction. The majority of stocks will require significant efforts to support recovery.
- ↓ There has been no significant progress towards applying an ecosystem-based approach. That said, a recent first step was made in adopting the Protocol on Biodiversity and Landscape Conservation (2003) under the Black Sea Convention. The purpose of this protocol is ‘to maintain the Black Sea ecosystem in the good ecological state and its landscape in the favourable conditions, to protect, to preserve and to sustainably manage the biological and landscape diversity of the Black Sea in order to enrich the biological resources’ (Art. 1).
- → A regular process for reporting on the state of the environment for the whole basin has not yet been established. That said, parties to the Black Sea Convention are expected to report annually to its Commission, and the first basin-wide assessment was published in 2002, covering the period 1995–2000.
- → Limited progress has been made in addressing land-based pollution. Poor wastewater treatment remains a particular problem.
- → The first marine protected areas are being designated, and the Ukraine is reported as having identified the first marine corridor for protection (Black Sea Commission, 2002). It is difficult to assess overall progress, however.
- → In 1994, signatories of the Black Sea Convention adopted the Protocol on co-operation in combating pollution of the Black Sea marine environment by oil and other harmful substances in emergency situations. Subsequent progress is difficult to assess.

2.5 FISHING IN AN ENVIRONMENTAL CONTEXT

Fishing is one of the most widespread human activities in the marine environment. It both affects and is affected by the state of the marine environment. Fishing yield, for instance, is directly linked to changes in the level of biomass and trophic structure. On the one hand, removing large quantities of fish, whether of one or multiple species, reduces diversity at species level and may affect dependent organisms, hence changing entire communities temporarily or permanently. On the other hand, marine pollution, including from land-based sources, may affect both the quality and quantity of fish available for human consumption. A decline in yield may, for instance, occur when suspended or dissolved pollutants, such as tributyl tin (TBT) or polychlorinated biphenyls (PCBs), result in a decline in reproductive success or faltering immune systems of fish. The nature of environmental and sectoral interactions is complex and manifold. Conversely, sound scientific proof for causal links is often sparse and evidence anecdotal. The following paragraphs are merely intended to frame the discussions on this topic.

2.5.1 Fishing as the Driver for Environmental Decline

While the overall yield of capture fisheries (including freshwater fisheries) seems to have remained fairly stable in recent years, yields of marine fisheries are decreasing (see Figure 3). Fishing effort, by comparison, has increased as new technologies have provided the means for more intense exploitation. Overall, capture fisheries result in the cumulative removal of significant biomass – with a total global marine catch of around 67.9 million tonnes in 2001 (excluding China)[12].

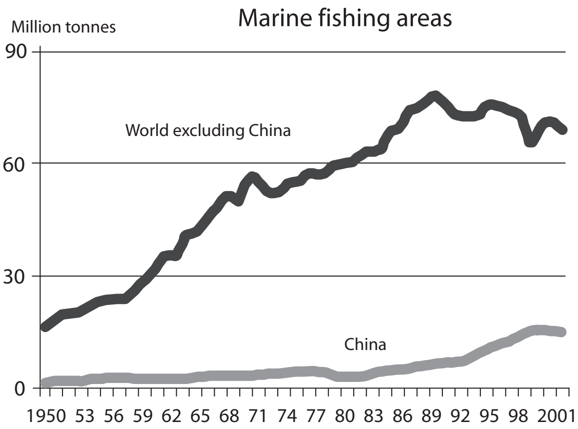

Figure 3. Marine fisheries yields.
Source: FAO, 2003

About 47 percent of the main stocks or species groups are fully exploited and are therefore producing catches that have reached, or are very close to, their maximum sustainable limits. A further 18 per cent of stocks or species groups are reported as overexploited, and 10 per cent are significantly depleted or recovering from depletion. Thus, more than two-thirds of world marine fish stocks offer no reasonable expectations for further expansion (FAO, 2002).

In the North-East Atlantic, 70–100 per cent of all commercial fish stocks are considered overfished, with 77 per cent in the North Sea and 75 per cent in the Baltic Sea (see Figure 4). Figures from the Mediterranean are somewhat less reliable, but around 69 per cent of commercial fish stocks are thought to be overfished. While almost all round fish stocks have declined and fishing pressure is currently not sustainable, small pelagic and industrial species are in better condition overall but need to be subject to reduced fishing rates. Deep-sea species also show signs of overexploitation. However, stocks of any one species are not equally at risk in all areas. Main concerns include:

- cod stocks in the North Sea, Skagerrak, Irish Sea and waters west of Scotland are now so depleted that the chance of a collapse must be seriously considered. ICES is recommending a closure of all fisheries targeting cod in these areas. Since cod is also a bycatch in mixed fisheries, such as haddock, whiting, flatfish, shrimp and prawn fisheries, these fisheries should also be closed unless they can demonstrate that they are not catching any cod;
- the dramatic decline of hake stocks caused alarm leading to cuts of total allowable catch (TAC) of up to 50 per cent in 2001; and
- whiting TACs were cut to 35 per cent for the west of Scotland in 2001.

12 The FAO (2003) reports that in 2001, total fishery production was reported to be 130.2 million tonnes, of which 37.9 million tonnes came from aquaculture. World capture fisheries production decreased slightly from 95.4 million tonnes in 2000 to 92.4 million tonnes in 2001. However, fluctuations in capture production in recent years were mainly due to variations in catches of Peruvian anchoveta which are influenced by the El Niño circulation. In fact, global capture production excluding anchoveta has remained fairly stable since 1995. Aquaculture production reached 37.9 million tonnes by weight (US$ 55.7 billion by value) in 2001, up from 35.5 million tonnes (US$ 52.1 billion) in 2000.

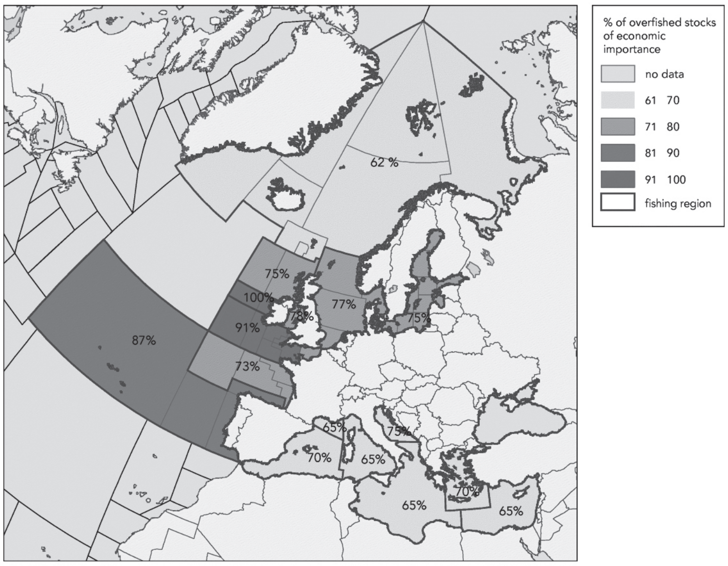

Figure 4. Percentage of overfished stocks of economic importance. Source: EEA, 2002

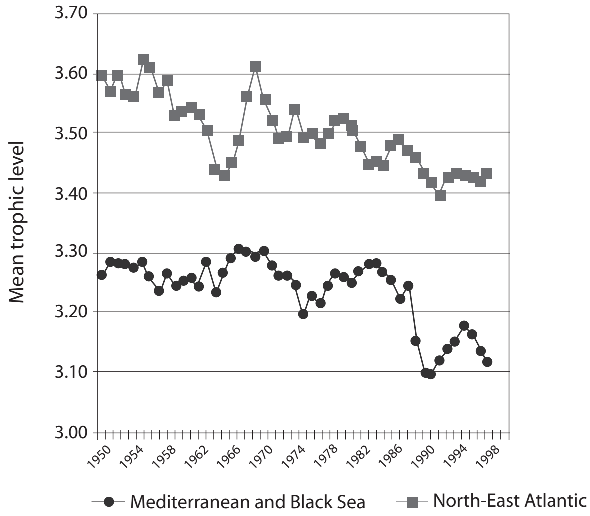

Figure 6. Mean trophic level of fisheries landings for the North-East Atlantic, Mediterranean and Black seas, 1950–1998. Source: EEA, 2003

In the wider Atlantic area, knowledge of the biology of most targeted species (mainly deep-sea species) is insufficient, but it is suggested that stocks can sustain low rates of exploitation. In the Mediterranean region, demersal stocks are outside safe biological limits. Small pelagic stocks in the same area exhibit large-scale fluctuations but are not fully exploited anywhere, except for the anchovy in the Algerian and Cretan seas. Anchovy stocks in the Balearic, Adriatic and Ionian seas are considered safe. Only two demersal and two small pelagic stocks are monitored by GFCM with a limited spatial coverage. The fish stock status differs between 2001 and 2002 as new areas are now in use, and only stocks with definite assessment by GFCM have been included.

While statistics for deep water fisheries are insufficient, it is thought that catches of oceanic species have almost tripled from 3 million tonnes in 1976 to 8.5 million tonnes globally in 2000 (see Figure 5). Many deep-sea species are thought to be highly vulnerable to overexploitation, due to their slow growth rates, late maturity and low reproductive capacity. Rates of endemism are also thought to be high amongst deep-sea species. Many deep-water fish reach an age of over 30 years, and some species, such as the orange roughy, can reach up to 150 years of age.

In addition to the obvious effectsh on fish biodiversity, the removal of significant biomass is considered to affect food webs. The 'fishing down marine food webs' is plainly evident from fish catch statistics, which show a stark downward trend in mean trophic level of landings for the North-East Atlantic, Mediterranean and Black Sea (see Figure 6). In addition, intense selection has favoured smaller fish, which mature earlier, possibly leading to irreversible changes in the genetic make-up of entire stocks.

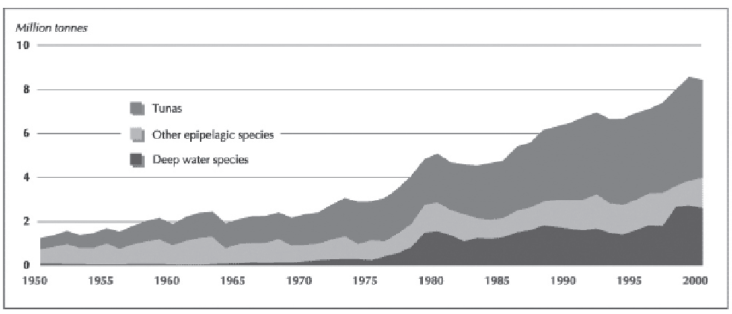

Figure 5. World catches of oceanic species occurring principally in high seas areas. Source: FAO, 2002

Non-target species are also directly affected. Annually, more than 20 million tonnes are killed worldwide in fishing gear (UNEP, 2004). Fishing for wild shrimp, for instance, represents 2 per cent of global seafood but 33 per cent (1/3) of total bycatch. Illegal longline fishing, which may involve lines up to 80 miles long with thousands of baited hooks, is also thought to cause excessive bycatch, killing over 300,000 seabirds annually, including 100,000 albatrosses. The annual global mortality of small whales, dolphins and porpoises in bycatch is estimated to be more than 300,000 individuals. Sharks are killed as bycatch, and for their meat and fins. As many as 100 million sharks are hunted and killed each year (UNEP, 2004).

As well as a negative impact on non-target species, many fishing techniques also have the potential to cause significant disturbance or damage to benthic habitats on both soft and hard substrates. According to ICES, the scientific information on the marine environment presently available is *'inadequate to evaluate the impact of fishing practices on sensitive habitats'* (ICES, 2002). That said, it is clear that trawling (notably beam trawling), dredging and the use of other towed gears are causing most havoc. In the North Sea, for instance, widespread trawling has resulted in a shift in benthic diversity and species composition from larger, more long-lived species to smaller, more opportunistic ones (ICES, 2002).

It is estimated that the world's trawling grounds could total approximately 20 million km^2, or nearly five times the size of the EU (CSMP, 2002). While areas on the continental shelf have historically come under the greatest pressure from trawling and dredging, damage to deep-water corals and sponge formations is now also widespread. It has for instance been estimated that between one third and one half of Norway's Lophelia reefs are damaged or affected by fishing (ICES, 2002). Australian scientists suggest that a single trawl pass removes between 5 to 20 per cent of benthic animals.

In addition to capture fisheries, mariculture can also be a significant driver of environmental decline. Mariculture production has steadily increased to 5 million tones in 2001 (excluding China) (FAO, 2002). In 1970–1999 there has been a four-fold increase in aquaculture production (fish and shellfish) in the 18 European countries assessed by the European Environment Agency (EEA, 2002). Marine fish made up the largest proportion of their aquaculture production in 1999. The highest aquaculture production figures per km of coast were recorded for the Netherlands (296.4 tonnes/km), France (105.2 tonnes/km), Spain (85.1 tonnes/km), Germany (79.6 tonnes/km) and Italy (54.9 tonnes/km). These figures, however, cover very different species and production systems. Estimates for the marine fish culture sector in the Shetlands suggest that the total annual discharge of ammonia to local waters is 2,100 tonnes. This is based on an annual production of 30,000 tonnes of fish, consuming an average of 1.4 tonnes of feed per tonne of fish produced, giving an annual input of 42,000 tonnes of pellets (British Marine Finfish Association, 2002).

Mariculture is also responsible for the introduction of farmed and/or alien species, notably through farmed fish escapees and contamination with pathogens. This may lead to competition, cross-breeding with wild species, and increased infection rates, all of which may lower the survival rates of wild fish. However, fishing is not the only source of introduction of alien species (see below).

2.5.2 Fishing Impacts in the Context of Other Pressures on Marine Ecosystems

The impact of fishing on marine ecosystems has to be considered in the context of other environmental pressures. Sometimes it may have cumulative effects, exerting the same type of direct or indirect effect as other human activities. In other situations, fishing may be 'rivalled' by pressures with altogether different effects on the marine environment, such as climate change. All pressures have to be considered, if the state of Europe's regional seas is to be improved long-term. It may, however, be possible to prioritise, depending on regional circumstances.

Climate change models (presented in FAO, 2002), for instance, predict the increase of stocks such as Atlantic and Pacific herring, Atlantic cod, South African sardine and Peruvian and Japanese anchovy until 2015, but thereafter forecast a decrease (see Figure 7). During the same period, the total catch of species such as Japanese, Peruvian, Californian and European sardine, Pacific salmon, Alaska pollock and Chilean jack mackerel is expected to decrease until 2015, but to increase after that. These predicted changes would be induced by environmental and man-made climate change, irrespective of fishing pressure. Similar effects have been studied in the North Sea. Recent research results indicate that climate-change induced fluctuations in plankton abundance and distribution have resulted in changes in cod recruitment in the North Sea (Beaugrand *et al*, 2003).

Shipping and fishing have cumulative effects with regards to sea transport. In the Mediterranean, an estimated 30 per cent of the total merchant shipping in the world and 20 per cent of global oil shipping exert strong pressures (EEA, 1999). The level of disturbance from the movement of fishing vessels is likely to be insignificant in comparison.

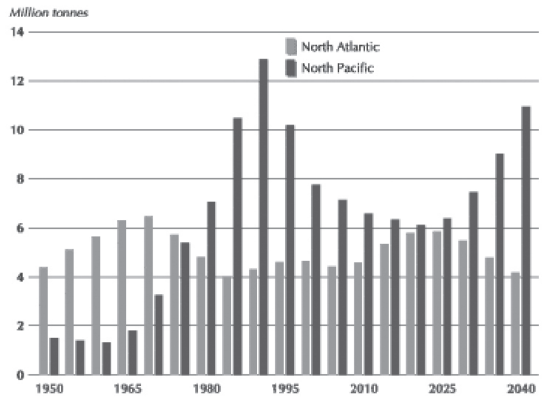

Figure 7. Observed (1951–1998) and forecast (2000–2040) catch changes for selected major commercial species in the North Atlantic and North Pacific. Source: FAO, 2002

When considering the problem of invasive species, fishing practices are not the only factor to consider either. The primary mode of arrival of alien species in European seas is shipping (154 species), with aquaculture coming only second (124 species) (EEA, 2003). The mode of arrival also varies between the regional seas. Shipping and aquaculture are thought to contribute equally to the number of alien species in the Black Sea and the Baltic Sea, whereas shipping is the major vector of arrival in the North Sea and aquaculture in the Atlantic Ocean.

2.6 RESPONDING TO THE CHALLENGES

The 1980s saw a shift away from an end-of-pipe approach to environmental protection, towards more pre-emptive measures, particularly in the field of pollution. It was further accepted that environmental pressures are usually of a transboundary nature, and thus require multilateral action and commitment. Today, multiple regional and international agreements, and an extensive body of national and European Community legislation are in place to encourage environmental protection and sustainable resource use. Some are directly aimed at the protection of marine resources, including for instance legislation under the Common Fisheries Policy, others contribute more indirectly, for instance by regulating fertiliser use and thus harmful agricultural run-off. Almost without exception the rules follow a sectoral approach resulting in a ‘patchwork of policies’ (CEC, 2002). Important exceptions are arguably the four Regional Seas Conventions (OSPAR, HELCOM, Barcelona and Black Sea).

While OSPAR started off on a more sectoral basis – with the 1974 Oslo Convention for the Prevention of Marine Pollution by Dumping from Ships and Aircraft and the 1978 Paris Convention for the Prevention of Marine Pollution from Land-Based Sources – it now has a wide range of competencies in the areas of land-based and sea-based pollution, protected area networks, threatened species and habitats. The other three conventions generally follow a similar multi-sectoral approach, with some variation in focus. None of the conventions, however, has competence over fisheries.

It is important to note that in the case of international and regional conventions, the success of measures usually relies on the willingness and ability of signatory states to implement and enforce appropriate national rules. In the case of the European Union, on the other hand, legislation is binding on the Member States. While the transposition, implementation and enforcement of Community rules may not be uniform across the EU, their application carries the same weight as national legislation.

EC legislation includes sectoral rules on:

- *hazardous substances* – such as Directive 76/769 relating to restrictions on the marketing and use of certain dangerous substances and preparations;
- *eutrophication* – such as Directive 91/676 concerning the protection of waters against pollution caused by nitrates from agricultural sources;
- *fishing* – such as Regulation 973/2001 concerning the use of purse seines to target dolphins;
- *chronic oil pollution* – such as Directive 2000/59 on port reception facilities for ship-generated waste and cargo residues;
- *maritime transport* – such as Regulation 417/2002 on the accelerated phasing-in of double hull or equivalent design requirements for single hull oil tankers; and
- *radionuclides* – are regulated to safety rules under the Euratom Treaty.

Important legislation that goes beyond a purely sectoral approach include the EC habitats Directive (92/43) and the birds Directive (79/409) aimed at the protection of biodiversity in the EU, including marine areas. However, the mechanisms for how these Directives interact with EU fisheries policy have not yet been fully established. It is the responsibility of the

Member States, on the one hand, to fulfil the requirements of the habitats and birds Directives. On the other hand, competence for the conservation of fisheries resources lies with the Commission under the Common Fisheries Policy (CFP). As a consequence, it is often unclear who is responsible for regulating potentially damaging fishing activities in protected areas. In the same vein, the water framework Directive (2000/60) establishes ecological and water quality standards for inland and inshore waters that go beyond a strictly sectoral approach. Similarly, Directive 76/160 on the quality of bathing water also sets water quality standards, aimed in this case at the protection of the health of the public.

Faced with increasing evidence of overfishing on the high seas, efforts to manage high seas fisheries accelerated, and are continuing today with the development of new Regional Fisheries Management Organisations (RFMOs) and the revitalisation of existing organisations. Moreover, a series of Codes of Practice is aimed at improving environmental conduct in certain sectors. This includes, for instance, the ICES Code of Practice on Commercial Extraction of Marine Sediments (1992).

The concept of Marine Protected Areas has been applied in all the regional seas, although there is to date only one High Seas MPA, designated in the Mediterranean under the Barcelona Convention.

2.7 CONCLUSIONS – ARE WE ON TRACK?

Despite some improvements, notably in relation to chemical loading, the state of Europe's regional seas is overall unstable. The main pressures are the same in all areas, although the significance of each varies by region.

The top four pressures are:

i. *Fishing and mariculture* have been ranked[13] as the primary threat in all but two regions, the Baltic and Black seas. Many commercial fish stocks in European waters are not assessed. For those that are assessed, 33–60 per cent of commercial stocks in the North-East Atlantic are outside safe biological limits, with the Baltic and West Irish Seas in a somewhat better shape than others. In the Mediterranean, the percentage of stocks recorded to be outside safe biological limits range from 10 to 20 per cent, but data are too insufficient to make a good assessment.
ii. *Eutrophication* – input from diffused agricultural sources and urban waste water still remain a problem. There have been significant decreases in riverine and direct loads of nitrogen and phosphorus into the Baltic and North Seas since 1985. However, no change in trend is observed in winter surface nitrate concentrations in the Greater North Sea. The Mediterranean Sea generally has low phosphate concentrations, except for some hot spots along the west coast of Italy. The Black Sea shows no decrease in phosphate concentrations, with the exception of Turkish waters at the entrance to the Bosphorus (EEA, 2003). The threat of eutrophication ranks first in the Baltic and Black seas.
iii. *Pollution* – in all but one of Europe's seas, pollution ranks second amongst the threats, topped in most cases only by fishing pressures. Violations of existing regulations aimed at preventing oil discharges at sea are frequent in all European seas (CEC, 2002). Accidental oil spills recorded during 1990–1999 amounted to 346 spills of over seven tonnes, totalling 830,000 tonnes. A few large spills dominate the statistics. The number of illegal oil spills has slowly decreased in the North Sea, but remains steady in the Baltic Sea. Limited, if any, aerial surveillance is conducted over the Mediterranean and the Black seas. Operational discharges from refineries are decreasing in most or all regions. Direct and riverine inputs of cadmium, mercury, lead, zinc, lindane and PCBs into the North-East Atlantic have decreased. In countries of Central and Eastern Europe, reductions of land-based pollution have been as high as 75 per cent in the period 1992–2000, mainly due to changes in their economy. Atmospheric inputs of cadmium, lead and mercury into the North Sea have also decreased, as have the loads of many hazardous substances to the Baltic Sea. Information for the Mediterranean and Black seas is too limited.
iv. *Invasive aquatic species* – the Mediterranean Basin has received about 500 alien species, mostly via the Suez Canal (opened in 1869), while less than a hundred are known to have arrived in the Atlantic, North Sea and Baltic Sea. After fishing, invasive species are thought to be the second biggest threat to the Mediterranean Sea.

In addition, climate change and coastal development have the potential to significantly affect marine ecosystems at large

13 For the purpose of this briefing we have based the rankings on publications by OSPAR and the Black Sea Commission. For the Mediterranean, no formal ranking of pressures and drivers could be found in the available literature, so that our assessment is based on a general literature review and educated judgment.

geographical scales. The International Panel for Climate Change, in their latest assessment, warns that *'a reduction of the Atlantic current is a likely response to increased greenhouse gas forcing'*.

The overall quality of coastal bathing waters has improved throughout the 1990s, and certain top predators (eg the white-tailed eagle) are beginning to recover. At the same time, however, fishing pressures are maintained at almost unchanged high levels, new gears are being developed and new stocks exploited, leading to more failing stocks and increasing habitat destruction.

On the whole, Europe is still far from meeting its WSSD and regional targets, the latter often being tougher than international commitments. Too often this is despite an extensive body of environmental legislation, leading to the conclusion that existing rules and their enforcement (or lack thereof) are not (yet) delivering on objectives.

Perhaps the most challenging target is that of halting the loss of biodiversity in the EU by 2010 (or significantly reducing the loss internationally). Despite early strategies and action plans[14], it appears that species struggle to survive, and the marine environment is no exception. Although action is required to restore as many as 60 per cent of commercial fish stocks, progress in adopting recovery plans is slow and does not look to be on track for restoring stocks by 2015.

All areas with the exception of the Black Sea now have programmes for the designation of MPAs, although few if any are aimed at fish stock recovery. Moreover, progress in identifying and designating sites is often less than satisfactory. The protection of offshore sites is particularly slow, and to date only one site has been protected on the high seas[15]. It is uncertain whether Europe is on track for establishing a network of MPAs by 2012.

Lack of monitoring, in particular of species biodiversity and habitat damage, still makes meaningful environmental reporting difficult. That said, reporting frameworks have been or are being developed and the monitoring of water pollution is relatively comprehensive, except for areas of the wider Atlantic.

More positive are the developments in addressing marine pollution. While still too high, many land-based sources of pollution have been reduced. There is also an increasing field of legislation regulating pollution at sea. Good progress has been and is being made in improving environmental standards in the offshore oil and gas industry.

As regards facilitating coastal land use and watershed planning by 2012, the EU is making a significant step towards meeting this target by implementing the water framework Directive.

14 The EU Biodiversity Strategy was adopted in 1998, followed by four Action Plans in 2001, including one on fisheries.
15 This High Seas MPA has been designated in the Mediterranean, where territorial waters (commonly) only go as far as 12 nm.

3 PRODUCTION OF FISH

Written by James Brown (IEEP) and Peter Tyedmers (School for Resource and Environmental Studies, Dalhousie University)

3.1 INTRODUCTION

This chapter explores the process and production methods (PPMs) of fish and fish products, whether wild caught or farmed. Negative impacts of PPMs can be of two sorts (OECD, 1997). A process or production method can affect the characteristics of a product so that the product itself may pollute or degrade the environment when it is consumed or used (product-related PPMs). Alternatively, a process or method itself can have a negative impact on the environment through, for example, the release of pollutants into the air or water during the production stage (non-product related PPMs). Here we consider the latter of the two, that is, the effects of how we produce fish. The analysis extends beyond the point of generating fresh fish to include the processing industry.

Minimising the negative environmental impacts of production is important for a number of reasons. Environmental damage, such as bycatch and farm pollution, can directly affect the resources on which the industries depend, such as target fish stocks and water quality. Additional societal costs include damage to the wider environment and non-target species, such as coral reefs and cetaceans. Such impacts can also reduce the competitiveness of individual operators and the industry, with bycatch for example incurring significant production costs in terms of fuel consumption and sorting time. On a macro level, environmental degradation can also undermine economic growth and human health. The incidence of such impacts often reflects the inputs used in production. Impacts can therefore be an indicator of production efficiency and hence industry competitiveness.

This chapter provides a broad overview of the major environmental challenges facing the fish producing industries: the capture, culture and processing of fish. The analysis is first placed into context by reviewing the most immediately relevant international and EU political and legal requirements and commitments. The key issues identified by the conference and the recommendations made are given in the conclusions.

3.2 POLICY CONTEXT

The World Summit on Sustainable Development (WSSD) Plan of Implementation includes an entire chapter on changing unsustainable patterns of consumption and production (Chapter III). A number of specific actions are spelt out to, among other targets, delink economic growth and environmental degradation. This is to be achieved through, *inter alia*, improving efficiency and sustainability in the use of resources and production processes, reducing resource degradation, pollution and waste, and increasing investment in cleaner production and eco-efficiency. If implemented in fisheries production systems, such actions would themselves move the EU in the direction of meeting the key WSSD targets on fisheries and the marine environment, namely the maintenance or restoration of fish stocks by 2015 (30 (a)) and the significant reduction in biodiversity loss by 2010 (42), as discussed in Chapter 2.

Many of the WSSD targets are reflected in EU level commitments, policies and work plans. Most notably, the basic CFP Regulation (2371/2002) includes requirements to develop multi-annual recovery and management plants for EU fish stocks, as well as the application of an ecosystem-based and precautionary approach. For the first time, there is also a clear legal basis for measures designed purely to reduce the impact of fishing on the environment.

There are a number of EU commitments to integrate the environment into EU policy broadly, and fisheries more specifically. This includes the 1999 Commission Communication on Fisheries Management and Nature Conservation in the Marine Environment (CEC, 1999), which sets out key measures to support better environmental integration, and the 6th Environmental Action Programme (2002-2012) calling for *'promoting greater integration of environmental considerations in the Common Fisheries Policy'*. Other developments have taken place within the framework for the Cardiff process (a strategy to integrate environmental protection requirements into EU sectoral policies). Most recently, the Commission developed an action plan to integrate environmental protection requirements into the CFP in May 2002 (CEC, 2002a). This lists a number of guiding principles and measures to secure environmental integration in the sector, including the use of long-term management plans, the establishment of no take zones, the development of guidelines for Best Fishing Practice, incentives for stimulating practices adding value to environmental integration, and the integration of environmental concerns into the aquaculture sector.

In the run up to the WSSD, the European Council made a number of commitments, including that 'The relationship between economic growth, consumption of natural resources and the generation of waste must change. Strong economic performance must go hand in hand with sustainable use of natural resources and levels of waste, maintaining biodiversity, preserving ecosystems and avoiding desertification.' To this end, it was noted that the 2002 review of the CFP should *'…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 over-fishing'* (Göteborg Presidency Conclusions, 2001). The Commission since adopted the Environmental Technologies Action Plan (ETAP) in 2004 (CEC, 2004a). The plan promotes the development and uptake of environmental technologies with a view to improving both environmental and industrial competitiveness. In the same vein, the Commission adopted a Communication on the promotion of more environmentally friendly fishing methods later in the year (CEC, 2004b). Other broad initiatives to address production and consumption include the Integrated Pollution Prevention and Control (IPPC) Directive, the EU Eco-Management and Audit Scheme (EMAS), the EU Ecolabel, the new community framework for taxation of energy products and electricity and the Integrated Product Policy (IPP).

3.3 CAPTURE FISHERIES

Over the past decade, total catch from the 25 EU Member States has declined by 14 per cent, from an estimated 7,261,000 tonnes to 6,247,000 tonnes (Figure 8)[16]. While this reflects the decline in landings from demersal stocks, such as cod, haddock and plaice, it masks the increase in landings from pelagic and benthopelagic stocks. These species account for the majority of EU landings, with sandeels, herring and mackerel being the most significant (Figure 9). The most important fishing grounds in the North-East Atlantic (including the North Sea) account for 70 per cent of EU catches. The rest is taken in the Mediterranean (8 per cent) and outside of EU waters (Figure 10).

As well as a declining catch, the EU fishing fleet has been in decline since the early 1990s, both in terms of power and tonnage (Figure 11). Over the period 1989–2000, the EU15 fleet decreased in numbers of vessels by 10 per cent, in tonnage by 6 per cent and in terms of power by 12 per cent (EEA, 2001a). This has been driven by a number of factors, including declining profitability in the industry and public decommissioning programmes under the now expired Multi-

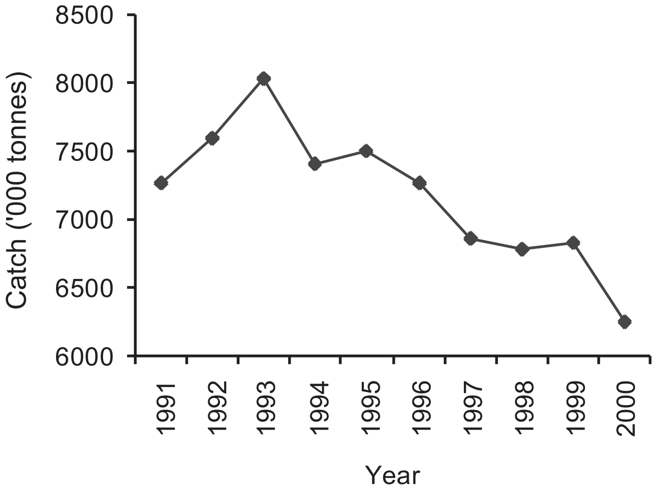

Figure 8. Total EU25 catch trend.
Source: Eurostat, 2003

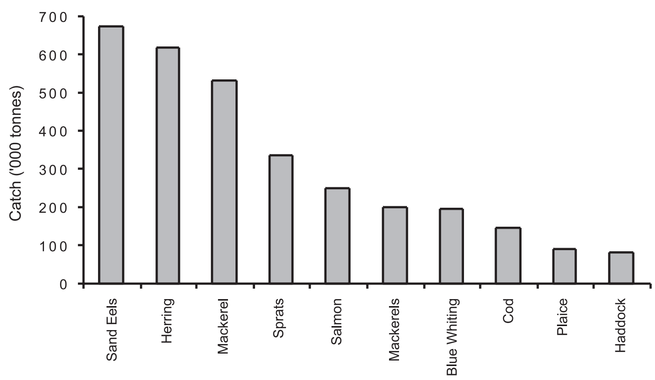

Figure 9. EU15 top ten caught species.
Source: Eurostat, 2002

16 Wherever possible, figures are used for the 25 EU Member States. Because of data limitations, however, EU15 data is sometimes used. Unless otherwise specified, data is from Eurostat (2003).

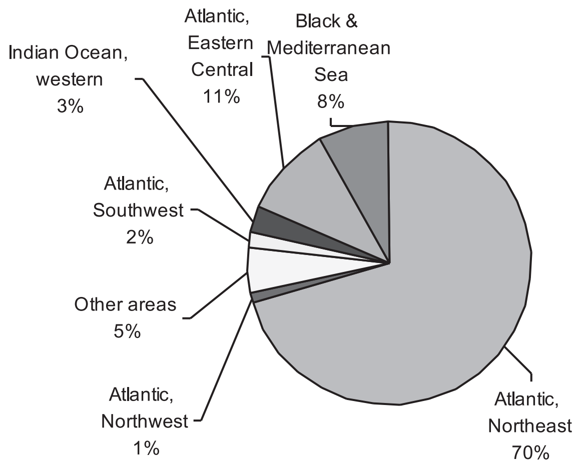

Figure 10. EU25 catches by major fishing areas. Source: Eurostat, 2001

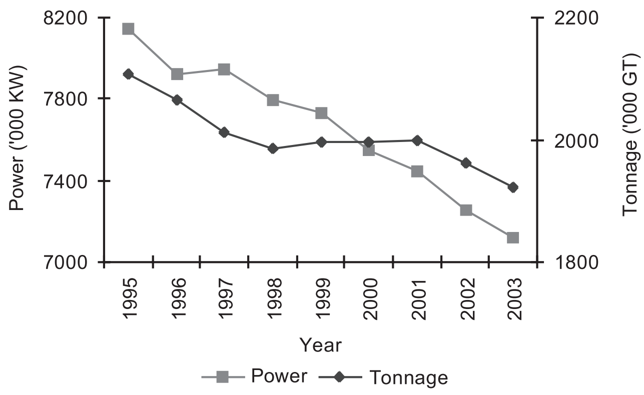

Figure 11. EU15 fleet size trends. Source: Eurostat, 2003

annual Guidance Programmes (MAGP). These reductions, however, have not been enough to address excess capacity in the EU fleet (EEA, 2001a). Because fleet capacity is still too high, the major challenge facing the CFP today is restructuring the industry in order to strike a sustainable balance between available marine resources and their exploitation[17].

Greece, Italy and Spain have the highest number of vessels. However, in terms of capacity, Spain, the UK and Italy have the largest fleet tonnages, while Spain, Italy, France and the UK have the highest fleet power (EEA, 2001a). In terms of catch, Denmark and Spain are the largest fishing nations in the expanded EU, taking 23 and 14 per cent respectively of EU catches in 2002 (Figure 12).

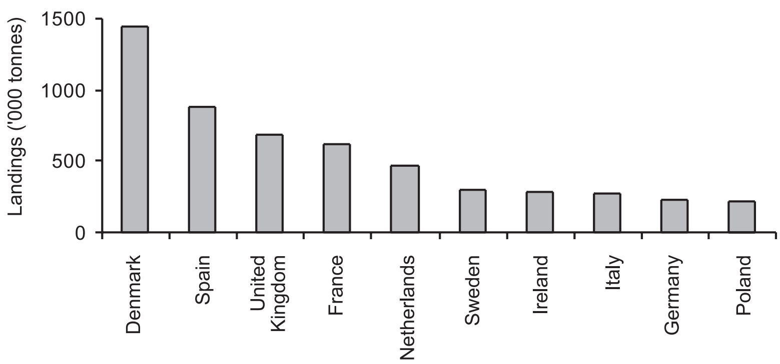

Figure 12. Top ten EU25 fishing nations. Source: Eurostat, 2002

Of the total EU catch, the industrial fishing sector accounts for approximately 21 per cent of total landings, at an average of 1.5 million tonnes in the years 1998–2000 (Eurostat, 2002). These fisheries are mainly carried out in the North Sea, the Baltic Sea and the North-East Atlantic. Denmark is the largest of the EU industrial fishing nations, taking 69 per cent of the total EU industrial fish catch. This is followed by Sweden (19 per cent) and Finland (5 per cent). Latvia and Lithuania have banned the targeting of fish for industrial purposes. The two main targets of EU industrial fisheries are sandeels and sprats. Between 1998–2002, they made up 42 per cent (642 000t) and 31 per cent (472 000t) respectively of the annual EU feed fish catch.

3.3.1 Ecolabelled Production

There are a number of ecolabels in the market place. Perhaps the most long established and well known is the single issue 'dolphin-safe' tuna label, which has been on the EU market since the early 1990's (Brown, 2005). The more recently established Marine Stewardship Council (MSC) however is generally considered the most comprehensive certification system in place, being a third party standard against which fisheries are certified.

Unfortunately there are no figures easily available on total consumption of ecolabelled products in the EU. In terms of

17 DG Fisheries Mission Statement http://europa.eu.int/comm/dgs/fisheries/missn_en.htm

production, four EU fisheries are certified by the MSC. While the amount of EU catch certified by the MSC accounts for only 0.6 per cent of the total, EU production and consumption of ecolabelled products is only set to increase with an increasing number of fisheries seeking MSC certification and Alaskan Pollack in the final certification stages. See also Chapter 5: Policy Instruments for a discussion of ecolabelling.

3.3.2 Environmental Impacts

Fishing gives rise to a host of environmental impacts, both directly and indirectly. The most immediate is that of the removal of target fish. An estimated 28 per cent of world fish stocks are considered to be overexploited or significantly depleted, with 47 per cent exploited close to their maximum sustainable limits (FAO, 2002). Fish stocks exploited by EU fleets have not escaped this trend, with many fisheries in EU waters at historically low levels. One of the major reasons for the decline in fish stocks is fishing.

Other impacts on the wider marine environment include bycatch of species such as birds, mammals and turtles, disturbance of the seabed and killing of benthic organisms. Both the direct removal of fish and wider environmental impacts affect the functioning and processes of marine ecosystems. Wider environmental pressures include oil pollution, generation of litter and energy use. Because of the vulnerability of fisheries to overexploitation, and the wider environmental impacts of fishing practices, managing both the level and nature of fishing becomes important in securing sustainable exploitation of fisheries. (See also Chapter 2 for a discussion of the state of the marine environment and the role of fisheries and other factors).

3.3.2.1 Stock and ecosystem impacts

Excessive removal of target and non-target species can lead to depleted populations, low recruitment and reduced genetic diversity. These are real issues with ICES estimating that less than a quarter of all stocks assessed are in good shape[18]. These stocks include familiar fish caught for human consumption, such as cod and hake. This overexploitation is believed to be responsible for the overall changes in size composition of stocks, with smaller individuals taking the place of larger individuals.

As well as these direct effects, there are wider impacts on the functioning of ecosystems to consider. Fishing can affect predator-prey relationships and previously stable community structures within ecosystems. Indeed, the decline in gadoid stocks is considered to be a possible factor in the increase in North Sea *Nephrops* stocks (Frid *et al*, 2003). Also in the North Sea, trawling is believed to have contributed to the shift in seabed communities from long-lived to short-lived opportunistic species, while concerns are raised (Tuominen and Esmark, 2003; Huntingdon et al, 2004) regarding the impact that the removal of large quantities of forage species by industrial fisheries may have on seabird populations and the recovery of cod.

The condition of stocks taken for industrial purposes in EU waters is considered generally good although variable (European Parliament, 2004). Most herring stocks within the region are reportedly in good condition. Some in the Baltic Sea, however, are reported to be at historically low levels, a problem compounded by poor data (CEC, 2004). The Atlantic blue whiting fishery, which accounts for significant landings, is also a source of concern. Despite the lack of knowledge about the biology and ecology of this species, it is being increasingly targeted (European Parliament, 2004). The bycatch of juvenile fish in industrial fisheries is particularly controversial. While this occurs in the Norway pout and sprat fisheries, a recent review concluded that industrial fisheries are relatively ‘clean’, with bycatch levels lower than those of fisheries for human consumption (European Parliament, 2004).

3.3.2.2 Bycatch and discarding

Bycatch and subsequent discarding occurs at significant levels across the EU. In addition to the fact that many discarded fish are dead or dying, there are a number of negative impacts on the environment. The increased mortality resulting from bycatch of mature fish reduces spawning stock size, with the taking of immature fish having the same effect on the future spawning stock. While difficult to quantify, discarding increases food to scavengers, affecting species compositions. Discarding is also wasteful in terms of use of natural resources and reduced stock productivity, as well as increased costs from sorting catch and lost fishing time. Furthermore, discarding undermines stock assessments, as

18 Unless indicated otherwise, this section draws upon Frid *et al* (2003).

landing records do not reflect true fishing mortality rates.

The level of discarding varies between EU fisheries. Data on discards are generally poor, as they are not regularly collected and not reported by the vessel owners. Estimates of the total quantities of fish discarded exist only for haddock and whiting in the North Sea and to the west of Scotland, and for the western cod stock in the Baltic[19] (Table 1).

Table 1. Estimates of discards in selected EU haddock, whiting and cod fisheries

			Percentage discarded			
			By weight		By number	
Species	**Area**	**Time Period**	**Min**	**Max**	**Min**	**Max**
Haddock	North Sea	1963 – 1999	20	50	20	60
Haddock	West Scotland	1978 – 1999	10	20	30	80
Whiting	North Sea	1960 – 1999	20	63	15	55
Whiting	West Scotland	1978 – 1999	15	60	20	80
Cod	West Baltic	1996 – 2000	5	10	25	30

In the North Atlantic, it is mostly small fish below their legal minimum landing sizes that are discarded. Gear selectivity is a key factor, with larger mesh sizes resulting in lower discard rates (10–15 per cent by weight) than the use of gears of small mesh size (50 per cent or more in some cases).

Mediterranean fisheries are typically multi-species and multi-gear with a high number of marketed species. However, some Mediterranean trawl fisheries discard from 20 to 70 per cent of their catches, depending on the depth of fishing and targeted stocks. There are big differences in discard levels depending on the gear types. Artisanal gillnetting incurs up to 9 per cent discards and trammel netting up to 35 per cent. When large amounts of sardine are taken in the anchovy fishery, discards may be as high as 80 per cent.

Non-commercial species are also taken as bycatch. This is sometimes detrimental. The common skate (*Raja batis*), for example, is extremely rare in the central and southern North Sea, the western Baltic Sea and western Mediterranean. It is believed to have been extirpated from the Irish Sea. There is no longer a directed fishery for the common skate in EU waters, but mortality that results from being taken as bycatch is considered to be the main threat to its survival. While no overall information is available on the numbers involved, birds, turtles and mammals such as cetaceans, are also taken as bycatch. The Baltic harbour porpoise population, for example, is at a critically low level and even very low levels of bycatch is considered a major threat to its persistence and recovery in the region (Berggren *et al*, 2002).

3.3.2.3 Energy consumption and performance

In addition to the most commonly considered environmental impacts reviewed above, contemporary fisheries also contribute to a broader range of resource depletion (eg petroleum consumption) and environmental impacts (climate change, acid precipitation, smog) due to their industrial character.

In terms of environmental impacts and energy consumption, the capture of fish appears to be the most problematic element of fish production, particularly in terms of energy inputs (Ritter, 1997; Ziegler *et al*, 2003). For example, an exhaustive analysis of the environmental impacts associated with the production and consumption[20] of a typical 500g frozen cod fillet in Sweden, showed that for each of the five impact categories considered, the fish harvesting stage accounted for between 70 and 99 per cent of total impacts (Figure 13).

19 Bycatch and discard data from CEC, 2002b.
20 The stages in the production and consumption process accounted for in this analysis included fishing, processing, storage, wholesaling, retailing, consumption in the home, sewage treatment and all intervening transportation (Ziegler *et al*, 2003).

Total energy use in commercial fisheries can range over three orders of magnitude (see Appendix). For example, some industrial fisheries dissipate as little as 1.5 GJ per tonne of fish landed. In contrast, fisheries for high value species such as shrimp, tuna or swordfish for direct human consumption commonly dissipate energy in excess of 1,000 GJ per tonne (Leach, 1976; Edwardson, 1976; Rawitscher, 1978; Lorentzen, 1978; Watanabe and Okubo, 1989; Tyedmers, 2001; Tyedmers, 2004; Thrane, 2004). Regardless of the scale of total energy inputs to commercial fisheries, direct fuel inputs typically account for between 75 and 90 per cent of the total industrial energy inputs to fishing (Figure 14).

In general, trawling tends to be more energy intensive than seining, purse seining or more passive techniques such as gillnetting and trapping (Wiviott and Mathews, 1975; Leach, 1976; Edwardson, 1976; Ágústsson et al, 1978; Lorentzen, 1978; Rawitscher, 1978; Nomura, 1980; Hopper, 1981; Watanabe and Okubo, 1989; Tyedmers, 2001; Ziegler and Hansson, 2003; Thrane, 2004). While not as strong or consistent a pattern, the energy intensity within a given gear sector and fishery has also been found to increase with vessel size (Wiviott and Mathews, 1975; Rochereau, 1976; Edwardson, 1976; Lorentzen, 1978; Watanabe and Okubo, 1989; Thrane, 2004). Where time series data are available, it is evident that the energy performance of many fisheries, and in particular those targeting species for human consumption, has deteriorated over time (Mitchell and Cleveland, 1983; Watanabe and Uchida, 1984; Tyedmers, 2001; Tyedmers, 2004).

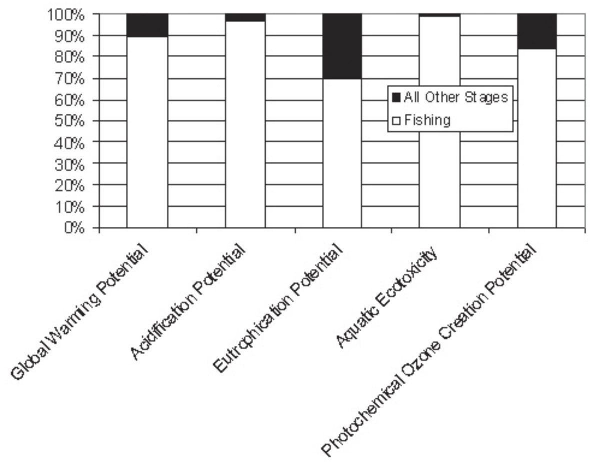

Figure 13. Environmental impact of fishing in relation to all other life cycle stages associated with the production and consumption of a typical 500g frozen cod fillet in Sweden. Source: Adapted from Ziegler *et al*, 2003

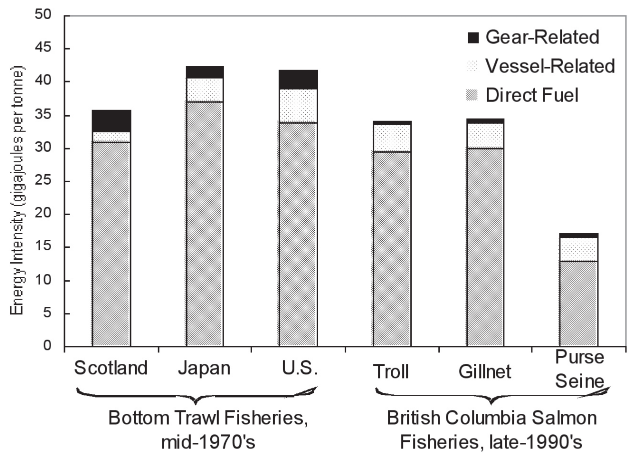

Figure 14. Relative contribution of direct and indirect energy inputs to various fisheries. Source: Tyedmers, 2004

A systematic analysis of the energy performance of the full range of EU-based fisheries has yet to be undertaken. However, data from a variety of sources provides an indication of typical levels of fuel use intensity associated with some EU-based fisheries (see Appendix). For example, EU-based industrial fisheries employing trawl gear burn on the order of 100 litres of diesel per tonne of fish landed (Tyedmers, 2001; Thrane, 2004). While this is comparable to other North Atlantic, non-EU industrial trawl fisheries, it is substantially higher than energy consumption in industrial fisheries using purse seines, such as the Icelandic capelin and the U.S. menhaden fisheries. Not surprisingly, EU-based fisheries for small pelagic species such as herring and mackerel for human consumption burn fuel at a level consistent with industrial fisheries (Tyedmers, 2001; Thrane, 2004).

The energy intensity of contemporary EU-based fisheries that target demersal finfish species and invertebrates for human consumption range widely. In EU demersal finfish fisheries, fuel inputs range from around 340 litres/tonne in the case of a Swedish gillnet fishery for cod (Ziegler and Hansson, 2003) to well over 2,000 litres/tonne in the case of German beam trawl fisheries that target both flatfish and cod (Tyedmers, 2001). The energy performance of these EU-based fisheries is generally comparable to other North Atlantic non-EU based fisheries.

While data regarding the energy performance of EU fisheries for invertebrates is limited to a number of Danish fisheries (Thrane, 2004), their performance is broadly comparable to similar North Atlantic fisheries prosecuted by non-EU countries (see Appendix). At the extremes, hand-gathering of mussels consumes as little as 10 litres per tonne, while trawl fisheries for Norway lobster burn just under 1,200 litres per tonne of landings.

3.3.2.4 Emissions to air

Little, if any, research has been undertaken to measure the emissions from EU fishing vessels during fishing operations. However, detailed monitoring of over 20 vessels undertaken by Lloyd's Register Engineering Services (1995) provides an insight into likely emissions from diesel-fuelled fishing vessels (Table 2).

Table 2. Typical emission factors associated with the combustion of diesel fuel by Marine engines under working conditions

	NO_x	SO_x	CO_2	CO	Hydrocarbons
Emission factors (g/litre fuel)	48	3.4	2,660	6.2	2.0

Source: adapted from Lloyd's Register Engineering Services, 1995, Table 5, p. 17

3.3.2.5 Emissions to water

Fishing activities are one of many non-point sources of marine pollution. This includes lost or discarded fishing gear, plastics, discharges of oil as a result of engine operations and bilge pumping, discharges of human and some limited processing wastes, and leaching of anti-foulant paints and other toxic chemicals. The environmental consequences of this littering include continued 'ghost fishing' of lost gear, tangling, strangulation of and ingestion by wildlife, and pollution. As well as the general effects on the marine environment and our experience of the sea and the beaches affected, littering has direct economic costs for the fishing industry. It affects fish resources, as well as increases vessel and gear repair costs. It is estimated that the impacts of all forms of marine litter, not just that resulting from fishing, for Shetland fishing boats could amount to £45,000 per year (Hall, 2000). Litter from fishing is also commonly washed up on beaches, negatively affecting coastal communities and tourism.

3.3.2.6 Environmental impacts affecting fish stocks

While fishing affects the environment, the environment also affects wild fish stocks and hence the fisheries that depend on them. The wider pressures on the marine environment and their importance in relation to fishing are discussed in Chapter 2. Perhaps the most fundamental of the environmental factors affecting fish stocks is that of climate change. While there is some disagreement over the scale and impacts of climate change, almost all climate models predict that surface temperatures are due to rise (Frid *et al*, 2003). This is likely to affect fish stocks and lead to shifts in abundance. While some stocks may benefit, others may lose. There is evidence that changes in North Sea temperatures since the mid-1980s have modified the plankton ecosystem in a way that has reduced the survival of young cod (Beaugrand *et al*, 2003). Climate change is therefore a significant issue that must be taken into account by managers and industry. The influence of climate change, however, does not detract from the diagnosis of overfishing – because a population is naturally small this does not justify its continued intensive exploitation.

Pollution is a more immediate issue in some cases. As highlighted in Chapter 2, eutrophication and other forms of pollution are significant pressures. In the Baltic Sea, for example, high dioxin levels have led to accumulation of dioxin in herring, reaching levels that exceed EU limits for human consumption[21]. While these fish are not allowed to be sold for consumption, feed manufacturers have responded by using these fish for fishmeal and oil production, employing methods such as carbon filtration to extract the dioxins (EP, 2004).

21 Dioxins enter the environment mainly through incineration processes and through the production and use of organochlorinated compounds.

3.4 AQUACULTURE

Aquaculture production has increased dramatically in the EU, and indeed globally, since 1970. While hailed as the solution to declining wild fish stocks and catches, aquaculture also gives rise to a number of environmental pressures. These include increased pressure on water and ecological systems and, in the case of carnivorous species, demands on wild fish stocks. However, it is difficult to quantify the impacts at a European or regional level due to lack of data (EEA, 2001b).

Within the EU, aquaculture production has grown to 1.2 million tonnes, divided equally between fish and molluscs (Figure 15). Rainbow trout is the main farmed fish species, followed by salmon (Figure 16). Seabream, seabass, turbot, halibut and more recently cod are farmed in coastal waters, while carp and eel are important freshwater species. Blue mussels are the main shellfish produced, followed by cupped oyster.

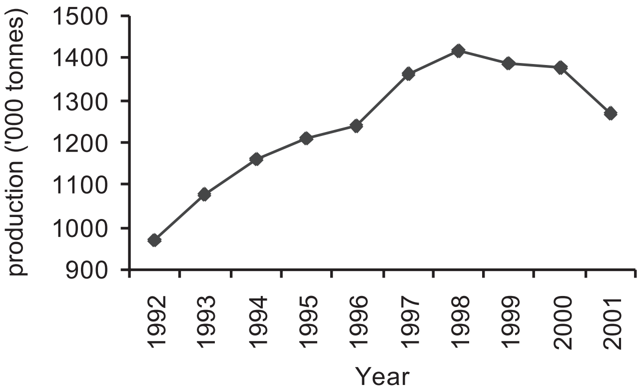

Figure 15. EU25 aquaculture production. Source: Eurostat, 2003

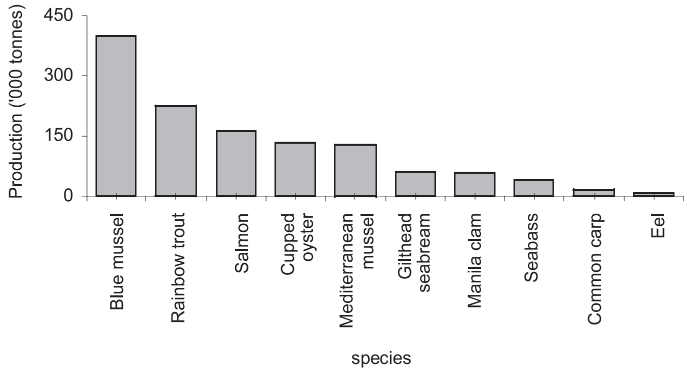

Figure 16. Top ten farmed species. Source: Eurostat, 2001

Spain, France and Italy are the largest producers of farmed fish products (Figure 17), but in terms of importance in overall national fish production, aquaculture dominates in Greece, Finland and Germany (Figure 18).

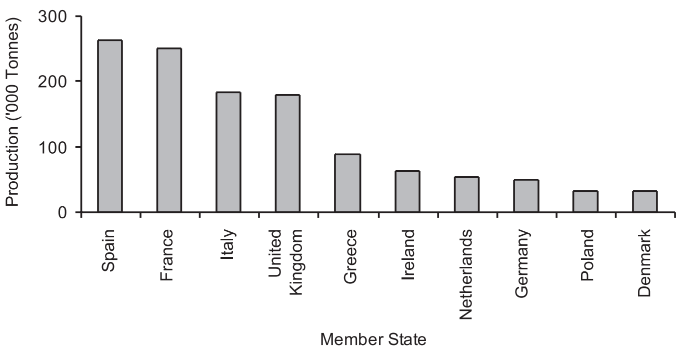

Figure 17. Top ten aquaculture producing countries. Source: Eurostat, 2002

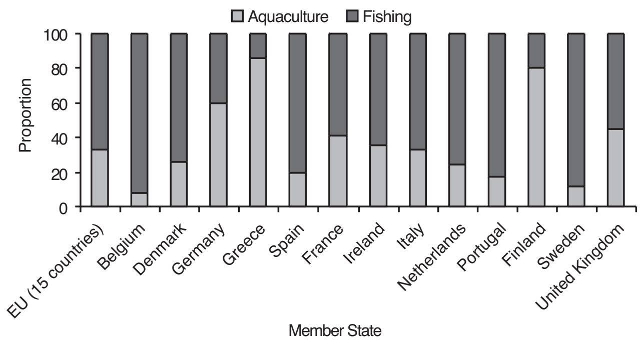

Figure 18. Source of fish production by Member State. Source: Eurostat, 2003

3.4.1 Organic Aquaculture

Organic aquaculture is a relatively recent development in the EU and globally. Production is mainly located in Europe and started in the last few years with farming of carp, along with rainbow and brown trout. Reliable production figures are very difficult to obtain, although recent surveys indicate that total EU organic aquaculture production is in the range of a few hundred to several thousand tonnes, amounting to less than 0.4 per cent of EU production (Hilge and Halwart, 2004).

There are at least seven Member States producing organic freshwater fish. Increases in freshwater organic production are expected from charr, brook trout, eel, perch, pike, pike-perch, tench and European catfish. Organic mariculture production is also increasing. Organic salmon are produced on a few farms in the UK and Ireland (2,800 tonnes in 2003) and attempts to produce organic sea bass and seabream are underway in France and Italy.

3.4.2 Environmental Impacts

Many of the traditionally conceived environmental impacts of aquaculture tend to be more localised than those of capture fisheries, affecting coastal regions and inland water bodies in proximity of the culture sites. The impacts of aquaculture in relation to other environmental pressures are discussed in Chapter 2. As in agriculture, aquaculture systems can be broadly described along a continuum from extensive to intensive. Extensive production systems typically involve minimal site or substrate preparation, relatively low stocking densities and little if any supplemental feeding and inputs of energy. In contrast, intensive operations typically involve high stocking densities and much higher levels of feed, chemical and exogenous energy inputs – all of which have the potential to contribute to increased levels of environmental impacts[22].

3.4.2.1 Pressure on wild fish stocks

While aquaculture may have been hailed as a solution to declining wild stocks and catches, it can itself put pressure on wild stocks, either as a source of farm stock or through the demand for feed. Farming of eel and bluefin tuna currently depend on the capture of wild fish because controlled breeding is not presently possible. Wild European eel stocks are considered to be below safe biological limits, with elver (juvenile eel) fishing one of several pressures (CEC, 2003). The recent expansion of tuna 'ranching' in the Mediterranean is also increasing the pressure on the bluefin tuna stock, with growing concern over its condition and management (Tudela and García, 2004).

The use of wild fish as feed in aquaculture is also controversial. Naylor *et al* (2000) calculated an average global wet fish to wet fish conversion ratio of 2:1 with conversion rates for some high value, intensively cultured species like salmon and eels ranging as high as 5:1. Some have argued that such low conversion ratios are superior to the typical 10:1 trophic transfer efficiencies observed in aquatic ecosystems (Pauly and Christensen, 1995), and that it is more efficient to catch forage fish and feed them to cultured species than to allow these fish to be preyed upon by species targeted for human consumption (Asgard and Austreng, 1995). Such a comparison is, however, overly simplistic as it assumes that animals destined for inclusion in aquafeeds are ecologically comparable to the typical diet of fish targeted for human consumption. Moreover, it also overlooks the myriad of energy inputs associated with producing fish feed and ultimately farmed fish.

3.4.2.2 Ecological and genetic impacts

Non-native species may be introduced to an area deliberately for farming purposes or accidentally. Alien species may be brought in and later escape from fish farms. Foreign organisms, such as disease organisms or small larval forms of invertebrates, may also be accidentally introduced with native species. Introductions can have serious consequences for native organisms, for example, by competing for food or space, or by spreading disease.

Escapees of native species can also cause significant problems. Interbreeding may occur when hatchery-reared fish are released into the wild to enhance the fishery, as is the case with salmon in the Baltic Sea, or when fish escape into the wild. Some rivers in Norway and Ireland have been found to contain 90 per cent and 50 per cent farm escapees respectively (Saegrov *et al*, 1997; Fleming and Einum, 1997; Fleming *et al*, 2000; Crozier, 1993; 2000; Clifford *et al*, 1998). The escapees may also migrate substantial distances and affect other areas. Salmon from a farm in Ireland were recaptured in English, Scottish and Welsh rivers (Milner and Evans, 2002), illustrating the nature of the problem. While it is estimated that over 1 million fish have escaped from Scottish salmon and trout farms alone since 1998 (SEERAD, 2003), total numbers of escapees and their impacts are unknown.

Given that feral animals may be infected with disease-causing agents or parasites, they have the capacity to re-transmit and potentially amplify the spread of parasites and infectious diseases to wild fish populations. Salmon farms, for

22 For a detailed account of the environmental impacts of aquaculture, see Staniford (2002a), which this section draws on.

example, are widely considered responsible for sea lice infestation on wild salmon and sea trout (Edwards, 1998; Butler and Watt, 2002; Bjorn and Finstadt, 2002; Gargan and Tully, 2002; Holst *et al*, 2002).

3.4.2.3 Energy consumption

While not as widely studied as fishing systems, energy analyses have been undertaken on a diverse range of aquaculture systems over the last 30 years[23]. To date, relatively few of these analyses have been undertaken on EU-based culture systems[24]. However, as many of the major aquaculture production systems are essentially 'globalised', research on systems elsewhere can be used to provide a first order characterisation of EU-based aquaculture systems.

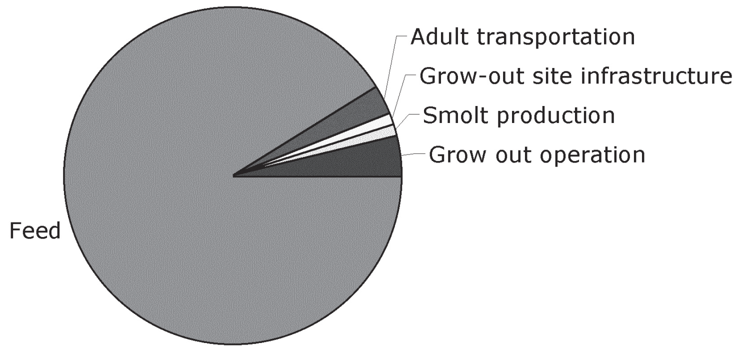

Figure 19. Typical proportions of life cycle energy inputs associated with the production of salmon and trout in marine net-pen systems. Source: Troell *et al*, 2004

Unlike commercial fisheries, the forms of primary energy inputs to aquaculture systems can be highly diverse and typically encompass a range of energy sources (Troell *et al*, 2004). Moreover, the majority of life cycle energy costs associated with the production of fish and shellfish in aquaculture tend to be 'embodied' rather than direct as is the case in fishing systems. In some extensive culture systems, such as long-line mussel culture, the energy embodied in capital infrastructure represents the majority of total inputs. In contrast, feeds and/or fertilizers typically represent the greatest proportion of energy inputs to most semi-intensive and intensive systems (Troell *et al*, 2004). The most extreme examples of this occur in net-pen culture systems used to raise salmonids and other high value finfish. In these systems, between 80 and 90 per cent of the life cycle energy inputs up to the point of slaughter are associated with the provision of feed (Stewart, 1995; Tyedmers, 2000; Seppälä *et al*, 2001) (Figure 19).

Determinants in the amount of primary energy used in aquaculture systems include the species under cultivation, the culture system used and subtle differences in production techniques, such as changes in feed formulation (Tyedmers, 2000; Seppälä *et al*, 2001). Bearing this in mind, Table 3 presents typical energy inputs associated with a number of species currently cultured within the EU.

Table 3. Energy inputs up to the point of harvest associated with various culture systems

	Salmon (marine net-pen)	Trout (marine net-pen)	Tilapia (pond)	Mussel (long-line)
Energy inputs (GJ/tonne)	99	29	24	4.6

Source: Seppälä *et al*, 2001 and Troell *et al*, 2004

Where direct comparisons have been made of energy inputs associated with competing fishing and intensive farming systems (eg for salmon), total energy inputs have been found to be at least three times higher in the intensive culture system (Tyedmers, 2000).

3.4.2.4 Emissions to air

As yet, no analyses have been undertaken to quantify the typical air emissions that result from the full range of aquaculture systems employed in the EU. One system for which air emissions have been quantified, however, is a typical

23 For a review, see Troell *et al*,, 2004.
24 For exceptions see Pitcher, 1977; Folke, 1988; Stewart, 1995; and Seppälä *et al*, 2001.

marine-based rainbow trout farm in Finland (Table 4).

Table 4. Life cycle[25] air emissions associated with the production of rainbow trout in a typical marine-based net-pen culture system in Finland

	CO_2	NO_x	SO_x	CH_4	N_2O	NH_3
Emissions (kg/tonne live weight)	750	7.2	1.7	1.3	0.5	0.36

Source: From Seppälä *et al*, 2001, Tables 8–13.

3.4.2.5 Emission to water

Aquaculture can result in the discharge of untreated waste and uneaten food into water. This has primarily local impacts on the seabed, particularly in areas with limited circulation, and can cause shellfish poisoning (Sandison, 2000). Open sea cage fish farming, for example, is increasingly recognised as a significant source of pollution in terms of organic matter and the nutrients nitrogen and phosphorus in organic waste (Staniford, 2002b; CEC, 2002c; DNM, 1999; WWF Scotland, 2000; OSPAR, 2001; HELCOM, 2001).

In addition to the nutrient discharges, chemicals are used to control diseases and parasites and for synthetic pyrethroids, artificial colorants, antifoulants and antiparasitics in intensive operations (Schnick *et al*, 1997; Alderman, 1999; Roth, 2000; Costello, 2001). Some of these pose environmental and public health threats (GESAMP, 1997; WHO, 1999; Douglas, 1995; Kelleher *et al*, 1998). Chemicals used on salmon farms include carcinogens, mutagens and a myriad of marine pollutants (Staniford, 2002b). Shellfish farmers are worried about the negative effects on shellfish such as lobsters, crabs, mussels, oysters and scallops of chemicals used to kill sea lice (Blythman, 2001; Ross and Holme, 2001). The sealice treatment, cypermethrin, for example, has been linked to reproductive effects in wild salmon and significant impacts on shellfish over several hectares (Ernst *et al*, 2001; Moore and Waring, 2001).

In addition to problems related to legally used chemicals, the use of prohibited chemicals continues (Intrafish, 1998; Barnett, 2000; BBC, 2000; Cameron, 2002a).

3.4.2.6 Environmental impacts affecting aquaculture

As with wild fish stocks, aquaculture itself is also affected by environmental impacts. Good water quality is key to productive aquaculture operations, and blooms of harmful algae in particular can affect the aquaculture industry. Of the twenty or so species of phytoplankton in the North-East Atlantic that produce toxins, some affect fish directly and some may poison people when infected organisms are consumed. This is a particular problem in molluscs, which are filter feeders and accumulate the toxins contained in the algae. Diseases affect aquaculture to such an extent that infectious diseases are considered to pose the biggest single threat to aquaculture (CEC, 2002c). Finally, there is growing evidence that contaminants in fin fish feed is leading to higher body contaminant levels of, for example, fire retardants and PCBs in farmed fish than in wild caught fish (Hites *et al,* 2004a; 2004b). Evidence also suggests that contamination is higher in farmed salmon from Europe than from North America and Chile (Hites *et al*, 2004b).

3.5 FISH PROCESSING

Fish are processed to produce fresh, frozen or marinated fillets, canned fish, fishmeal, fish oil and fish protein products, such as surimi. Fresh fish products are highly perishable therefore require refrigerated storage. Conversely, highly processed products, such as canned fish, fishmeal and fish oil, have a longer shelf life so require little if any refrigeration.

Approximately 79 per cent of EU fish production is used for human consumption and the remaining 21 per cent is used to produce fishmeal and oil. Of the fish processed for human consumption, around 15 per cent is marketed fresh. In

25 Stages in the product's life cycle included production of raw material input to feed, feed processing, hatchery and grow-out site operations, slaughter and packaging.

1994 to 1999, total EU processing production increased by 41 per cent in volume and by 76 per cent in value. In 1999 it was valued at approximately €12 billion from about 4 million tonnes of product (Nautilus Consultants, 2003), and the UK, France and Spain accounted for 20, 19 and 18 per cent of the production value respectively.

There are almost 100,000 employed in over 3,000 processing enterprises in the EU. Although EU production has grown, most Member States have seen a reduction in the number of processing companies in recent years. At the same time, the average number of employees per processing enterprise has increased from 30.4 in 1994 to 37.8 in 2000, illustrating the consolidation in the industry (Nautilus Consultants, 2003). Key drivers behind these structural changes are supply shortages and competition from cheaper imports.

3.5.1 Environmental Impacts

As for the food processing industry in general, the key environmental issues associated with fish processing are water consumption, effluent generation, energy consumption, generation of by-products, and, in some cases, noise and odour generation. While this section considers on-shore processing facilities, many of the issues discussed are relevant to on-board processing as well[26]. The quantities and types of wastes generated depend upon a variety of factors including:

- fish type, size and shape;
- transportation and conveyance methods;
- reception and handling of raw materials;
- processing times and technologies;
- amount of carcass washing;
- washing temperatures;
- cleaning and sanitation procedures; and
- rendering operations.

While the environmental impacts from fish processing are by no means trivial, it is important to view them in the broader perspective of the entire fish production process. As noted, the capture of fish appears to be the most problematic element of fish production, particularly in terms of energy inputs (Figure 14) (Ritter, 1997; Ziegler *et al*, 2003). Total energy inputs have also been found to be at least three times higher in intensive salmon farming than for wild caught salmon (Tyedmers, 2000).

3.5.1.1 Water consumption

Water is used for holding and transporting fish, for cleaning equipment and work areas, and for fluming offal and blood. Automated processing equipment generally has permanently installed water sprays to keep equipment clean and to flush offal away.

Typical fresh water consumption per tonne of fish intake is 5–11 m^3 for fish filleting, 15 m^3 for canning and 0.5 m^3 for fishmeal and oil production. Fishmeal and oil production also uses about 20 m^3 of seawater per tonne of fish processed. Most seafood processors have a high fixed water use for cleaning the plants and equipment. Water use per unit product therefore decreases as production volume increases, so that smaller-scale sites tend to have significantly higher water use per unit of production.

3.5.1.2 Effluent

Fish processing effluent contains high levels of organic matter, phosphates and nitrates because of the presence of oils, proteins, scraps of flesh, blood and soluble substances from entrails, as well as detergents and other cleaning agents. Sources of effluent for the basic fish processing operations are the handling and storage of raw fish prior to processing, fluming of fish and product around the plant, defrosting, as well as the cleaning of equipment and work areas throughout the process. Canning operations generate effluent from the draining of cans after precooking and from spillages of sauces, brines and oil. Major sources of effluent from fishmeal and fish oil production are bloodwater from

26 This section draws on the analysis of UNEP, 2001; SFIA, 1999; and PPRC, 1993.

the unloading and storage of fish, and high-strength effluent from the centrifuges and condensate from evaporators. Thawing operations can also account for up to 50 per cent of the waste water generated.

Effluent quality is highly dependent upon the type of fish being processed. The processing of oily fish species generate much higher pollution loads than processing of whitefish species, due to the high oil content and the fact that these species are usually not gutted or cleaned on the fishing vessel. Effluent from the processing of oily fish can also contain very high levels of oil. Typical ranges for the chemical oxygen demand (COD) loading in fish processing effluent per tonne of fish intake are 50 kg for the filleting of whitefish, 85 kg for the filleting of oily fish, 116 kg for canning and 42 kg for fishmeal and oil production.

3.5.1.3 Energy consumption

Thermal energy, in the form of steam and hot water, is used for cleaning, heating water, sterilizing and rendering. Electricity is used for the operation of machinery and for refrigeration, ventilation, lighting and the production of compressed air.
Typical electricity consumption per tonne of fish processed is 65–87 kWh for filleting, 150–190 kWh for canning and about 32 kWh for fishmeal and oil production, plus 32 litres of fuel oil used for thermal heating.

3.5.1.4 Byproducts

A large proportion of solid waste produced by processing plants is generated from the separation of the desired food elements from the rest in the early stages of processing. In some cases, the materials are composted. Other significant solid wastes include packaging materials such as waxed corrugated boxes, pallets, shrink wrap, strapping ties, drums and polystyrene. Many of these products can be reused or recycled.

3.5.1.5 Refrigerants

The loss of chlorofluorocarbons (CFCs) to the atmosphere is an important environmental consideration where they are used in refrigeration systems because of their role in ozone depletion in the atmosphere. For such operations, the replacement of CFC-based systems with non- or reduced-CFC systems is important.

3.5.1.6 Air emissions and odour

Despite being typically localised, odour generation, and generally to a lesser extent smoke and dust, can be important environmental issues. Processing of fish byproducts is responsible for more odorous contaminants than cannery operations because of the more decomposed state of the raw materials. The largest sources of odour are the fishmeal driers.

3.6 CONCLUSIONS

Reviewing the sources of environmental pressures from the production of fish, it is evident that there are many opportunities for reducing the negative impacts while maintaining or even improving industry competitiveness. This can be achieved through technical improvements, economic instruments, better regulation, enforcement of existing regulations and, in some cases, prohibiting particularly undesirable practices.

If the EU is to fulfil its international and domestic commitments relating to fisheries and the marine environment, there is a pressing need to limit (and enforce) the amount of fish that can be caught, and to ensure that they are caught with minimal impacts. For aquaculture, there is a need to decouple the industry from natural resource use, and most notably wild fish stocks. Cleaner production is also important in limiting the impacts of the processing industry. However, even with cleaner production systems in all of the three industries (capture, culture and processing), if consumption growth continues at its historic rate without limits to resource extraction, be they fish, water or fossil fuels, any benefits from improved efficiency are likely to be offset. This would point towards the need to address consumption – how much and of what types of fish, and other protein products – people consume. This is the subject of Chapter 4.

While it varies by system, aquaculture and capture fisheries account for the majority of environmental impacts, both in terms of stock and ecosystem pressures and energy consumption. This points towards the need to question the choices between large scale and small scale fishing operations, intensive versus extensive aquaculture and different types of fish processing. Furthermore, it becomes apparent that there is a need for close examination of the societal objectives underlying fish production within broader management of the marine environment. Indeed, this needs to be viewed within the much wider context of food production.

The conference working group discussed these issues and the challenges of maximising the positive contribution of fisheries, whilst reducing negative impacts to acceptable levels. It was acknowledged that using existing technologies, there is already great scope to redress the balance and some progress is being made by fisheries organisations, the processing industry and policy makers. Further improvements will generate potential benefits for the sector in terms of its sustainability, but also its profitability and competitiveness.

Efforts to improve the environmental performance and resource efficiency of production should be reinforced through a series of targeted and complementary policies and measures. The EU can stimulate innovation in the sector through research, funding, regulation and even voluntary agreements. There is also scope for target-setting, followed by coordinated action at the level of the Member States, to tackle different issues in a concerted and effective way.

The working group identified a number of areas where improvements need to be carried out. The recommendations are aimed at the Commission as well as at other stakeholders. It should be noted that not all members of the working group agreed on all points.

1. Catch data as base for management and stock assessment

The working group recommends:

- Finding and applying a common and comparable methodology for reporting catch data that includes bycatch and discards, not only landings;
- Catch data reported must include fish caught for “fattening” or feed in the aquaculture sector;
- Member states should take their role to assure completeness and accuracy of catch data more seriously. Aside from requirements to report on bycatch and discards, the basic legislation/requirements are already in place.

2. Recreational fisheries

The working group called for improved understanding of the scale of harvesting carried out by so called recreational fisheries. Today, recreational fisheries are largely outside the scope of CFP management measures. The working group recommends:

- Consideration should be given to improving information on the recreational sector, particularly in the Mediterranean, ensuring that recreational fisheries are fully accounted for within fisheries management measures;
- Any measures to protect stocks, such as time and area closures, should apply equally to all parts of the sector;
- The use of large-capacity (industrial-scale) gear could be restricted to licensed fishing activities;
- Particularly destructive fishing methods, such as night-time spear fishing with light, should be prohibited all together;
- Licensing and/or regulating bag limits for recreational fisheries where appropriate, such as for eel and juvenile bluefin tuna;
- Education programmes for recreational fishers on aquatic ecosystems and their possible impacts.

3. Bycatch and discards

The working group saw unnecessary bycatch and subsequent discarding associated with fisheries as a key issue, affecting both the image, productivity and efficiency of the sector. Despite receiving political attention, real progress in tackling the problem is insufficient, particularly in terms of the most wasteful fisheries. In this area there is particular scope to work with the catching sector to develop to reduce the environmental and resource impacts associated with fishing. The working group recommends:

- Full implementation of existing bycatch reducing techniques and technologies throughout the EU;
- Adoption of a 5-year sectoral action plan for reducing discards by 50 per cent, through reducing bycatch or finding ways to utilize the catch. A consultation process among stakeholders on how to achieve the action plan should be carried out;

- Funding should be made available under the new European Fisheries Fund (EFF) for implementing selective fishing techniques and meeting the targets set in the action plan;
- Subsidies should also be made available to facilitate the retention of bycatch by small-scale fishers;
- Exploring possibilities and consumer campaigning to market more of the species caught than today, thereby utilizing more of bycatch.

4. Protecting juveniles and megaspawners

The capture of large numbers of juveniles, as well as the important 'mega-spawners', is a particular problem. Large amounts of juveniles being discarded makes minimum catch size regulations meaningless, for example. The groups recommends:

- That better use is made of time/area closures (including MPAs) to protect both juveniles and mega-spawners, and that these are respected by all users;
- Real-time monitoring of the proportion of juveniles in the catch, followed by temporary shutdown when pre-agreed trigger points are reached;
- Improvement of gear selectivity and requirements to use them where appropriate;
- Consistency between minimum mesh sizes and landing sizes;
- Speeding up the designation and protection of Natura 2000 areas, such as Posidonia-meadows, that are important breeding and nursery grounds for many fish species.

5. Aquaculture production

The working group discussed ways of increasing the sustainability of fish farming and recommends:

- The use of wild juveniles, such as young bluefin tuna or elvers, to stock farms needs to be properly identified and recorded within existing catch reporting systems;
- Improvements should be secured in order to decrease the sector's dependence on wild-caught fish for feed, by developing high-protein, vegetable alternatives;
- Improved control of escapees from fish farms, as well as monitoring of their impact on biodiversity and wild stocks;
- Introducing stronger, common guidelines for eco-labelling and organic farming;
- Implementation of the polluter pays principle in fish farming to improve environmental performance;
- Abolition of public support for unsustainable farming methods.

6. Non-compliance with regulations, control and enforcement

The working group saw the need for more international control, with Member states failing to enforce current legislation and recommends:

- Giving the new European Control Agency some teeth, so that it can track down and investigate suspected illegal activities;
- That the Council acquires at least one joint patrol vessel to control EC fleet activities in international waters;
- Increased responsibility among the actors for ensuring sustainability of fish sold to processors and wholesalers (ie improved chain of custody tracking). In particular, the retailers could put more pressure on the suppliers;
- Immediate harmonization of penalties for non-compliance between Member states;
- Much stronger economic incentives to comply with the rules - fines need to be set at 100 times the value of the landing to be effective;
- Mandatory educational activities and training courses, linking compliance to stock protection.

4 CONSUMPTION AND TRADE OF FISH

Written by James Brown (IEEP) and Mahfuzuddin Ahmed (WorldFish Center)

4.1 INTRODUCTION

Consumption is central to the sustainability debate, not just in terms of how much is being consumed but also in terms of what is being consumed, how it is produced, and the product form and origin. Fish[27] consumption levels and patterns have given rise to increasing levels of trade in fish products. Trade itself has a number of environmental issues associated with it, including the generation of greenhouse gases and chemical pollution. Conversely, the highly traded nature of fish products makes trade-based interventions a potential avenue for addressing environmental issues. Because of the close relationship between consumption and trade, and the sustainability issues associated with them both, their role as drivers of the fishery system is considered here.

Breaking down the different elements of consumption patterns reveals that 'sustainable consumption' is complex. It is much more than a matter of individuals eating 'dolphin-safe' tuna, if it means that the tuna has to be transported between continents. Likewise, locally caught fish may avoid issues of 'food miles', but this may be negated if fuel intensive production techniques are used. The sourcing of fish from outside Community waters, through fishing agreements and imports, raises further issues regarding the impact and role of the EU in international development and poverty alleviation.

This chapter begins by discussing trade and consumption related policies that are intended to address environmental sustainability issues. This sets the scene for the discussion of some of the major EU fish trade and consumption trends. The key issues identified by the conference and the recommendations made are given in conclusions.

4.2 POLICY CONTEXT

The EU has in place a host of policies on, and influencing, trade and consumption. While this provides a strategic framework for sustainable consumption and production, actual decisions on trade are heavily determined by the World Trade Organisation (WTO), which sets global rules aimed at liberalising international trade. The current Round of WTO negotiations is focusing in particular on ways of developing the international trading systems in a way that is beneficial to developing countries. Within the EU, the EU's Common Commercial Policy determines all external trade relations, while internal trade is heavily governed by the EU's internal market rules.

The importance of consumption and trade to the sustainability debate is reflected throughout the World Summit on Sustainable Development (WSSD) Plan of Implementation. An entire chapter of the Plan is dedicated to changing unsustainable patterns of consumption and production (Chapter III). In this, it is stressed that developed countries should take the lead in promoting sustainable consumption and production patterns. In securing benefits from globalisation while tackling the challenges that it presents, the need to examine the relationship between trade, environment and development are further stressed (Chapter V).

In the run up to the WSSD, the European Council made a number of commitments, including that *'… the EU should promote issues of global environmental governance and ensure that trade and environment policies are mutually supportive'* and *'The relationship between economic growth, consumption of natural resources and the generation of waste must change. Strong economic performance must go hand in hand with sustainable use of natural resources and levels of waste, maintaining biodiversity, preserving ecosystems and avoiding desertification'* (Göteborg Presidency Conclusions, 2001). Following the WSSD, the Commission adopted the Communication Towards a Global Partnership for Sustainable Development (CEC, 2002). In this, the potential of the EU to advance sustainability through trade was further reiterated with a priority objective being to provide incentives for environmentally and socially sustainable

27 Unless otherwise specified, the term 'fish' includes all fishery products.

production and trade. Consumption issues have not, however, been addressed specifically with respect to fisheries.

4.3 CONSUMPTION AND TRADE TRENDS

4.3.1 Global Context

Because the EU is heavily dependent on trade for its fish production and consumption, it is important to consider global consumption and trade trends. Indeed, it is inappropriate to consider EU consumption and trade in isolation given the highly globalised nature of the fish market. The total food fish supply for the world grew at a rate of about 2.4 per cent per annum between 1961 and 1999[28] (FAO, 2002). In 2000, global production from capture fisheries and aquaculture together supplied about 89 million tonnes of food fish. Of this, 63 million tonnes (71 per cent) was used for human consumption, with the remaining 29 per cent destined for non-food uses, mainly fishmeal and oil.

Of the 89 million tonnes of global production, marine capture fisheries accounted for 71 million tonnes (80 per cent). This was equal to catches in the early 1990s, following the oscillations of the 1994–1998 period caused by the influence of El Niño on the catches of Peruvian anchoveta. Inland capture fisheries accounted for a further 6.6 million tonnes. Global aquaculture production in 2000 was 11 million tonnes, accounting for 12 per cent of global fish production. Aquaculture has continued to grow in both volume and in terms of relative contribution to the world's supply of fish for direct human consumption. Developing countries account for some 90 per cent of aquaculture production, producing mainly herbivorous, omnivorous or filter-feeding species.

Between 1961 and 1999 the world population expanded at 1.8 per cent per annum. Since the late 1980s, however, population growth has occasionally outpaced the growth of total food fish supply, resulting in a decrease in per capita fish supply from 14.6 kg in 1987 to 13.1 kg in 2000. In the richer countries, food fish consumption has tapered off globally, while consumption in the poorer countries has grown rapidly, and the increasing demand has been met mainly through inland aquaculture. Although fish are an important protein source in developing countries, overall per capita consumption remains highest in developed countries.

Over the past two decades, fishery products were among the most traded primary food products. Roughly 40 per cent of global fish output by value (33 per cent by weight) was being traded internationally in 1998, compared with 10 per cent of global meat output. In 2002, fish imports reached a new record of more than US$61 billion (Nomura, 2004). While developed countries accounted for about 82 per cent of the total value of these imports, developing countries accounted for more than 20 per cent of the total value of exports. This unprecedented level of trade is against a backdrop of increasing fresh and frozen fish prices and declining prices of canned finfish products, shrimp and salmon.

4.3.2 EU Trade Patterns

4.3.2.1 Total fish trade

While EU fish catches have been in decline, EU fish consumption has been increasing[29]. The gap between the two has therefore been met through increased imports. The EU is a net importer, but it also exports significant quantities of fish, with imports, exports and the trade deficit all increasing over the past decade. Between 1993 and 2002, imports and exports of fisheries products increased from 6.7 million tonnes to 9.1 million tonnes (36 per cent) and 3.9 million tonnes to 5.5 million tonnes (39 per cent) respectively. The trade deficit subsequently increased from 2.8 million tonnes to 3.6 million tonnes (33 per cent) (Figure 20). Analysis of trade flows by Member State further reveals that even the largest importers export a significant amount of fish, with Spain and Denmark both being notable in this respect (Figure 21).

28 Figures exclude China because there is growing evidence that reported statistics for capture fishery and aquaculture in China are too high.
29 Wherever possible, figures for the 25 EU Member States are used. Because of data limitations, however, EU15 data is sometimes used. Unless otherwise specified, data is from Eurostat (2003).

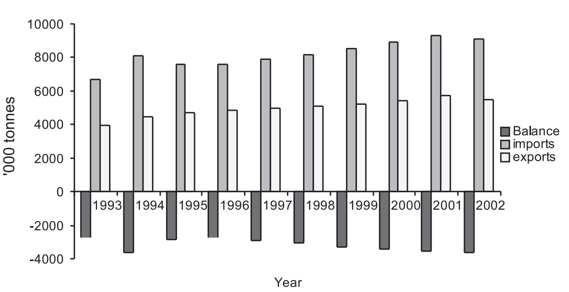

Figure 20. EU15 import, export and trade balance. Source: Eurostat, 1993–2002

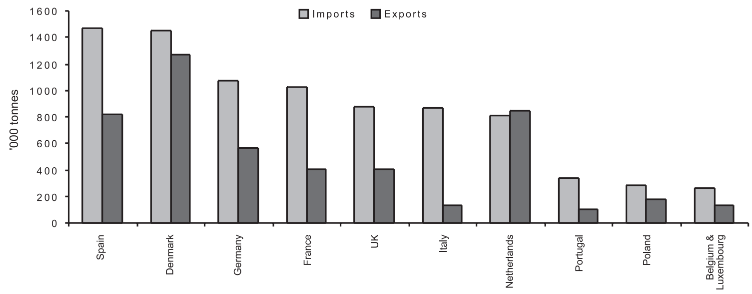

Figure 21. Top ten importing EU25 Member States. Source: Eurostat, 2002

4.3.2.2 Fishmeal and oil

Although fishmeal and oil production[30] is included in the figures above, it is discussed here in more detail because it is often considered central to the wider sustainability debate[31]. The EU is a net importer of fishmeal (442,000 tonnes) and fish body oils (63,000 tonnes). Again, however, these figures mask trade flows into and out of the EU. Germany, for example, accounts for 20 per cent of EU fishmeal imports while it consumes only 6 per cent. This difference is due to international meal traders, who subsequently re-export to other EU countries and to Norway. Such throughput can account for between a third and a half of supply to key consuming countries, such as the UK. The EU exports one third of its fishmeal products and is a significant importer of raw material (65 per cent of fishmeal supplies) from South America.

4.3.2.3 Processed fish products

The European processing sector is undergoing contraction and consolidation due to supply shortages and competition from cheaper imports. Some European companies are using the comparative advantages of countries outside the Community by exporting EU-sourced raw material for low-cost part-processing in countries such as China, and then bringing it back to the EU for finishing (Nautilus Consultants, 2003).

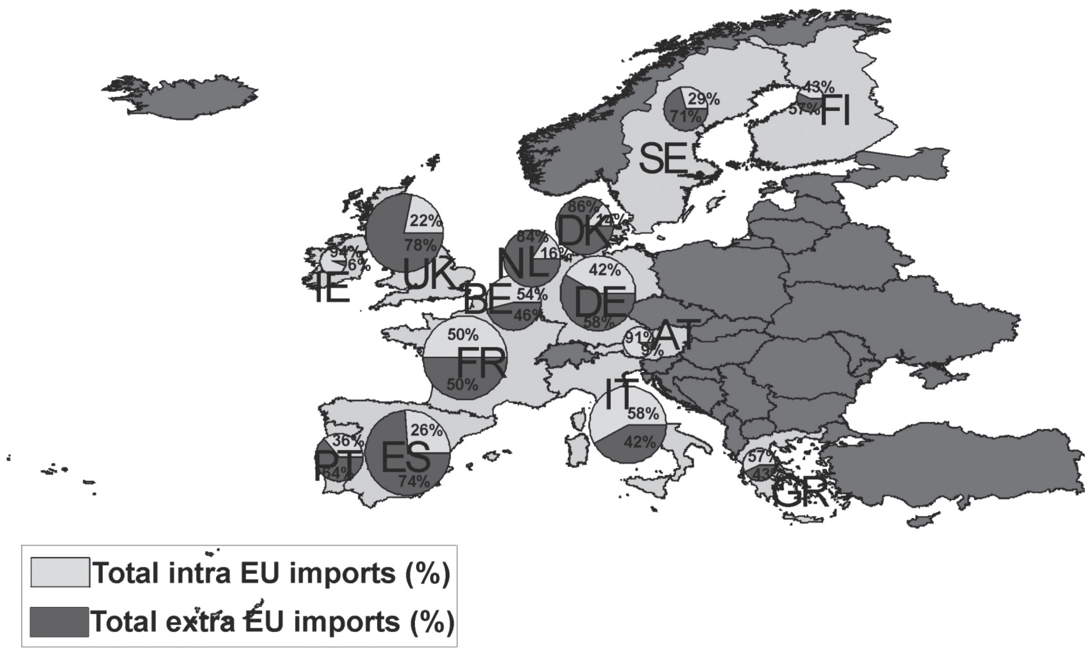

Figure 22. Intra- and extra-EU15 imports by value ('000 Euro) in 2000. Source: Nautilus Consultants, 2003

30 Much of the data on and analysis of the fishmeal and oil industry in this chapter draws on a European Parliament report (2004).

31 Common criticisms of industrial fisheries include removal of food of wild fish stocks, taking of juvenile and adult species (commercial and non-commercial) as bycatch, and the supplying of raw material to the animal and fish farming feed industries.

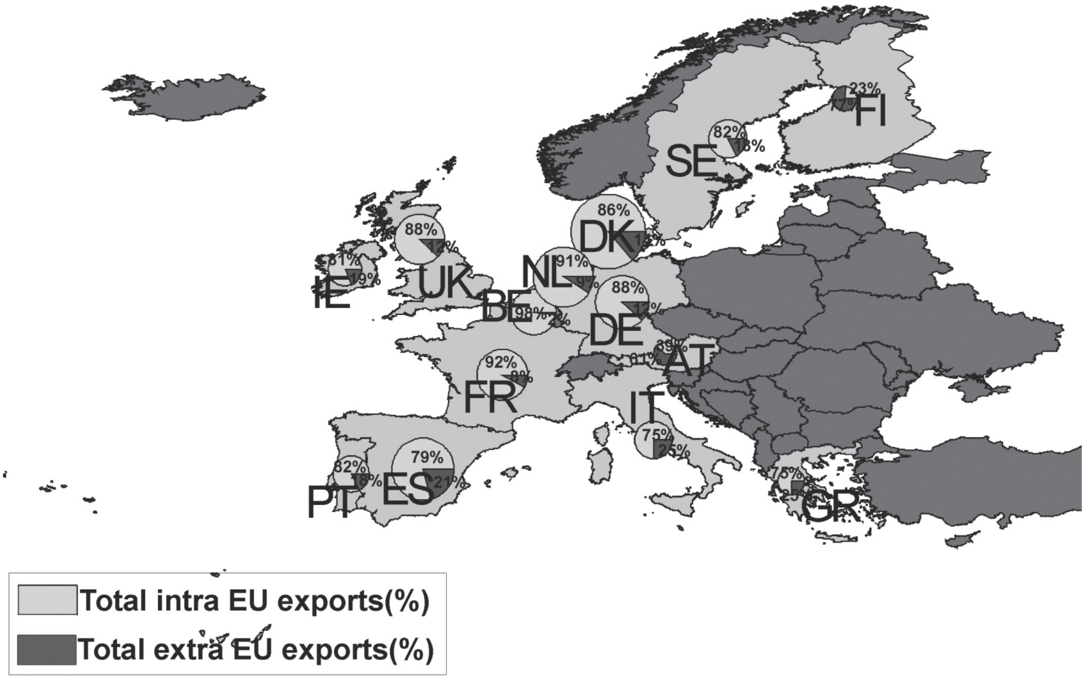

Figure 23. Intra- and extra-EU15 exports by value in 2000. Source: Nautilus Consultants, 2003

From 1994 to 2000, extra-Community (EU15) imports of processed seafood increased 36 per cent, from €6.13 billion to €9.55 billion[32]. The EU processing sector also imported approximately €4 billion worth of unprocessed seafood products (fresh or frozen whole fish) in 1999. During the same period, the level of intra-Community trade in processed products increased by around 39 per cent to €5.7 billion. The total EU imports of processed seafood products in 2000 were subsequently over €15 billion (Nautilus Consultants, 2003). In terms of exports, 86 per cent of EU value is derived from intra-Community trade (€6.6 billion in 2000) with less than 900 million of processed seafood products exported in 2000. These trends, and the Community dependence on imports, are illustrated most clearly in Figure 22 and Figure 23, which present intra- and extra-Community imports and exports by Member State in 2000.

4.3.3 EU Consumption Patterns

4.3.3.1 Fish for human consumption

Human consumption of fish by the EU25 increased from nine million tonnes in 1991, when complete data is first available, to ten million tonnes in 1999 (10 per cent) (Eurostat, 2003). Spain and France are the largest consumers of food fish, followed by Italy and the UK (Figure 24). Per capita consumption increased at a rate of 1.3 per cent per annum

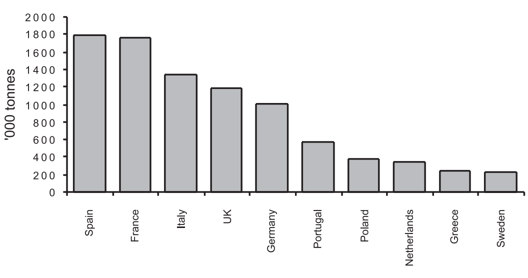

Figure 24. Consumption of top ten EU25 Member States (1999–2001 average). Source: Eurostat, 2003

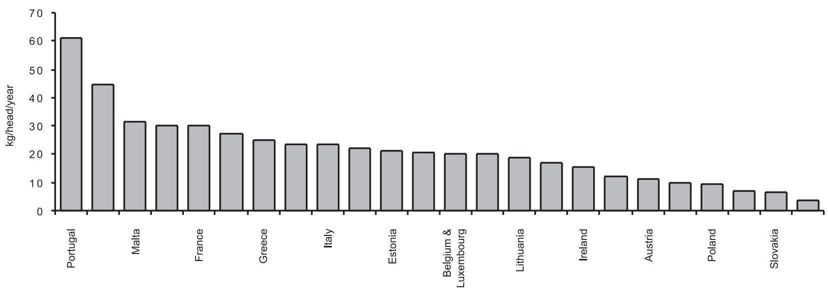

Figure 25. Per capita consumption of EU25 Member States (1999). Source: Eurostat, 1999

32 Trade figures for processed seafood products are expressed in value terms because volume figures are not readily available.

between 1973 and 1997, with the 1999–2001 EU25 average being 21.35 kg per head per year. This figure varies by Member State, with Portugal having the highest per capita consumption rate (61.1 kg/head/year), followed by Spain (44.4 kg/head/year), and with Hungary at the lowest end of the range at 3.8 kg/head/year (Figure 25).

In 1998, the main species consumed were mussels (7 per cent), cod (7 per cent), tuna (6 per cent), herring (6 per cent), cephalopods (squid, octopus and cuttlefish; 5 per cent), sardines (5 per cent) and salmon (4 per cent), shrimps (4 per cent) and trout (3 per cent). Demersal species and lower value small pelagic fish each accounted for approximately 15 per cent of the overall consumption (FAO, 2002).

4.3.3.2 Product types

Approximately 79 per cent of EU fish production is used for human consumption and the remaining 21 per cent is used to produce fishmeal and oil. Of the fish processed for human consumption, around 15 per cent is marketed fresh (Nautilus Consultants, 2003). Working from the best available data, frozen fillets and frozen shrimp and prawns are the largest import group in the European Economic Area. Because these are generally re-exported within the region after further processing, the export values are a useful proxy of consumption preferences (Figure 26). 'Frozen fillets' consists of frozen whitefish blocks imported from Norway, Iceland and more distant markets, such as vessels operating in the Southern Ocean. Blocks of skinless and boneless whitefish are sawn into retail portions and combined with a variety of sauces to produce ready-meals. Enrobing in batter or breadcrumbs is also a popular product form for frozen fillet. The prominence of fresh and chilled salmon is relatively recent, and a result of increased aquaculture production in Norway, Scotland and Chile.

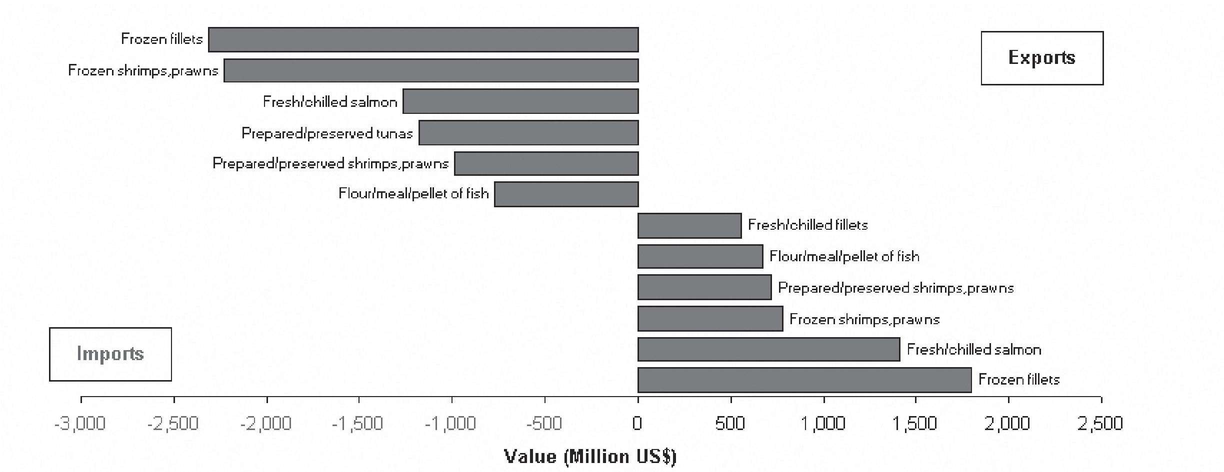

Figure 26. Major import and export commodities in Western Europe in 1996, as classified under the FAO Harmonized System Commodity Classification. Source: FAO[33]

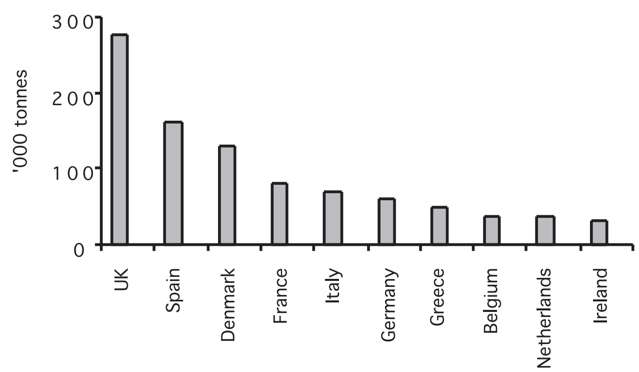

Figure 27. Fishmeal consumption of top ten EU15 Member States (1997–2001 average).
Source: Eurostat, 2003

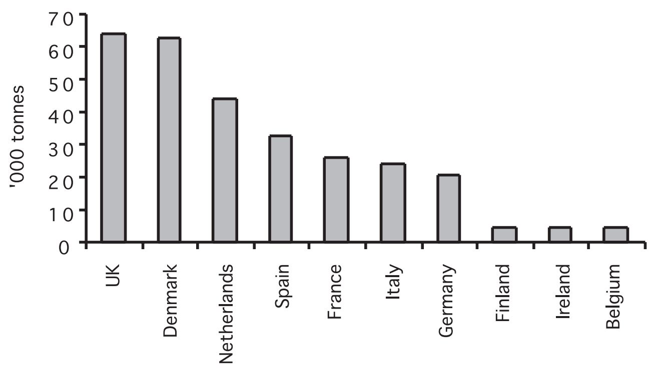

Figure 28. Fish body oils consumption of top ten EU15 Member States (1997–2001 average).
Source: Eurostat, 2003

33 http://www.fao.org/fi/fifacts/plots/WEuro/weste12.asp

4.3.3.3 Fishmeal and oil

The EU is one of the main consumers of fishmeal and accounted for approximately 18 and 19 per cent of world meal and oil consumption respectively between 1997–2001. The yearly EU25 consumption of fishmeal and fish oil is 1.2 million tonnes and 230,000 tonnes respectively. The UK, Spain and Denmark are major consuming countries of fishmeal and oil (Figure 27 and Figure 28). In 2002 and 2003, meal consumption, and consequently imports, fell 18 per cent against the preceding years because of the ban on the use of fishmeal in ruminant feed.

Over the past six years, the use of fishmeal in aquaculture has grown by 18 per cent. Its use in the pig and poultry sector has decreased, although the market share has remained constant due to a drop in demand resulting from the ban on feeding fishmeal to ruminants (Table 5).

Table 5. Average EU annual fishmeal consumption in 1998 and 2002.

Use	1998		2002	
	'000 tonnes	Per cent	'000 tonnes	Per cent
Aquaculture	214	21	254	33
Pigs	310	31	252	32
Poultry	280	28	225	29
Ruminants	152	15	–	–
Other eg pets	39	4	50	6
Total EU consumption	995		781	

Source: European Parliament, 2004

The trout farming industry is the main consumer of fish oils within the aquaculture sector, although recent growth in demand has come largely from salmon farming (Table 6). The increase occurred despite an increase in the price of fish oil relative to rape seed and soya oils. Demand from bass and sea bream aquaculture has been driven by increased production in the Mediterranean countries (itself fuelled by EU subsidies), while consumption from trout farms has fallen as a result of decreasing production.

Table 6. EU fish oil consumption in aquaculture ('000 tonnes).

Cultured species	1998	2002
Trout	65	62
Salmon	45	58
Bass and bream	20	30
Others	5	5
Total	135	155

Source: European Parliament, 2004

4.3.4 Outlook to 2020

Delgado *et al* (2003) projected global fish demand and supply under six different scenarios:

i. most plausible set of assumptions about demand, population growth and income, resource and technology trends;
ii. a much faster growth trend for aquaculture than in the previous decade;
iii. a more efficient fish conversion efficiency for fish oil and fishmeal;
iv. an ecological collapse – failure in sustaining capture fisheries production;
v. lower production for China; and
vi. a slower growth for aquaculture.

Global consumption is projected to vary between 106 million metric tons (in case of ecological collapse) to 142 million metric tons (in case of faster aquaculture growth), a difference in the level of consumption by nearly 34 per cent. The consumption levels in EU countries vary by about 33 per cent, from seven million metric tons to nine million metric tons respectively, under the two scenarios (Table 7). On the other hand, fluctuations in production between faster aquaculture growth and ecological collapse are projected to be only 17 per cent for the EU compared to 33 per cent for the entire world (Table 8). Hence, EU's consumption levels can be expected to fluctuate more than its production under the different scenario.

Table 7. Projected total consumption of food fish 2020 under various scenarios ('000 metric tons)

Region	Most likely	Faster aquaculture	Fishmeal efficiency	Slower aquaculture	Ecological collapse	Lower China production
EU15	6,716	7,020	6,763	6,456	5,988	6,716
Japan	5,172	5,132	5,115	5,204	4,757	5,168
USA	4,927	5,107	4,935	4,790	4,243	4,929
Developed	27,618	28,323	27,755	27,053	23,872	27,624
Developing	102,495	116,155	103,025	91,999	84,286	95,062
All	130,112	144,478	130,781	119,050	108,158	122,687

Source: Delgado *et al* (2003)

Table 8. Projected total production of food fish to 2020 ('000 metric tons)

Region	Most likely	Faster aquaculture	Fishmeal efficiency	Slower aquaculture	Ecological collapse	Lower China production
EU15	8,807	9,307	8,825	8,413	7,004	8,763
Japan	7,439	7,814	7,447	7,139	6,282	7,412
USA	6,251	6,609	6,267	5,971	4,804	6,205
Developed	29,192	30,700	29,259	28,001	23,089	29,031
Developing	98,583	111,222	99,176	88,884	83,074	91,315
World	127,776	141,923	128,435	116,885	106,162	120,347

Source: Delgado *et al* (2003)

While Delgado *et al* considered the EU15 as a whole, the FAO (2002) projected future trends in fish production and consumption in 28 individual European countries. This was done on the basis of estimated production capabilities, demand functions and the political framework of the EU. Although the absolute estimates of fish for human consumption are expected to decrease in only three countries (Estonia, Latvia and Spain), per capita fish consumption is expected to decrease in Norway, Portugal and Sweden in addition to these three countries as a result of demographic changes. Marine fish (tunas, small pelagics, demersal and others) are expected to remain the main fish group consumed. Most of the growth in consumption, however, is expected from cephalopods, crustaceans, freshwater fish and anadromous fish. Frozen and prepared and/or preserved fish are expected to dominate the category of fish for food consumption.

4.4 CONSUMPTION DRIVERS

Consumption is driven by a number of factors (Figure 29). These are complex and often inter-related, with some also playing a role in driving production systems, such as technology (see Chapter 3). While by no means exhaustive, some of the main drivers of consumption of fish products are considered in further detail here, as a background to discussion of potential opportunities for addressing environmental issues related to consumption.

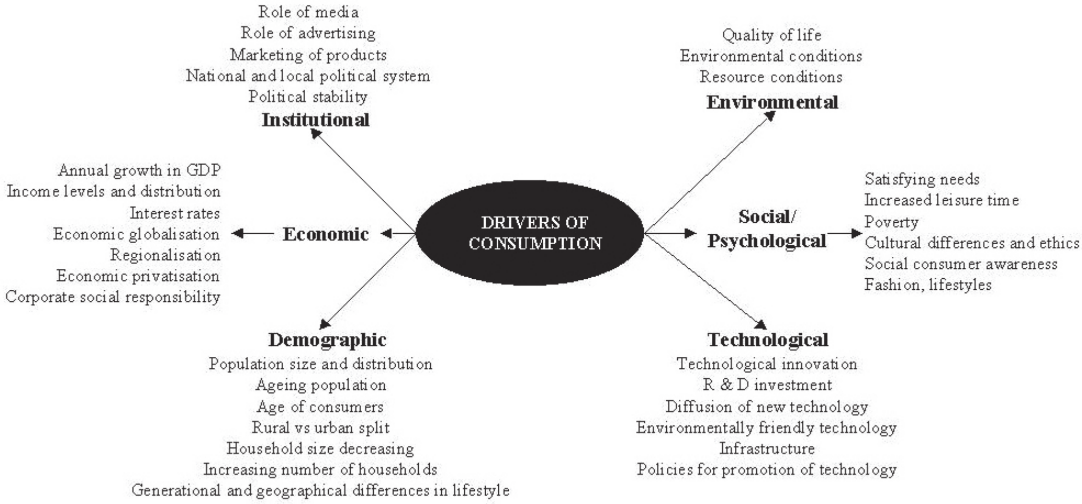

Figure 29. Generic drivers of consumption. Source: Bowyer *et al*, 2004

4.4.1 Prices

Fresh and frozen fish have shown a long-term increase in their real prices since the Second World War. This contrasts with red meat prices, which lost up to half their value on world markets between the early 1980s and the late 1990s (Delgado *et al*, 1999). Canned finfish products prices, however, have declined with shifts in developed country consumer tastes, while shrimp and salmon prices have dropped due to aquaculture expansion. While these trends have filtered into the EU retail prices, fish prices are kept artificially high through EU tariff barriers (Hird *et al*, 2004)[34]. Such tariffs are extensively used to 'manage' supplies to the domestic processing industry in the face of declining EU catches (OECD, 2003).

Based on evidence, real price rises of food fish will, on average, cut into fish consumption (Asche and Bjorndal, 1999). Conversely, a fall in prices will lead to a proportional increase in consumption. Theory suggests that a reduction in consumption caused by price rises is likely to be stronger for the lower income groups. This mean that any future increases in prices will affect developed countries proportionately less than for developing countries.

4.4.2 Population and Wealth

Animal product consumption, particularly fish products, grows fastest in countries with rapid population growth, rapid income growth and urbanization (Rae, 1998; Delgado and Courbois, 1998). These factors are expected to come into play to varying degrees in the EU. EU population growth is not significant, with the population of the EU25 countries growing from 452 million in 1995 to 459 million in 2003 (1.5 per cent). It is expected to grow to 461 million in 2005 (EC, 2004). This slowing population growth, however, is expected to be offset by income growth. The economy of the EU25 grew by an average of 2.2 per cent between 1996 and 2003, and is expected to grow by at least 2 per cent over the next two years (EC, 2004). Together with an economic recovery of the central and eastern countries of the region, the historic increase in demand for fish is anticipated to continue (Varadi, 2001). The nature of population growth may also have important implications. Recent immigration levels into Western Europe, for example, has been a factor in increased demand for some cyprinid species and the African catfish (Hilge and Halwart, 2004). Urbanisation is also likely to be an important factor in the ten new Member States[35].

4.4.3 Fish and Animal Feeds

Demand for fishmeal and fish oil is primarily determined by the underlying demand for livestock and fish, together with a range of factors including feed conversion efficiency, the relative prices of competing feeds, and performance of

34 The EU has 357 tariff lines for fisheries products. Of these, 10 are duty-free, 6 less than 3 per cent, 127 in the 5–9.9 per cent range, 60 in the 10–14.9 per cent (high tariff) range, and as peaks (duties over 15 per cent) 72 in the 15–19.9 per cent range and 82 in the 20–26 per cent range (Hird *et al* 2004).

35 Ten new Member States joined the EU on 1 May 2004: Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia.

competing consumers of fishmeal and fish oil. High-value aquaculture that produces carnivorous fish and crustaceans has strong demand for these feed inputs. Given the particularly globalised nature of aquaculture, the 'upgrading' observed in the developed countries that is currently occurring within the developing world is expected to be a key factor in this growing demand (Delgado *et al*, 2003).

4.5 ENVIRONMENTAL ISSUES

Trade, globalisation and consumption are often heavily criticised because of their environmental and social implications. The effects of fishing and aquaculture, such as stock depletion and habitat destruction, are often discussed as part of the consumption debate (eg Matthews and Hammond, 1999). While consumption and trade may be drivers of these problems, they are arguably issues of production and as such are discussed in Chapter 2. Despite the criticisms, we actually lack empirical evidence as to the effects of international trade in fish, fish products and fisheries services on fish stocks, marine ecosystems and the broader environment (Dommen, 1999). There is also a lack of knowledge as to the effect on fisheries and marine ecosystems of applying certain trade rules and measures to the fisheries sector. Despite these knowledge gaps, there are real issues surrounding the interactions between trade, globalisation and consumption and the negative impacts they may have.

4.5.1 Trade

4.5.1.1 Driver of overfishing and damaging production methods

Trade is ultimately a response to demand. Some of the key resource problems that arise in the absence of good management, can be exacerbated by trade. Export orientation can increase pressure on resources that coastal communities depend upon by, trade priorities can heighten political pressures around access to stocks and producers can employ environmentally undesirable practices in response to increasing demand. In the face of weak or absent management regimes, increased fishing pressure may come in the form of overcapitalisation and/or illegal, unreported and unregulated (IUU) fishing. There may also be a tendency to employ damaging fishing methods (see also Chapter 3). In both of these cases, the analysis thus turns to the forms of instruments and governance needed to secure sustainable exploitation (see chapters 5 and 6).

There are concerns that the increases in trade in fish will result in increased resource use and therefore exacerbate overfishing. There are counter arguments, however, that increased trade can generate increased revenue that can be used to strengthen fisheries management systems. With few exceptions relating to specific cases, current knowledge does not allow us to draw conclusions as to the accuracy of either statement. This makes it inappropriate to make broad statements of how environmentally undesirable trade is. Indeed, one could argue that it would not be particularly useful to attempt to make such generalisations given that the contexts are so diverse. There are nonetheless a number of key issues related to the relationship between trade and the environment:

- the effects of trade flows on the environment are not always readily identifiable because they largely manifest themselves indirectly through impacts on levels and patterns of production and consumption;
- trade and environment issues cannot properly be addressed in isolation from broader development and sustainable development questions;
- effective environment and natural resource management policies must be in place to ensure that trade and trade liberalisation contributes to effective resource allocation and sustainable development;
- assessments of trade and trade liberalisation should identify both the positive and negative environmental and social effects of specific trade measures, such as the removal of trade restrictions or distortions;
- trade rules may be used with the aim of enforcing conservation and resource management policies, domestically or extra-territorially;
- civil society has an important role to play in international discussions where trade, conservation and sustainable development issues intersect: when diverse perspectives are engaged in real dialogue, better policies emerge; and
- trade rules may have a potential role in strengthening development efforts.[36]

36 This list is adapted from Dommen (1999).

4.5.1.2 Food miles

The increasing trade in fish has much wider environmental impacts than just those relating to fish stocks or the marine environment. Indeed, environmental concerns relating to trade in food has given rise to the term 'food miles', used in discussing the distance food travels from its point of production to reach the point of consumption and the resulting environmental impacts.

Pollution – transport in all forms is a major consumer of energy and typically a significant source of pollution. While data is not readily available on the level of EU fish food miles, case studies in the food industry demonstrate that transportation of food is a significant source of emissions, including greenhouse gases, as well as contributing to road congestion and other pressures. In the UK, for example, very little food is freighted by rail, a less polluting option than road or air. Air freight, a particularly polluting form, is also set to increase substantially over the next 20 years (Goetz *et al*, 1999).

Packaging – food transported long distances often needs greater degrees of packaging to retain product quality. In addition to consuming more resources producing, transporting and disposing of this packaging, this can result in waste and pollution as retailers seek to dispose of this waste as cheaply as possible. In the UK, an average of 137 kg of packaging per person was used in 1995. Of the 25 million tonnes of waste produced in the UK in 1997, a third was food packaging (Goetz *et al*, 1999).

Processing – the increasing trade in raw and processed fish products is discussed above. Processed fish incurs greater food miles than fresh produce, because of the additional transportation of ingredients (and packaging) required prior to distribution to retail outlets. Many modern forms of processing, such as canning and freezing, are also more energy intensive than traditional methods of smoking and salting (see Chapter 2). The amount of energy incurred to maintain chilled and frozen fish products will also increase with distance travelled.

4.5.2 Fisheries Agreements

Fisheries Agreement may be considered a form of trade as the fish caught in Third Countries are subsequently sold on the European markets. Many stocks targeted by the EU fleet are the same as those targeted by the national fleets. In accordance with UNCLOS, the EU fleet should be given access only to the 'surplus' that the coastal state is unable to access. However, in the past the EU has pushed to get access to fully exploited or even overexploited resources (for instance coastal demersal species in West Africa) (Gorez and O'Riordan, 2003). Access agreements are also negotiated on a bilateral basis, whereas several of the stocks are transboundary and migratory.

Many third countries have large EEZs they are not in a position to control effectively. This opens the door to under-reporting of catches and of bycatch. It also makes it difficult to evaluate the full environmental impact EU fleets are having. The use of observers only partly addresses this issue. They are often paid by the vessel owners, creating conflicts of interest. The observers and the monitoring and control personnel may simply be bribed or intimidated (Gorez and O'Riordan, 2003).

The environmental impacts of fisheries agreements are therefore likely to be at least as great as those associated with fishing in EU waters. There is, however, no reason to assume that ceasing the agreements improves the situation. The Third Countries have often a great need of foreign currency and the EU fleet is likely to simply be substituted by other fleets.

4.5.3 Consumption

4.5.3.1 Efficiency gains versus the pace of growth

Human impacts on the environment, including those of consuming fish, are determined by a race between consumption and efficiency improvements. As consumption increases, so do environmental loads and demands, whether they are on fish stocks or the wider environment. The counter to this is efficiency gains, such as bycatch reductions, increased feed conversion rates and improved processing systems. Indeed, there are significant opportunities for improving the efficiency of fish production systems (see Chapter 3). The question is: which of the two are winning? While the answer will most likely depend on the case in question, there is little evidence to suggest that historic efficiency improvements will increase to the levels required to offset the projected growth in consumption. Even in the event of reduced waste, the reproductive capacity of fish stocks, which fish farming is also dependent upon (see below), will ultimately be a limiting factor on sustainable fish production levels.

4.5.3.2 It's a fish eat fish world

Aquaculture and its dependence on wild fish stocks is an issue that straddles both the consumption and production debates. While aquaculture may have been hailed as a solution to declining wild stocks and catches, it can itself put pressure on wild stocks, either as a source of farm stock or through the production of feed, as well as compete for space. The use of wild fish as feed in aquaculture is particularly controversial because of issues of protein loss in farming carnivorous species and the ecosystem effects of removing fish that are preyed upon by fish harvested for human consumption. These issues are discussed in more detail in Chapter 3.

4.6 CONCLUSIONS

Breaking down some of the commonly discussed environmental issues associated with consumption and trade, it becomes apparent that many are in fact more production than consumption related. The use of wild fish as a basis for terrestrial and aquatic farming systems and the practice of EU vessels fishing overexploited stocks off of West Africa are issues of production. However, production is a response to consumption, and trade is the link between the two. In an ideal world, where management systems are adequate, increasing demand and trade would not have implications for resources and ecosystems; increased demand would lead to increased prices, but not necessarily increased fishing or use of destructive fishing or farming methods. In reality, however, this is not the case and the relationships between trade, consumption and production present opportunities for altering production by changing consumption and trade patterns. Further to this, consumption and trade themselves also give rise to specific environmental pressures. While also part of the production debate, ever-increasing levels of consumption undermine efficiency gains. More separable from production, trade also impacts the environment through transport, packaging and processing.

The conference working group discussed these issues at length. The central challenge seems to be developing broad policy responses to the consumption and trade issues that target, as well as solicit inputs and participation from, a range of stakeholders, including governments, processors, wholesalers, retailers and consumers.

Information programmes such as ***local, organic and ecolabelling*** can contribute to moving towards environmental sustainability. Maximising the potential of such programmes, it is necessary to ensure that they are developed in such a way that they are not misleading or abused. The Commission needs to produce a legal framework proposal for minimum eco-, local and organic labelling standards building on international standards, such as those proposed by FAO. Furthermore, the Commission needs to produce a Plan of Action and/or a discussion chapter with regard to minimum labelling standards and voluntary agreements between retailers and the Commission or Member States.

Traceability is a prerequisite for any information scheme to provide a basis for ensuring that products can be reliably labelled. While such labelling may be less complex than local, organic and ecolabelling, it can still play an important role in enabling consumers to make informed choices. This includes labelling of species, place of capture, country of origin, and method of fishing or farming. To this end, there should be improved traceability for information programme and control purposes; traceability infrastructure improvements; and better enforcement of existing and new requirements.

A number of stakeholders, including the capture and processing sectors, have concerns over the often-***negative consumer and industry perceptions***. While consumers are inundated with positive messages about the health benefits of eating fish, they are almost exclusively told that eating fish is not good from a resource point of view. There is comparatively little advice on which fish products can be consumed without these concerns and little information about where management progress is being made. This means that consumers typically have a negative perception of the fish producing industries, which might decrease consumer demand and so be damaging to the industry. Similarly, industry predominantly has a negative perception of the Common Fisheries Policy, which means that trust between government and industry is weak. This could be addressed by both the Commission and the industry by asking RACs to develop positive messages about the CFP. The Commission could also launch EU-level consumer campaigns for sustainable fisheries in cooperation with the stakeholders.

While it is important to develop a legal framework for consumer information programmes and to subsequently develop the programmes themselves, this may not be enough to guarantee their uptake or application. Producers may not be able to afford the costs of certification or may need assistance in organising themselves for certification, especially in the initial stage of transformation to standardisation and certification schemes. The EU should use ***financial instruments*** to support its own industry and similarly also support third countries through its development programmes. A budget line for consumer information programmes should therefore be included in the European Fisheries Fund (EFF) that is presently under discussion. This should include support for industry meeting the costs of certification as well as financing NGO consumer campaigns. Support should also be provided to developing countries in meeting labelling standards. This could be through, for example, capacity building under EU and Member State development programmes, with particular emphasis on small-holder producers and processors who otherwise would be displaced from the commodity supply-chain. Such support should work hand in hand with the schemes of support for social and economic safety-nets in developing countries.

Finally as a form of trade, the environmental impacts of ***fishing access agreements*** made between the EU and third countries are likely to be at least equal to those that occur in EU waters. As such, it is important that agreements be made on the basis of best available information and that the principle of the user pays is applied. As a starting point, there should be a significant increase in the access fee for vessel owners fishing under access agreements, and information on resources should be made available before negotiations between the EU and third countries begin.

5 POLICY INSTRUMENTS

Written by Dirk Reyntjens (IEEP) and Anthony Cox (OECD)[37]

5.1 INTRODUCTION

This chapter reviews the instruments available for fostering the environmental integration in the CFP. It is structured around five major groups of policy instruments:

i. Command and control instruments;
ii. Economic and fiscal incentives;
iii. Spatial planning;
iv. Voluntary agreements; and
v. Information programmes.

The fisheries sector is taken here as including both capture fisheries and aquaculture. Capture fisheries and aquaculture result in negative externalities, including damage to the environment, such as bycatch, benthic disturbance and nutrient loading. These necessitate government intervention. While the fisheries sector is of minor importance to the EU economy as a whole, it can play a vital economic and social role in coastal communities where alternative sources of income and employment are often limited.

Fisheries, together with most other sectors, are increasingly subject to environmental constraints. Integration of environmental protection requirements into Community policies is an obligation under Article 6 of the EC Treaty. Council Regulation 2371/2002 states that the Common Fisheries Policy shall provide for coherent measures concerning *'limitation of the environmental impact of fisheries'* and the Commission has set out its ideas in a number of policy documents[38]. In Communication 2002/186, the Commission states that environmental integration in the CFP is based on the principles of precaution, prevention, rectification at source and the polluter pays.

The key issues identified by the conference and the recommendations made are given in the conclusions.

5.2 POLICY CONTEXT

There is clearly a growing international political commitment to responsible fisheries. Most notably at the WSSD in Johannesburg in 2002, Heads of State and Governments agreed to several objectives, among them the maintenance or restoration of fish stocks by 2015 (30 (a)) and a significantly reduced rate of biodiversity loss by 2010 (42), as discussed in Chapter 2.

Many of the WSSD targets are reflected in EU level commitments, policies and work plans. Most notably, the basic CFP Regulation (2371/2002) includes requirements to develop multi-annual recovery and management plants for EU fish stocks, as well as the application of an ecosystem-based and precautionary approach. For the first time, there is also a clear legal basis for measures designed purely to reduce the impact of fishing on the environment.

5.3 COMMAND AND CONTROL INSTRUMENTS

To date, the EU has primarily relied on regulatory instruments to limit the environmental impact of its fisheries. We will call them command and control instruments to avoid confusion with the term 'regulation', which denotes a specific legislative instrument in the EU. The Common Fisheries Policy consists of approximately 400 such Regulations passed by

37 The views expressed in this paper are those of the author and do not necessarily reflect the views and opinions of the OECD Member countries.
38 COM(1999)363 Nature conservation and fisheries management; COM(2001)143 Elements for an integration strategy; COM(2001)162 Biodiversity Action Plan, COM(2002)186 Commission Action Plan to integrate environmental protection into the Common Fisheries Policy.

the Council of Ministers, relatively few of which involve the establishment of economic policy measures. There are three key reasons for this. First, traditional bureaucracies tend to rely on calculable rules that trigger responses from whom the regulations are targeting (Porter, 1995). A common view is that this approach offers more reliable outcomes since objectives can be clearly specified in physical terms. Second, there are issues of EU competence that explain the reliance on command and control instruments. Fisheries are an exclusive competence of the EU. Qualified majority voting in the Council can decide on fisheries regulations. However, the use of economic instruments requires unanimous agreement in the Council of Ministers and is therefore much more difficult to achieve, because any one country can block the measure. Third, in the case of EU fisheries, command and control instruments have the added advantage that they allow the Commission to circumvent the constraints of a limited Community budget (Lequesne, 2004).

There are a certain number of problems associated with command and control instruments. They are normally a reaction to a problem that has already occurred. It may be difficult and protracted to reach an agreement on the measure proposed, by which time the problem has grown worse. This also means that the measure probably reflects the best option at some time in the past but not necessarily currently. Command and control measures will treat all with the same brush. The alternative is to define different measures for different zones but then problems may arise at the borders.

5.3.1 Absolute Prohibitions

Command and control instruments take several forms. Absolute prohibitions seek to completely ban certain activities or production processes. Examples include certain destructive fishing methods, the use for fishing purposes and the keeping on board of toxic and soporific or corrosive substances, of electric shock generators and of explosives in the Mediterranean. It is currently prohibited to use non-selective purse seines in certain fisheries where high cetacean bycatch is encountered or to use drift-nets intended for the capture of specific fish species, including tuna, marlin, swordfish, cephalopods and some species of shark. Prohibitions may also be seasonal or temporary. Fishing for bluefin tuna with encircling nets in the Mediterranean Sea, for example, is prohibited from 16 July to 15 August, and fisheries are often closed temporarily for public health reasons. Prohibitions may apply to specific types of gears in well-defined areas. Council Regulation 602/2004 forbids the use of bottom trawls or other similar towed nets in contact with the bottom on the Darwin Mounds.

5.3.2 Licensing

A licence is necessary before a unit is authorized to operate. The EU fishing licensing system has no explicit objective. It primarily serves the need of fleet management (Brown et al, 2004). Under the CFP, all European fishing vessels have to have fishing licences in order to catch, retain on board, transfer or land fish (Regulation 3690/1993). The responsibility for issuing fishing licences rests with the Member States. Member States and the Commission also issue 'special fishing rights' to regulate access and fishing to specific areas and fisheries (Regulation 1627/94). Licences and special permits include information on the type of vessel, main gear types, engine power, length, tonnage and fleet segment, and they form the basis of information systems for monitoring the vessels and gears used. Licensing is sometimes associated with a cost-recovery scheme intended to cover the administrative, monitoring and enforcement costs of a particular fisheries management regime. The issuing of licences can be associated with preconditions that need to be fulfilled. For instance it may be required that certain standards be met. A licensing system can also be used to impose effort limitations. This may raise questions of equity, however. For instance, on what ground can a license be denied fairly?

The establishment of marine fish farms will often require at least two types of 'licences': a planning permission for the installations above the low water mark and a seabed lease for the farm itself.

5.3.3 Standards

Standards apply either to the process used in the production (technology standards), to the products produced (product standards) or to the amount and quality of material that is discharged back into the environment (emission standards). In fisheries, standards are used often in conjunction with licensing.

Production (technology) standards are imposed in terms of gear specifications such as minimum mesh or hook sizes, or maximum dredge weight and sizes. For instance, Council Regulation 867/2004 imposes the use of BACOMA exit windows for towed nets in the Baltic Sea cod fishery. In aquaculture, while there are a number of independent standards (such as for organic production), there are few examples of government standards in Europe (see Chapter 3 for more details on the use of organic or eco-labelling standards).

Product standards have also been imposed for instance in terms for minimum capture and landing sizes. For example, Annex IV of Council Regulation 1626/94 fixes minimum sizes for a number of species landed in the Mediterranean.

Emission standards are less commonly used in EU capture fisheries. Examples are limited to bycatch limits set to protect specific target and non-target species from depletion, such as cetaceans and cod. Council Regulation 831/2004 sets a limit of 10 per cent on the number of undersized bluefin tuna. Annex V of MARPOL on the prevention of pollution by garbage from ships specifies the distance from land and the manner in which garbage from ships can be disposed of. It identifies a number of special areas where stricter standards apply (the North Sea is one) and completely bans the disposal of all forms of plastic. Annex VI of MARPOL, which will enter into force in 2005, sets limits for sulphur and nitrogen oxide emissions from ships undertaking international journeys and prohibits the deliberate release of ozone depleting substances.

On the other hand, emission standards are very important in the regulation of marine aquaculture operations. For instance, in the UK, the operation of marine fish farms requires a discharge-consent that may include a range of conditions. In Communication 2002/511, the Commission announces its intention to study whether the Council Directive 91/676/EC on the water pollution caused or induced by nitrates from agricultural sources and the Council Directive 96/61/EC on the Integrated Pollution Prevention and Control should be extended to cover intensive aquaculture operations.

5.3.4 Threshold Levels

Threshold levels are expressed in terms of the value of given indicators. In fisheries, these take the form of reference points expressed, for instance in terms of spawning stock biomass (must be above a given minimum) and fishing mortality (must be kept below a given maximum). Limit reference points represent a situation that management should avoid. Target reference points are what management is aiming for. Council Regulations 423/2003 and 811/2004 specifically set minimum and target levels for mature cod and hake stocks. Threshold levels are not in themselves policy instruments. They need to be linked to some instrument or management action. Ideally, management action is triggered automatically if the threshold level is reached. In Norway, for example, if the number of under-sized fish reaches 15 per cent of the catch, skippers are obliged to inform the authorities, who will temporarily close the area. *Effort control* can be used to keep fishing mortality below a given threshold. Most recently, effort control measures have been made a central part in the cod recovery plan.

5.3.5 Total Allowable Catch

Total Allowable Catch (TAC) is not primarily an environmental management instrument. In principle, it is used to set a maximum take from a particular stock. It occupies a central part in the management of EU fisheries. The TACs specify the amount of fish from specific stocks that the vessels of the Member States may land within a given year. The actual mechanisms by which TACs are taken up and enforced are set by the Member States themselves. One possibility is the allocation of individual transferable quotas (ITQs).

Based on a Commission proposal, the TACs are set annually by the Council of Ministers at their December meeting. In elaborating its proposal, the Commission will have taken advice from stakeholders including fishers' representatives through the Advisory Committee on Fisheries and Aquaculture (ACFA). The other formal advisory body to the Commission is the Scientific, Technical and Economic Committee for Fisheries (STECF). The STECF is composed of national fisheries experts selected and nominated by the Commission itself. The STECF advises on the recommendations made by fisheries research institutes, in particular the International Council for the Exploration of the Seas (ICES).

The TAC system is often decried but it has a number of positive points. Particularly relevant to the EU context is that it offers a neat manner to share out the resource between Member States. It does so without pre-judging how the MS itself wants to administer its share. There are, however, also a number of drawbacks. The actual decisions taken by the Council of Ministers are often different from the Commission's proposals and usually involve higher TACs than recommended by the research institutes. In spite of the recent reform of the CFP, this system appears to have remained relatively unchanged. For stocks being the objects of recovery plans, the Council of Ministers is now, in principle, constrained by targets that have to be met and limits on the TAC variation between successive years. However, it is the Council itself that will have set these targets and limits. In addition, the setting of TACs puts high demands on science and the concept is difficult to apply to multi-species fisheries. The use of TACs may also encourage under- and misreporting, discarding and high-grading.

5.4 ECONOMIC AND FISCAL INCENTIVES

In order to induce particular outcomes from fishers, economic and fiscal incentives entail a modification in the relative prices of either input or output, a financial transfer and/or other incentives. Since the 1980s, there has been a trend towards increasing use of economic instruments in the industry/manufacturing sector. The Fifth EU Environmental Action Programme (1992–2000) revolved *inter alia* around attempts to broaden the range of instruments but did not explicitly consider fisheries. With the exception of subsidies, these types of instruments have not been employed extensively in the EU fisheries sector. One difficulty is that any Community measure of a fiscal nature requires unanimity in the Council (Article 93 of the EC Treaty). Article 175 of the EC Treaty makes it clear that this is also the case for environmental taxation. Member States, however, can develop national taxation measures as long as these do not conflict with the internal market. Many of these measures would also require a price to be put on natural resources and environmental damage.

5.4.1 Environmental Charges and Taxes

Environmental charges and taxes put a price on natural resources and on environmental damage. Charging for access to the resource is generally referred to as rent collection. Such revenue can be used for the public purse, so that society at large benefits from the use of a public resource. Taxes or charges aiming at rent recovery can be levied on different factors, such as the licence, the quantities caught or landed, or as a function of the inputs used in the fishery. Environmental charges are in principle designed to reflect the level of environmental impact that fishing activity might have on a specific part of the environment, the intended effect being to internalise some of the environmental costs of fishing. Such charges can also be used to encourage the adoption of less damaging fishing methods or the diversification of fishing effort into other, less damaging, activities.

While the concept of environmental charges and taxes is appealing, there are several barriers to its application. Setting a price on natural resources and on environmental damage is not straightforward. Also taxes and charges, particularly if linked to the output, for instance the quantity or value of fish landed, may provide additional incentives for misreporting. The effects of charges and taxes will be different for different types of operations and will reflect issues such as elasticity of demand and supply, equity arguments, and collection and enforcement costs. In practice there are few examples of rent collection in fisheries, the most obvious probably being the fees paid by foreign fleets to access a resource.

5.4.2 Financial enforcement incentives

Financial enforcement incentives take the form of non-compliance fees (penalties) or fines for breaching regulations. In principle, such penalties should be more or less proportional to and greater than the savings made by the individual fisher through non-compliance. In practice, it is harder to set such specific penalties without the use of the legal system to determine the appropriate size of the penalty. This, in turn, raises the transaction costs associated with the use of these instruments. In the EU, Member States are very keen to preserve their sovereignty in matters of enforcement. This results in different probabilities of prosecution and magnitude of fines in different countries. This contributes to the perception of the absence of a 'level playing field' (one of the major complaints of the industry) and to undermining the legitimacy of the CFP. Paradoxically this is one case in which the capture fisheries sector asks for 'more EU' instead of 'less EU'. The establishment of a European Fisheries Control Agency (Eurocontrol) is an interesting development in this area.

5.4.3 Subsidies

The use of subsidies is widespread in the EU. Under the Fifth FIFG, around 3.7 billion EUR is committed to the fisheries sector for the period 2000 to 2006. Taking into account the matching funds from the Member States, the total amount is much higher. Subsidies are provided for a wide range of purposes: vessel construction and modernisation; health and safety improvements; product quality improvements; infrastructure; marketing programmes; minimum price schemes; and so on. Subsidies can cover forms of financial assistance to provide incentives to polluters to alter their behaviour. Subsidies are available to adjust (reduce) fishing effort, to improve the selectivity of fishing gear, for the protection and development of aquatic resources (for instance through the creation of marine protected areas or artificial reefs), and to diminish the costs of compliance with new regulations.

There is a strong case for some form of support to facilitate the transition to a more sustainable pattern of fishing. However, it is not always clear that subsidies are the most effective way to achieve environmental goals. Subsidies have a wide range of effects, many of which are not taken into account or are overlooked when subsidy policies are being developed. Most current subsidies are 'perverse' in the sense that they encourage rather than penalise damaging activities. They distort the signals and incentives facing fishers, often in an environmentally harmful direction (for instance by encouraging overcapacity and overfishing). Progress has been made on subsidy reform. Council Regulation 2369/2002 phases out the use of subsidies for any expansion of fishing capacity. The Commission has identified as a priority the elimination of public aid for the modernisation or renewal of the fishing fleet, except for aid to improve safety or product quality not likely to increase fishing capacity (COM(2002)186).

Examples of subsidies for more environmentally friendly fishing methods

Fishing for litter Funding from INTERREG is being used to support the 'Fishing for Litter' initiative under the Save the North Sea project. Normally, litter that is brought up in fishing nets is dumped back in the sea. This aim of this project is for fishing vessels to bring the litter ashore. Fifty-four vessels are currently participating, and more than 200 tonnes of litter was landed in 2002/2003. The project – developed by KIMO International – covers the costs of waste collection and disposal at ports, as well as awareness-raising, research and project coordination.

Handline caught bass and mackerel The South West Handline Fishermen's Association has set up a labelling scheme for line-caught bass demonstrating that the fish is locally caught using low impact methods. The scheme is funded by the proceeds of labels sold to the Association's members. Three years of FIFG funding has been secured to maintain the accreditation of the mackerel fishery with the Marine Stewardship Council.

Invest in Fish South West The project, led by WWF-UK, the National Federation of Fishermen's Organisations and Marks & Spencer in England, aims to provide a long-term strategy for managing fishing fleets and the wider marine environment on a regional basis, while taking important local characteristics into account. The initiative involves three years of consultation, evaluation, expert opinions and deliberations. FIFG funding was awarded by DEFRA to support the work. It is feasible that similar projects could be developed for other regions, to support regional or local management planning processes.

While not a subsidy, it is worth mentioning that fisheries (and agriculture) benefit from substantial tax concessions, in particular on fuel, to support investment and increase profitability.

5.4.4 Trade Measures

The highly traded nature of fish products makes trade-based interventions a potential avenue for addressing environmental issues. Indeed, the FAO International Plan of Action to prevent, deter and eliminate Illegal, Unreported and Illegal Fishing (IPOA-IUU) advocates the use of bilateral and multilateral trade and market related measures to tackle IUU fishing. There are three broad types of trade measures: catch certification schemes under Regional Fisheries Organisations (RFOs); discouraging individuals and companies to conduct business with entities engaged in or supporting IUU fishing (awareness); and adoption of laws that make it a violation to conduct business with entities engaged in, or supporting, IUU fishing (business controls).

The EU is currently a member of eleven RFOs and is due to join two more. Several use trade measures to promote compliance. These are most commonly trade documentation schemes, which aim to collect more accurate and comprehensive data on fishing and identify imports of illegally caught fish.

5.4.4.1 The use of trade measures in the EU

Communication (2002)186 identifies *trade measures* compatible with the Community's obligations within the WTO as an instrument to promote sustainable and environmentally sound fishing practices. The Community will examine measures adopted in international fora, whether binding or not, with a view to their implementation. The Community does indeed use such measures. For instance, the Catch Documentation Scheme for the toothfish (*Dissostichus* spp.) is intended to ensure that what is imported by the EU has been caught in accordance with the guidelines developed by CCAMLR. In August 2004, the Commission proposed amendments with the intention of closing loopholes by which IUU toothfish may find its way into the EU market.

Another example is the use of trade restrictions by the International Commission for the Conservation of Atlantic Tunas (ICCAT) to effectively prohibit tuna and swordfish imports from countries that break ICCAT rules. As an ICCAT member, the European Community transposes such sanctions into its own legislation. Measures have been used to effect against Belize, Honduras and Saint Vincent and the Grenadines, with new restrictions placed on Bolivia, Cambodia, Equatorial Guinea, Georgia and Sierra Leone in April 2004[39].

Despite these measures, a recent FAO review of implementation of the IPOA-IUU reported that, internationally, trade-related measures are the least adopted and implemented mechanisms against IUU (FAO, 2004). Of those used, catch certification schemes are the most common. Arguably therefore, there is significant room for further intervention in this area.

There is an ongoing debate on the possibility of CITES listing of commercially exploited aquatic species. There is currently a proposal for a Memorandum of Understanding between FAO and CITES. The very point of CITES is to control trade of endangered species but some countries argue that the role of CITES should be limited to exceptional cases only, as more extensive listing would potentially have serious negative consequences for normal fishing activities.

5.4.5 Rights-based Instruments

In fisheries, rights-based instruments predominantly takes the form of *individual transferable quotas* (ITQs). There are, however, many other forms of right-based instruments such transferable licenses, community-based catch quotas and individual transferable effort quotas (Le Gallic, 2004). The use of ITQs began in the 1980s: in New Zealand (1982), Canada (1983), Iceland and Australia (1984) (Davidse *et al*, 1997). The Netherlands was the first EU Member State to use ITQs (1985). They have since been introduced in the UK and, to a lesser degree, in Denmark (pelagic fishery). There are strong economic arguments for the introduction of ITQs. The basic idea is that they encourage compliance with a global TAC while facilitating the reduction of fishing effort, thereby contributing to increased economic efficiency. The introduction of ITQs is not, however, a socially or institutionally neutral operation. By separating production from ownership it introduces a new production factor – the right to a quantity of fish – which needs to be paid for (Mongruel and Pálsson, 2004).

39 Regulation 826/2004; Regulation 827/2004; and Regulation 828/2004

5.4.6 Environmental Liabilities

Environmental liabilities allows for stakeholders affected by pollution to demand compensation. In March 2004, the Council and Parliament approved Directive 2004/35/EC that makes individuals financially liable for environmental damage, notably damage to protected areas designated under the EC birds or habitats Directives. Many Member States already have liability regimes in place that should apply equally to damage caused by the fisheries sector as they apply to damage caused by other sectors.

5.5 SPATIAL PLANNING

The EU Compendium of Spatial Planning Systems and Policies (CEC, 1997) defines spatial planning as *'the methods used by the public sector to influence the future distribution of activities in space'*. It typically involves several different layers of administration. Spatial planning balances public and private interests, as well as use and non-use values. It is seen as an essential tool for sustainable development. It is undertaken with the aim to create a more rational organisation of space usage and linkages between different uses in order to balance demands for development with the need to protect the environment, and to achieve social and economic objectives.

Marine spatial planning has some specific features that distinguish it from more classical, land-based spatial planning. This derives from several typical marine characteristics:

- the ownership is usually public;
- there are no residential settlements;
- sea-use is not necessarily exclusive, though for instance aquaculture and shipping tend to be (land-use is nearly always exclusive);
- the three-dimensional aspect of the marine environment means that it may be put to different uses at different levels in the column.

In May 2002, the Council approved a recommendation concerning Integrated Coastal Zone Management (ICZM). The recommendation outlines steps that the Member States should take to develop national strategies for ICZM. National strategies are required to be in place by Spring 2006 and their development should involve all the coastal stakeholders.

Marine spatial planning is of direct importance in at least two different fisheries-related contexts: Marine Protected Areas (MPAs)/no-take zones and marine aquaculture. It is particularly important for marine aquaculture. The difficult scientific/political issue is to determine the amount of alteration of the marine environment and the landscape that is acceptable. Marine aquaculture often involves restricting access to selected areas and may be perceived as privatisation of a public space. The great attraction is that the issues are addressed once and, hopefully, for all, for the zone as a whole, and are not decided on the merits of any individual prospective fish farmer (Wijkstroom, 2001).

The designation of MPAs and no-take zones does not amount to a 'privatisation' of the marine environment but imposes restrictions on the use that can be made of it and may therefore entail economic losses. MPAs can offer protection to habitats and species. To a certain extent, they are a new name for the old concept of 'boxes', which have been used as a fisheries management/conservation tool for many years. There is, however, some uncertainty as to their effectiveness. Marine animals tend to move over large distances and may spend considerable time out of the MPA or no-take zone where they are not protected. Effectiveness of an MPA will depend on how big it is, where it is situated and what its objectives are. One complicating factor is that the impacts on stakeholders will be unequally distributed. In addition, it may lead to a concentration of fishing effort and subsequent environmental impact in areas around the MPA.

Fishers may either oppose or promote MPAs depending on their perception of who is set to gain from their establishment. In Italy MPAs tend to be seen as a help to restrict the unlimited urbanization of the coast, which in itself is threatening fishing. The situation is different in the Spanish Mediterranean islands, where the tourism industry sees the MPAs as assets, which leads to a further marginalisation of the small-scale fishers that are no longer of local economic importance.

The birds and habitats Directives require the designation/classification of sites, which together make up the Natura 2000 network. The Directives are binding on the Member States and have had a major impact on conservation policy at the national level, particularly terrestrial policy. There is also great and as yet largely un-harnessed potential to use the Directives to establish MPAs.

5.6 VOLUNTARY AGREEMENTS

Voluntary Agreements (VAs) are increasingly being looked to as possible instruments in environmental management. The arguments are that Vas can be finely tuned, quick to set up and they build on the industry's knowledge, whereas regulations can be too cumbersome and inflexible, and economic and fiscal incentives too costly. The main risk to the environment is that of 'regulatory capture' or the instrument turning out to be weaker than the alternative foreseen or needed. In 1996, the Commission provided some guidance on the design and implementation of VAs (COM(96)561). Key issues are target setting, monitoring and reporting.

VAs come in many forms and shapes, which causes some confusion as to their potentials, limits, risks and rewards for different stakeholders. Experience from other sectors allows drawing some conclusions about the circumstance in which they are more likely to be successful. These are: homogeneous industry, few players or a strong association, presence of a VA champion and the absence of a critical short-term target that must be met (Egenhofer and ten Brink, 2003). It is doubtful that these favourable conditions exist for any but a few specific fisheries in the EU.

The use of VAs in fisheries management raises institutional issues at the EU level. Fisheries are an area of exclusive EU competence. Member States and regions can only act if explicitly delegated power; yet it is not clear whether the Commission can be a party to a VA. It is also unclear what possible roles the Regional Advisory Committees could have.

The EU Eco-Management and Audit Scheme (EMAS) is a management tool for companies and other organisations to evaluate, report and improve their environmental performance. The scheme has been available for participation by companies since 1995 (Regulation 1836/93) and was originally restricted to companies in industrial sectors. Its use is now expanding to fisheries, mostly aquaculture. The Italian EMAS Agency, APAT (formerly ANPA), has published a manual for the application of EMAS to the fish farming sector (ANPA, 2002).

The EU has a code of conduct for sustainable aquaculture that was created by the Federation of European Aquaculture Producers. This code was intended to promote the responsible development and management of aquaculture within the EU, in order to assure a high standard of quality food production whilst giving the necessary respect to the environment and consumers' demands (FEAP, 2002). It serves to establish and recommend guiding principles for those in Europe producing live fish. The code addresses such points as the responsibility of the fish farmers to the fish, the environment and the consumer.

The FAO Code of Conduct for Responsible Fisheries and the European Code of Sustainable and Responsible Fisheries are not VAs between industry and governments, but 'soft' political statements agreed between States.

5.7 INFORMATION PROGRAMMES

Information programmes are intended to allow consumers to act responsibly by giving them information about the environmental impacts associated with the products they purchase. There is considerable interest in them. In Communication (2002)186, the Commission announces its intention to consider the potential for eco-labels to stimulate environmentally sound fishing practices. To date, no such Communication has been forthcoming. However, the Commission recently announced a tender for defining appropriate and measurable criteria for certification of fish stocks[40]. FAO guidelines may be adopted at the 6th COFI (Committee on Fisheries) in 2005.

40 Call for Proposals DG FISH/2004/03. Awarding of grants for contributions to a priority programme for the provision of fisheries scientific advice in the Community.

There are a number of eco-labels already in the market place but the broad EU eco-labelling scheme, the EU Flower, does not currently include fish products. Perhaps the most well-known eco-label is the 'dolphin-safe' tuna label, which has been in the EU market since the early 1990s (Brown, 2005). The more recently established Marine Stewardship Council (MSC) is, however, generally considered the most comprehensive certification scheme in place, providing an MSC standard with third party certification. Unfortunately, figures on total consumption of eco-labelled products in the EU are not easily available. In terms of production, EU fisheries certified by the MSC represent less than one per cent of the catches.

At least 18 organic agriculture associations within Europe have developed criteria for organic fish, mussel and crustacean farming, with standards varying significantly. While there are a number of independent/private standards, there are few examples of government standards in Europe. There is a strong case for unifying standards to avoid consumer confusion and an argument for revisiting the scientific basis of criteria, as some of them result in environmental burdens higher than more intensive methods (Hilge and Halwart, 2004). Another problem is that providing consumers with information merely gives them an opportunity to take environmental concerns into account. Information does not automatically lead to changed consumer behaviour. Attitudes to eco-labelling vary amongst the different Member States. Consumers in France, for example, are more interested in local produce labelling, whereas, in Northern Member States, consumers prefer state certification (see Chapter 3 for more information about eco-labelling and production).

5.8 CONCLUSIONS

There are a number of synergies between usual fisheries management objectives and the environmental dimension. Currently, the very basis of the fishing industry is threatened. In its report on the state of the marine environment, ICES (2003) mentions that in 2001 only 18 per cent of the 113 stocks assessed [in the Northeast Atlantic] were inside safe biological limits (see Chapter 2 on the state of Europe's regional seas for a more detailed overview). A reduction in fishing effort would be beneficial for many fish stocks and fisheries, and have positive implications for the environment. Alone, none of the policy instruments mentioned above will resolve all the issues concerning the impact of the fisheries on marine ecosystems while also maximising employment and/or profitability of the fleets. The table below attempts to identify some of the advantages and disadvantages of each (group of) policy instruments.

The choice of a particular instrument mix must be informed by the objectives of fisheries management and the institutional set-up. The long-term sustainability of the resource basis is clearly an overarching objective. It is also one to which the EU and its Member States have committed themselves both at the level of the EU and in international for a, such as the WSSD in 2002. However, the CFP allocates fishing rights to Member States and they are free to pursue different objectives within this framework of resource sustainability. For instance, the objectives can be maximizing jobs through small-scale fisheries or maximizing profits from the fishery, which may be through a small number of large vessels. In terms of enforcement, the Member States are very keen to preserve their sovereignty.

		Advantages	Disadvantages
Command and control measures	**General**	• Objectives can be clearly specified in physical terms • Decision taking by QMV • No impact on budget	• May be difficult to reach agreement • Blunt. Treat all with the same brush. Problems at the border between different areas/zones • Reactive. Lag behind the problems
	Licensing	• Possible to link to other instruments • Mechanism to control effort	• Legitimacy
	TACs	• Offer a neat mechanism to share resources between Member States	• Historical tendency to allocate more than recommended • High enforcement costs • May encourage under- and misreporting • High demand on science • Difficult to apply in mixed fisheries • Encourages high-grading

		Advantages	Disadvantages
Economic and fiscal incentives	General	• Addresses the drivers for behaviour that needs changing	• Difficult to use as this requires unanimity in the Council • Difficult to set a price on natural resources and environmental damage • May encourage misreporting • Final effect on the sector difficult to predict • High transaction costs
	Subsidies	• Incentive to alter behaviour • Facilitate adoption of better technology	• Many subsidies in place are perverse
	ITQ	• Can be implemented by MS if they wish • Better resource and capital use	• Not socially neutral (inequity?) • High-grading
Spatial planning	General	• Places fisheries in a broader context in order to balance public and private interests, as well as use and non-use values	• Resource intensive
	MPAs	• Conceptually simple • Ease of enforcement	• Impacts on stakeholders unequally distributed
Voluntary agreements		• Simple to put into practice • Flexible • Rely on the experience in the sector	• In fisheries, facilitating factors not present (homogeneous industry, strong association, VA champion, no critical short-term target) • Danger of regulatory capture • Competence of the Commission?
Information programmes		• Allows consumers to act responsibly • Market based, potentially altering incentives	• Proliferation of information programmes (labels) may be confusing for consumers • Legitimacy of criteria • Costs of certification • Information does not necessarily lead to changed consumer behaviour • Consumers in different Member States attach different importance to different criteria

The Working Group held valuable discussions and agreed that there is a *need for a more effective application of the instruments already in use*. However, fisheries policy development in the EU is also at a stage when greater consideration can and should be given to strengthening and broadening the range of policy instruments used. The current reliance on command and control instruments unnecessarily restricts the policy options available to effectively manage fisheries.

1. Spatial Instruments

The Working Group agreed to recommend establishing a scientifically robust and effective program of Marine Protected Areas as a fisheries management tool, recognizing that these can provide multiple ecosystem benefits.

Actors: EU Institutions, MS, Regional Conventions, NGOs, fishermen

2. Subsidies

The Working Group recommends:

- *Reducing the overall level of subsidies* to the sector and to increase the conditionality for their allocation, including for vessel decommissioning and licence retirement;
- *Better targeting* of existing subsidy programs and the prohibition of subsidies likely to promote unsustainable practices;
- Conducting an *economic, social and environmental impact assessment* of existing subsidies and requiring such impact assessments before the introduction of new subsidy programs;

- Introducing *cross-compliance* as a mean of delivering environmental benefits from subsidies and of improving enforcement of environmental regulations.

Actors: European Commission, national fisheries regulators.

3. Rights-based Instruments

The Working Group concluded that more use should be made of rights-based instruments. This will help foster better stewardship of resources, better engage fishermen in helping to promote sustainable fisheries and lead to improved governance of resources. The lessons from the application of rights-based management in other countries, as well as in the EU, will help to show the potential benefits to fishermen and wider communities. There is a range of potential instruments that can be applied at different levels of geographical scale that will help achieve this. For instance, a distinction can be made between inshore and offshore fisheries:

- In inshore fisheries, community-based cooperative management arrangements may be a more appropriate mechanism to help achieve economic, social, and environmental, sustainable development goals.
- In offshore fisheries, internationally-traded ITQs are an option to help improve the efficiency and transparency of the sector.

Actors: include fishermen and fishing industry, Commission, and other regulators, RACs.

4. Technical instruments and thresholds

The Working Group agreed that:

- A high priority should be set on *substantially reducing juvenile capture and mortality*. There is a need to re-examine the technical means for achieving this including in particular the minimum landing sizes.
- *Systems requiring the landing and subsequent auction of bycatch* should be considered. The proceedings of the auction could go to research promoting sustainable fisheries management.
- *Improved control and enforcement of effort* is necessary. This may require the more widespread use of days-at-sea restrictions and real time closures of fishing grounds.
- *A higher involvement of fishermen* in developing and improving technical measures is required. This could be done through RACs.

Actors: fishermen, Member States, Regulators, RACs, Regional Fisheries Management Organisations.

5. Eco-labelling

The Working Group welcomed the intention of the Commission to set rules and standards for the eco-labelling of fisheries products in the EU. It recommends the development of a Community eco-label and the general promotion of eco-labelling through education and information campaigns aimed at instilling understanding, trust and credibility of eco-labels among consumers.

Actors: EU Institutions

6 GOVERNANCE

Written by Dirk Reyntjens (IEEP) and Douglas Wilson (IFM)

6.1 INTRODUCTION

This chapter explores governance issues in EU Fisheries Management. Governance, as opposed to government, is the process by which economic and social matters are managed and the capacity of the institutions to manage them fairly, rationally and predictably. Governance is about institutional performance and the relationship between state, market and society. It should not be equated with or confined to state activities. The governance perspective examines the broad range of institutions that influence how public policy goals are met or fail to be met.

The White Paper on European Governance (CEC, 2001) states five principles underpinning good governance. These are participation, openness, accountability, coherence and effectiveness. The White Paper does not define these principles, rather it sets out to illustrate what they ought to mean in the EU context. These same principles are restated, albeit in a different wording, in the CFP framework regulation (2371/2002) (Article 1 para 2).

In addition to these principles, there are two focal images in the current European vision of marine governance: the precautionary approach and ecosystem-based management (Degnbol *et al*, 2003).

This chapter provides a brief overview of the legal and policy context before examining the implementation of the five principles of good governance as identified in the White Paper on European Governance. Following this review it examines the governance implications of the two focal images. In the conclusions, a number of key issues and recommendations discussed at the conference are listed.

6.2 LEGAL AND POLICY CONTEXT

6.2.1 International Framework

The most important body of international law specifically governing international fisheries is the 1982 UN Convention on the law of the Sea (UNCLOS)[41]. The 1995 Agreement Relating to the Conservation and Management of Straddling and Highly Migratory Fish Stocks builds upon the UNCLOS. It provides for the establishment of Regional Fisheries Management Organizations (RFMOs). These organizations may issue recommendations on management and conservation of fish stocks by which their parties have to abide. The EU is currently a member of eleven such organizations and is due to join two more.

There is clearly a growing international political commitment to responsible fisheries. At the WSSD in Johannesburg in 2002, for example, Heads of State and Governments agreed to maintain or restore fish stocks by 2015 (30 (a)) and significantly reduce the rate of biodiversity loss by 2010 (42), as discussed in Chapter 2.

Despite this, the system fails in a number of situations. Firstly, coastal states are not compelled to manage fisheries resources within their Exclusive Economic Zone (EEZ) in a responsible manner. Secondly, on an international level, it merely provides a framework for management and has never actually been intended to do more. Problems arise when some parties do not wish to collaborate or cannot reach agreement, as there are no binding mechanisms on how to resolve disputes. There are no effective means to exclude vessels not abiding by the rules agreed upon in a regional fisheries management organization if its flag country is not a party to that organization. In addition, open access remains for high seas stocks that are neither migratory nor straddling, such as seamounts and ocean ridges.

41 The United States of America and Peru have not yet acceded to the UNCLOS

Example of an International Fisheries Governance Failure

In the case of blue whiting in the North-East Atlantic, agreement has not been reached in the North-East Atlantic Fisheries Commission (NEAFC) for the past 5 years on how to share the TAC. This has resulted in the EU and others increasing their self-proclaimed 'shares'. Since 1997 the total international catches have trebled and are now over 2 million tons whereas the last TAC set by NEAFC is 650,000 tons.

There are few formal rules that deal with governance issues in international environmental or fisheries agreements. The most notable convention in this respect is the 1998 Århus Convention on access to information, public participation in decision-making and access to justice in environmental matters. The EC and all Member States have signed this convention, which entered into force on 30 October 2001. It provides for:

- the right to public access to environmental information that is held by public authorities;
- the right to participate from an early stage in environmental decision-making; and
- the right to challenge, in a court of law, public decisions that have been made without respecting the two aforementioned rights or environmental law in general (access to justice).

The convention thus establishes relatively far-reaching provisions directly relevant to fisheries governance issues, particularly in terms of transparency and accountability. The EU has since moved to align its legislation with the Århus Convention. The European Parliament and the Council have adopted two Directives concerning access to environmental information and public participation in environmental decision-making (CEC, 2003a; CEC, 2003b). They have to be transposed into national law by the end of 2005.

The 1995 FAO Code of Conduct is a non-binding instrument, but in 1999 the 126 Members of the FAO Ministerial Meeting adopted the Rome declaration on the Implementation of the FAO Code of Conduct for Responsible Fisheries unanimously. The code refers explicitly to the need for transparency in decision-making processes, not only at the level of states but also at regional and sub-regional level. Other provisions refer indirectly to the need for efficiency and effectiveness to achieve timely solutions to urgent matters. For clarity, the basis for and purposes of measures should be explained to resource users, and accountability should be achieved through greater stakeholder participation in decision-making.

Other international instruments relating to biodiversity conservation[42] and fisheries management[43] also refer to issues of governance, but on a more limited scale.

6.2.2 EU Decision-Making Framework

The EU policy process is characterised by three clearly separated stages in which different actors play very different roles. In the first stage, the Commission uses its monopoly of initiative to try and forge compromises around a proposal. In a second stage, decisions are taken by bodies that are directly (the European Parliament) or indirectly (the Council) accountable to an electorate. The opinion of the EU Parliament is usually sought before the Council takes a decision. At this stage, negotiations may be required to reach political agreement on a given measure. Thirdly, the Commission then monitors the implementation by individual Member States.

Fisheries policy is an area of exclusive Community competence. Member States can only act as far as powers have been delegated by the Community, such as for the coastal zone. The coastal zone may be up to 12 miles wide, though many Member States have kept it narrower. Even within the coastal zone, measures taken by Member States may not be in conflict with the overall CFP.

---

42 1992 UN Convention on Biological Diversity (Article 14) - public participation in environmental impact assessment of projects likely to have significant impacts of biological diversity;

43 1995 UN Agreement on Straddling Fish Stocks and Highly Migratory Fish Stocks (Article 12) - transparency and participation of non-governmental organizations in decision-making processes.

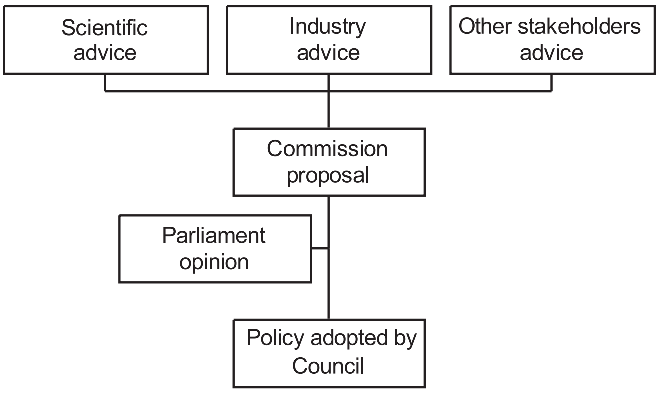

Figure 30. Outline of EU fisheries decision-making procedure

For environmental matters the picture is slightly more complex. Environmental policy is a shared competence between the EU and its Members States. Not only can Member States act on their own initiatives, in some cases they have to. Both the European Parliament and the Council have to agree on Regulations and Directives (a procedure referred to as co-decision). The proposed Constitutional Treaty would extend the co-decision procedure to fisheries matters, with the exception of Total Allowable Catch (TAC) decisions. This would give the Parliament a far greater role in developing legislation than today.

6.3 PARTICIPATION

Participation is a set of activities aimed at engaging or influencing public institutions. There are a number of forms of participation in fisheries management. These approaches differ in terms of who is making decisions and at what level they are making them. Different stakeholders define participation in different ways. The most basic understandings of participation among fisheries stakeholders are perhaps working together to achieve common goals, mobilizing one's own stakeholder group to achieve narrow goals, and facilitating broad accountability.

Participation is one of the key concepts in the White Paper on Governance. It is supposed to enhance both the legitimacy and effectiveness of European governance (CEC, 2001). The key questions are: who should participate, at what level and when in the policy development and implementation process? The CFP framework Regulation calls for a *'broad involvement of stakeholders at all stages of the policy from conception to implementation'* (CEC, 2002).

6.3.1 The Advisory Committee on Fisheries and Aquaculture

At EU level, the only formal forum for participation has until recently been the Advisory Committee on Fisheries and Aquaculture (ACFA). ACFA is composed of 20 representatives of professional organisations in the production sector, the processing industry and the trade in fishery and aquaculture products, as well as organisations representing the interests of consumers, the environment and development. The Commission appoints the Members, following proposals from Community-level organisations that it considers the most representative of the interests concerned. ACFA is consulted in the process of developing Commission proposals but has no role in monitoring their implementation and effectiveness. In the EU, the representation of fishermen's interests is still largely confined to the framework of the Member States. This reflects deep-seated and powerful corporatist mediational structures (Lequesne, 2004).

The different sectoral groups and interested parties are not treated equally within ACFA. Council Regulation 2000/657/EC stipulates that 'the cost of ... meetings arranged by the European trade organisations which are aimed at preparing meetings of the Advisory Committee on Fisheries and Aquaculture' shall be born by the Commission (CEC, 2000). No such assistance, except for travel costs, is given to the three representatives of consumers, environment and development interests thus limiting their actual ability to contribute meaningfully to the debate. Non-(fisheries) professional organisations contribute 3 members out of 20. Other end-users of the marine environment are not represented at all.

6.3.2 Regional Advisory Councils

In May 2004, the Council reached an agreement on the establishment of Regional Advisory Councils (RACs) (CEC, 2004a). They are currently being established with the process being most advanced for the North Sea and the North Western waters RACs. A broader range of interests will be represented in the RACs than on ACFA. However, the RACs will be focussed on fisheries management and they will be dominated by industry interests. The idea to establish RACs arose out of calls for a more participatory, transparent, ecosystem-based and/or devolved approach to EU fisheries management. While RACs respond to these calls, they do so only in so far as regionalising stakeholder advice to the Commission; they are not designed to become regional decision-making fora. Other stakeholders, however, including politicians at both the EU and national levels, have articulated a clear intention to try to move these RACs in the direction of regional decision-making bodies. In practice, however, the Treaties make no provision for stakeholder participation in decision-making.

In summary, participation in EU decision-making on fisheries is very restricted, though the RACs are a positive step. The RACs are characterized by a limitation to non-decision making and to sectoral groups and interested parties, ignoring general actors such as political representatives and democratic institutions, and leaving the initiative to the Commission and decision-making to the Council (and the Parliament). This is partly due to the specific challenges created by the European dimension, starting with the communication problems related to language barriers. Involving stakeholders formally in decision-making would pose a significant challenge. Arguably this may require a Treaty change, which is unlikely to be made to suit the aspirations of fishermen. In addition, any government needs to retain decision-making powers, even the EU. Yet participation is only meaningful if there is a potential for compromise and resolution of conflicts. This is recognised by the Commission, and it has indicated the possibility to implement measures elaborated and adopted by consensus within RACs. However, as there is currently no shared understanding of the resource situation, reaching consensus may be difficult.

6.4 OPENNESS AND ACCOUNTABILITY

Internationally, different formal approaches to openness and accountability exist and these forms of openness have different and complex influences on policy outcomes. According to the White Paper on Governance (CEC, 2001), openness refers to the active communication with stakeholders and society at large about what is being done and decided by the use of language that is accessible and understandable to the wider public. Accountability is the need to answer for the results of one's actions or the institutionalised responsiveness to those affected by one's action.

These definitions make sense in the context of the EU. Policy-making and implementation involve different actors at the stages of proposal-making, decision-taking and implementation. They also illustrate the Commission's quest for legitimacy among national administrations. These will often seek to make the Commission pay the political price for regulations they have endorsed in the Council of Ministers (Lequesne, 2004).

CFP proposals are elaborated by DG Fisheries and formally adopted by the College of Commissioners before they can be forwarded to the Council and Parliament for decision-making. The Commission will normally try to reach consensus before it makes its initiative public. In particular, it will seek scientific and technical advice from mandated research institutions and the opinion of sectoral actors and interested parties. A certain number of preparatory acts and documents of public interest can be found on the Commission's website. As 'guardian of the Treaties' and of the common good, the Commission also sees itself as occupying a special place of 'expert rationality' in relation to Member State governments, which tend to be much more subject to pressures from the industry (Lequesne, 2004).

Decision-making by the Council is much less open. The time span between the submission of a proposal by the Commission and a Council decision can be considerable. A short survey of key fisheries and environment legislation gave a range from 14 days to over three years, with the average being around one year. Reaching a Council decision often requires negotiations led by the Presidency, which may imply compromises before an agreement is reached (which in most cases must be acceptable to the Commission). In the past, this stage has been associated with several pitfalls such as procrastination and unbalanced weighting of short-term and long-term considerations, and the absence of a clear hierarchy of long-term and mid-term objectives. In particular, Member States have often awarded themselves larger quotas than the scientists had declared to be sustainable.

This is one of the most controversial and pressing areas of decision-making, where openness and accountability come into conflict with other values. A participatory approach to fisheries governance should begin with a shared understanding of what is going on in the sea. Sharing such an understanding implies an approach to develop the scientific basis of management decisions that has itself, in some sense, been participatory. Our common sense understanding of science, for good reasons, does not include the idea of 'participation'. Science is supposed to yield objective knowledge, not participatory compromises. While originally fisheries research aimed at explaining phenomena observed by fishermen, it is now geared towards answering the needs of fisheries administration. A number of institutions are being developed in fisheries management to address these critical tensions. Within the EU this is addressed most directly with an attempt to change the unit of scientific advice from the biological unit of the fish stock to the social unit of the fishery, so that advice can be more directly integrated with how management decision-making is actually structured.

6.5 COHERENCE

According to the White Paper on Governance (CEC, 2001), 'coherence requires political leadership and a strong responsibility on the part of the Institutions to ensure a consistent approach within a complex system'. The April 2001 Council invited the Commission to present concrete proposals on environmental integration within the framework of the reform of the CFP in 2002. The Commission forwarded an action plan to integrate environmental protection requirements into the CFP (CEC, 2002). This lists a number of guiding principles and measures to secure environmental integration in the sector, including the setting up of long-term management plans for the most important and the most vulnerable fish stocks, the creation of 'no-take-zones', the development of guidelines for Best Fishing Practice, incentives for stimulating practices adding value to environmental integration, and the integration of environmental concerns into the aquaculture sector. It also committed to the development of an experimental monitoring system based on indicators, which was to become operational by 2003. A report on the environmental performance of the CFP is promised for 2005. The Council adopted conclusions on the Action Plan in January 2003, welcoming it as an important step towards implementing the integration strategy and inviting the Commission to present appropriate proposals for its implementation.

The Strategic Environmental Assessment Directive does apply to EU plans and programmes (CEC, 2001), but these are rarely developed for the fisheries sector. The Commission made a commitment to conduct impact assessments on all its major proposals, be they regulatory or any other proposal having an economic, social or environmental impact (CEC, 2002). This applies to the fisheries sector as well. The procedure foresees a two-stage process to assess social, economic and environmental impacts: a first filtering stage leads to a decision on whether or not to do an extended impact assessment (IA). Extended IAs are to include stakeholder consultation. To date, the procedure was applied only three times in relation to fisheries: in relation to proposals for recovery plans for Southern hake and the Norway lobster stocks in the Cantabrian Sea and Western Iberian waters, and the Cetacean Regulation (CEC, 2004). The manner in which these impact assessments were conducted fell short of the Commission's own guidelines, but improvements are expected as part of what is a 'learning by doing' process (Wilkinson *et al*, 2004). This being said, while impact assessments are a tool for improved coherence, fisheries are and will remain a matter of management under uncertainty.

The EU fisheries structural policy aims to help the sector adjust to the challenges facing it, in particular the need for reductions in fishing fleet capacity. The fisheries 'Structural Fund', FIFG (Financial Instrument for Fisheries Guidance), has contributed to fisheries conservation projects, but it has also been used to support investment in new and more intensive fishing practices and to expand aquaculture production. This clearly goes against the principle of coherence. However, a phase-out of those subsidies most directly contributing to overcapacity, notably subsidies to boat building, has been agreed (CEC, 2002). As part of the implementation of the Sustainable Development Strategy, the structural assistance Regulation for the fisheries sector was amended in July 2004. Among other things, the new Regulation states that *'Aquaculture enterprises should be encouraged to improve their environmental performance and to develop voluntarily initiatives that go beyond the minimum legal requirements in terms of environmental protection'* (CEC, 2004). In July 2004, the Commission made a proposal for a Council Regulation on a European Fisheries Fund (CEC, 2004). The purpose of the EFF is to help facilitate the implementation of measures adopted under the reform of the CFP, among these the policy for the sustainable development of coastal fishing areas.

Environment and development NGOs have long voiced concerns over EU fisheries policy in third countries, pointing to the 'footprint' that agreements leave on local communities as well as the environment. There has also been considerable pressure from environment and development interests within the Commission and some Member State administrations to at least make agreements coherent with other EU policies. In February 2002, the Commission set out external aspects of an EU Sustainable Development Strategy – Towards a Global Partnership for Sustainable Development (CEC, 2002). This suggests that the EU will develop a 'strategy for distant water fisheries to contribute to sustainable fishing outside Community waters through global and bilateral partnership at national and/or regional level.' A Commission Communication 'on an integrated framework for fisheries partnership agreements with third countries' followed the proposal in December 2002 (CEC, 2002). In July 2004, the Council adopted conclusions on the Communication reiterating several general principles, such as only fishing the surplus and the need for coherence with other Community policies (ie Development and Trade). More importantly, the conclusions define the minimum content of a Fisheries Partnership Agreement and state that impact assessments must be made in preparation for their negotiation.

Cross-compliance is the linking of different policies. It is a tool to achieve coherence. In practical terms it entails a requirement for a recipient to prove that provisions of other policy instruments have been met in order to be eligible for government support. The concept of cross-compliance in agriculture has been gaining ground since the 1970s, and was first applied in the United States. In Europe, the discussion about the relevance of cross-compliance to European agriculture policy began only in the 1990s, along with the growing commitment within the EU to integrating environmental considerations into agricultural policy. This instrument has become one of the most important tools of integrating environmental concerns into farming practices in the EU, though the implementation inevitably differs between the Member States.

There has hardly been any debate on the use of cross-compliance in fisheries. The only current example is the requirement for the promoters of intensive fish-farming projects to submit the results of an impact assessment study together with their application for support under the FIFG. Various items of EU environmental legislation are relevant to the fisheries sector, notably the birds and habitats Directives, and could be subject to cross-compliance.

6.6 EFFECTIVENESS

According to the White Paper on European Governance (CEC, 2001) 'policies must be effective and timely, delivering what is needed on the basis of clear objectives, an evaluation of future impact and, where available, of past experience'. The EU fisheries management objectives are not explicitly stated. However, the long-term sustainability of the resource basis is clearly one overarching EU-wide objective. It is reflected in the mission statement of DG Fisheries. This internal EU commitment is also reflected in international fora and most notably in the international targets contained in the WSSD Plan of Implementation.

DG FISH mission statement

'…the major challenge facing the CFP today is to strike a sustainable balance between available marine resources and their exploitation. The capacity of the European fishing fleet is too large and the sector must be restructured if that balance is to be attained…'

WSSD Plan of Implementation

'…by 2015 at the latest to have maintained or restored stocks to levels that can produce the maximum sustainable yield; …'

The number of stocks inside safe biological limits has been declining (see Chapter 2 for a review of the available evidence). It is this realization that has prodded the reform process, which culminated in December 2002. While it could be argued that it is still too early to objectively judge the effectiveness of the reformed Common Fisheries Policies, the omens are not good.

The annual negotiations on the allocation of TACs in 2002 and 2003 largely occurred on the same basis as before, belying the long-term management perspective that all actors have agreed to be necessary. Scientific advice on TACs has not been followed. The recovery and management plans have been hailed as a cornerstone of the new CFP. Yet two years on, only two recovery plans (for cod and for Northern hake) are being implemented and, compared to the original Commission proposals, these have been significantly weakened. Two more plans (for sole and for Southern hake and Norwegian lobster) were still being discussed nine months after being proposed by the Commission (Brown, 2004). There are as yet no management plans in place. There is no evidence that the declining trend of the resource base has been reversed. Judged against the criterion of long-term sustainability of the resource base, the Common Fisheries Policy has not been effective.

6.7 AREAS WHICH PRESENT PARTICULAR GOVERNANCE CHALLENGES

6.7.1 The Precautionary Approach

The precautionary approach in fisheries management if often articulated following the FAO Code of Conduct for Responsible Fisheries (1995).

FAO Code of Conduct for Responsible Fisheries (1995)

'6.5 States and subregional and regional fisheries management organizations should apply a precautionary approach widely to conservation, management and exploitation of living aquatic resources in order to protect them and preserve the aquatic environment, taking account of the best scientific evidence available. The absence of adequate scientific information should not be used as a reason for postponing or failing to take measures to conserve target species, associated or dependent species and non-target species and their environment.'

In practical terms, a precautionary approach requires the identification of some optimum situation and adopting a lower fishing effort in order to accommodate uncertainty in the identification of that optimum. This is really about who bears the costs and benefits associated with the uncertainty attached to management decisions. What the precautionary approach is saying is that the costs associated with uncertainty about appropriate fishing levels should be borne more heavily by the existing fishing industry and less by the future fishing industry and fisheries managers, environmentalists and scientists who also stand to benefit from more successful conservation (Degnbol *et al*, 2003). As such it can be seen as an uncertainty-based version of the 'polluter pays' principle, which is a pillar of good environmental policy. The downside is that the present and future fishing industries can often be different people. This leads to:

- the precautionary principle further undermining the present industry's support for management; and
- because it is usually the larger, more flexible and better financed fishing companies that can survive longer under the greater risk, the structure of many or most fishing fleets will shift towards larger-scale operations.

This second trend could be considered to be desirable, from a purely economic efficiency perspective.

The precautionary approach also leads to a blurring of the distinction between scientific advice and management decisions. Because the underlying question is about the distribution of the costs associated with uncertainty, the identification of this optimum situation is inherently a political process. But the political decision is closely interlinked with scientific decision-making and too often presented as a 'scientific' result. 'Precautionary models' are created and, because of a desire for quantification, the precaution is articulated in terms of assessment model error. Precautionary assumptions are often built into the judgements involved in the model building process (Wilson and Degnbol, 2002). The precision of the models used is in itself the result of management decisions, for instance in terms of budget allocations to research. In addition, different scientific advisory bodies use different concepts and terminologies in formulating their advice (Stokke and Coffey, 2003). Excessive technical language may further obscure the picture for laypersons.

The reduction of the precautionary approach to management based on precautionary models also means that the uncertainty in decisions about management measures, which has multiple sources ranging from unrecorded discards, black landings, unknown levels of natural mortality to unknown effectiveness of management measures and beyond, is reduced to the leftovers of what any stock assessment scientist will tell you is a very shaky 'certainty'. This cannot be our long-term mechanism for institutionalising the precautionary principle in fisheries, let alone integrating fisheries and environmental policy. Management institutions must be developed that are able to be truly precautionary, ie to distinguish between various sources of uncertainty and formulate adaptive responses.

6.7.2 The Ecosystem Approach to Fisheries

A definition of the Ecosystem Approach to fisheries in the European context was attempted in 1997 when the Intermediate Ministerial Meeting on the Integration of Fisheries and Environmental Issues in the North Sea called for the development and implementation of an ecosystem approach in the management of marine ecosystems (North Sea Secretariat, 1997). Both the CFP basic Regulation 2371/2002 and the WSSD refer to the adoption of the ecosystem approach to fisheries management.

1997 Intermediate Ministerial Meeting on the Integration of Fisheries and Environmental Issues in the North Sea – Official text of Statement of Conclusion

'2.6 Further integration of fisheries and environmental protection, conservation and management measures, drawing upon the development and application of an ecosystem approach which, as far as the best available scientific understanding and information permit, is based on in particular:

- *the identification of processes in, and influences on, the ecosystems which are critical for maintaining their characteristic structure and functioning, productivity and biological diversity;*
- *taking into account the interaction among the different components in the food-webs of the ecosystems (multi-species approach) and other important ecosystem interactions; and*
- *providing for a chemical, physical and biological environment in these ecosystems consistent with a high level of protection of those critical ecosystem processes.'*

The international fisheries management community, and FAO in particular, is developing approaches to fisheries management that take more of an 'ecosystem' perspective. This is a critical step forward as it is unrealistic to treat fish stocks as if they were isolated systems. But it presents extensive governance challenges; the issues that have arisen to date in just making decisions about fisheries and fish stocks will be magnified, both in terms of information needed and the number of organized and concerned stakeholder groups, as we move more to making decisions about ecosystems. This will be true even if we think of 'ecosystem' in the narrowest possible sense.

The implications of ecosystem management for the scientific basis of governance are substantial. 'Ecosystem' is an ambiguous concept (O'Neill *et al*, 1986). In European seas, any baseline definition of an ecosystem would be speculative. Many scientific approaches to ecosystem management essentially treat it as multi-species management, which is something we should be striving for but which places extreme data demands on a management system that is already a squeezed between demands for more precision on the one hand and the costs of delivering that precision on the other (Degnbol, 2002). Even the much simpler problem of considering predatory-prey interactions involves many more players in governance. This has been demonstrated by the issues around sandeel and sea birds in the North Sea, where management based on predator-prey relationships was successfully implemented after considerable effort – against a fishery operating at a long distance with little or no local political clout.

Ecosystem approaches do not sit well with the realities of bureaucratic environmental management. Bureaucracies depend on calculable rules to trigger responses (Porter, 1995), while ecosystem approaches present complex interactions of parameters that are difficult to quantify and interpret in real decision-making time. More fundamentally, the concepts needed to make ecosystem management work do not translate into firm, legal definitions (Schlager and Friedmund, 1996), even ones as simple as boundaries (Haueber, 1996). Some discussions of ecosystem management from a precautionary perspective have pointed to ecosystem traits that are hard to define (Bailey, 2000), such as 'structure' and 'biodiversity' in the definition cited above. Adding such definitional problems to the uncertainty that precaution is meant to address would to lead to trying to justify greater and greater precaution to the point where marine ecosystem management could be perceived as an attack on the very idea of the economic exploitation of the marine environment. This is not something that can be solved by research or even through definitions 'agreed upon' within the scientific community. We have learned from hard experience that scientific consensus that can stand up in court is hard to achieve even about relatively simple things.

An often suggested response to these problems is the creation of large Marine Protected Areas (MPAs). MPAs should certainly be part of the management toolkit. But, from a governance perspective, large MPAs bring with them a very grave difficulty in that their impacts on some fishing communities, regions and nations are bound to be substantially greater than on others. How can MPAs be made both politically and environmentally feasible in the shared waters of Europe?

Ecosystem management is an important and worthy goal. We need to consider, however, if there is anything in the idea of 'ecosystem management' that goes beyond conserving single species, protecting habitats and protecting genetic diversity, or would good management of these more specific concerns take care of the emergent and international problems that ecosystem management focuses on? Does practical marine ecosystem management really mean managing by a small set of individual indicators that are extracted from the larger ecosystem?

6.8 CONCLUSIONS

Contemporary EU fisheries management is based on a model in which mandated research produces knowledge, which is used to inform management decisions at EU level. Member State bureaucracies then implement these decisions. Interaction with representative democratic institutions and with stakeholders is limited. This model is facing a severe crisis. It is clearly failing to meet its objective of long-term sustainability of the resource base, as more and more fish stocks are considered to be outside safe biological limits and in need of recovery plans. At the same time, it is facing a lack of legitimacy as end-users and other stakeholders question the very knowledge-base of this management.

The Conference working group discussed these issues at length. There is concern about the excessively top-down approach to fisheries regulation in EU waters. The State's emerging role in governance is to develop the policy and regulatory frameworks, fix the overriding objectives, legitimate and balance stakeholders' interactions, and carry out enforcement. Some consideration should be given to devolving more responsibility, with the Commission responsible for setting principles and objectives and elaborating the legislative framework for fisheries and environmental management, making regional institutions progressively more responsible for adapting and 'fine tuning' management to the local realities. Member States, in addition to their sovereign responsibilities in the EU, would be responsible (and accountable) for the enforcement of these regulations. Moves in this direction are already occurring but more substantial changes are needed.

Accountability, and the transparency that makes these changes possible, is perhaps the key to effective governance. The current system of governance for sustainable management of the marine environment in Europe fails in this regard in three key ways.

1. **Downward accountability:** The ability of stakeholders to hold the management system accountable is informal, hence not transparent and often weak. Current reforms, such as the creation of the RACs, begin to move in the right direction and efforts that empower, formalise and increase the transparency of stakeholder decision-making need to be strengthened.
2. **User group behaviour:** User group behaviour in the marine environment is in many ways not transparent, leading to problems with compliance with the rules as well as in gathering the information needed for management. A system to make these activities transparent is needed, that is both based on and requires the cooperation of user groups and related industries. This could include such actions as observer programmes, the wider use of Vessel Monitoring Systems (VMS) and a dealer and fish transaction database that allows the tracing of fish. As well as compliance monitoring, observer programmes can support the gathering of effort and catch data.

3. **The creation of a knowledge-base for management:** Transparency is what makes science, and hence an agreed-upon body of knowledge, possible. Full participation by stakeholders in the processes that create the biological, social and economic knowledge to be used for environmental management is needed throughout Europe. ICES has taken a lead in this effort by opening up its scientific deliberations to observers from conservation NGOs and the fishing industry. Other activities, such as collaborative research involving both scientists and user groups, have proved very important in other areas and is beginning to be more widely used in Europe. These and other activities need to be strengthened.

While the EU has accepted the principle of coherence, actions are often not coherent. The addition of "maritime affairs" to the Fisheries Commissioners title is welcome. Hopefully it will be reflected in a more coherent working relationship between DG Fisheries and DG Environment, whereby the capacity of both DGs to take environmental responsibilities into account is increased. Furthermore, social issues are handled by many institutions but need to be a specific element within the work programmes of DG Fisheries and DG Environment.

RACs are welcomed as an appropriate scale for inclusive stakeholder participation, as well as a means of endowing the policy process with much stronger, regionally specific and/or stakeholder-led sources of professional advice. In their present form, they are purely advisory bodies. However, if shown to be successful in providing well-informed, relevant and consensual advice, they could be given more of a management role in the future. In that case, it would be useful to consider ways to give RACs powers without having to renegotiate the basic EU Treaties in the process.

An important issue for the effective functioning of RACs is to guarantee effective, two-way communication between the RACs and the European institutions, on the one hand, and the Member States, on the other, to ensure full transparency in the ways in which advice from RACs is received and acted upon by the Commission and Council of Ministers. At the same time, it will be important to ensure effective communication between the stakeholder representatives and their constituents and communities, and to ensure unrestricted access of the stakeholders to their representatives. The Commission/Member State organisations have a joint responsibility to ensure that the RACs will dispose of resources adequate to their present and future purpose.

Within the overall governance structure, it will be vital to guarantee effective working relations between RACs and the existing Advisory Committee on Fisheries and Aquaculture. It is important to ensure a reasonable balance and consistency of representation within RACs, for example between representatives from different Member States. At the same time there is a need to recognise the value of RACs to develop their own region-specific internal structures, reflecting the particular structure of its fisheries.

The ecosystem approach specifies that our concerns and management objectives should coherently encompass the entire ecosystem. Ecosystems are defined on different scales. The appropriate geographical scale for issues of local, regional or global character varies. While it will be natural for RACs to address regional fisheries issues, local fisheries problems should be addressed on a smaller scale. Decisions within the ecosystem approach should be taken on the basis of the precautionary principle. Ecosystem status quality assessments should provide the basis for decisions on restricting human impacts. These decisions should be taken by analysing the human impacts on the ecosystem, taking into account natural variability, such as the environment influence on resource development.

Strict application of the precautionary principle would prevent most human activities, since most activities will risk some impact on the ecosystem. It should be expected that every impact would be the concern of some interest group. Therefore, there is a need for a process that defines what is a legitimate concern and what is not. This process is political and it is one that is more familiar to environmental institutions than fisheries institutions. This is because of the wider scope associated with environmental organisations, for example OSPAR and HELCOM, whereas the remit of fisheries commissions is defined more narrowly. The process is iterative. Once an issue is on the table there is an information collection phase, followed by a political evaluation of whether the issue should remain on the political agenda or not. This process is part of the general political process, and putting marine ecosystem concerns on the political agenda is no different from dealing with other issues.

7. LOOKING TO THE FUTURE

The high-level IEEP/FISH conference sought to re-examine the challenges facing sustainable development of the EU - capture fisheries and aquaculture sector, taking a long-term, environmental perspective, and placing it within the pan-European and global contexts, in particular the WSSD targets on fisheries, oceans and biodiversity. The aim was to generate fresh thinking, including on a range of policy instruments, to ensure the transition of the EU fisheries sector to a sustainable industry. The conference deliberations and conclusions were to inform discussions within the EU, with a view to securing renewed commitment to the 2002 CFP reforms as well as international targets.

The conference was held to coincide with the beginning of a new era in the EU: the historic enlargement in May 2004 when ten more countries joined the EU, the election of a new and bigger European Parliament in June, and the start of a new European Commission. Enlargement has wide-ranging implications. For example, there are now ten new members of the Council, operating under new voting procedures and weighting introduced by the Treaty of Nice. Each of the three institutions mentioned above is likely to undergo further changes if the European Constitution, signed in Rome in 2004, is accepted by the Member States.

Institutional changes such as these present opportunities but also a great deal of uncertainty. The new Commission has already introduced some potentially significant structural changes to accommodate a new focus on maritime issues, by appointing a Commissioner for Fisheries and Maritime Affairs, Dr Borg, and creating a Directorate General to reflect this extension of responsibilities. The Green Paper on Maritime Affairs promises to further deepen and strengthen the EU's engagement in marine affairs, potentially resulting in a more coherent approach. While these Commission changes are cautiously welcomed, the extension of the Parliament and the Council creates the potential for pervious political agreements to be revisited. Although all of the 'new' institutions are bound by earlier legislative agreements, including the 2002 CFP reforms, they may not feel as committed to the overall direction and spirit of these reforms as their predecessors were. Nor are they bound by the body of 'softer' statements – such as the Gothenburg Summit conclusions on sustainable development – made by previous politicians. Under these circumstances, maintaining support for and momentum around the CFP reforms could prove to be a particular challenge.

Yet it is surely in the interest of fisheries and environmental actors that the reform process continues. Indeed, given the state of resources and the negative public image this is starting to generate in some countries, it is arguably in the sector's interest to lead the reform process. Instead of blaming governments for failed or inappropriate management, the sector could demonstrate a proactive, solution-oriented attitude by agreeing to a programme of environmental improvement. There is particular scope to explore the role of voluntary agreements between industry and government in the area of bycatch reduction which represents a terrible waste of natural resources. The ultimate vision for the EU sector should be one of a modern, 'clean', competitive and, above all, responsible sector, which supplies Europe's citizens with a healthy source of protein.

Financial support for developing and implementing such voluntary measures may prove to be crucial, even if the overall benefit of government aid to support sustainable fisheries remains controversial in some quarters. Ongoing discussions over the future of the EU's budget and the new European Fisheries Fund for 2007-2013 will be extremely important. The final agreement will determine both the amount of money to be made available for the fisheries sector, where it should be targeted and what kinds of activities it should support. The proposed European Fisheries Fund is small compared to other areas of EU expenditure, with a budget of less than 5 billion for the seven year period. But this makes it all the more pressing for funds to be used prudently, to underpin activities that are truly 'win-win-win' – benefiting the sector, communities and the environment over the long term. A roll back to the pre-2002 arrangements, where most funding was used to support boat building and indiscriminate modernisation projects, will only hinder the long-term survival of the sector.

Funding is just one of a number of instruments that can be used to deliver fisheries management objectives. Consideration should be given to strengthening and broadening the range of instruments used, including rights-based instruments. This is a sensitive area but one calling for a mature debate on the potential benefits and drawbacks of, for example, ITQs versus collective user rights. There is a growing body of experience on designing such instruments so that they support rather than undermine the interests of fisheries and fishing communities. This experience should underpin an informed European discussion of the matter, and any policy proposals that might result. Here and elsewhere there are important opportunities to be grasped in the EU's search for fisheries that are ethically and socially just, as well as delivering effective resource management.

The challenge for IEEP and other actors is to raise and promote discussion on these and other instruments, tackling not only fishing pressures but also key drivers behind fishing and fish farming, such as trade and consumption. Sustainable fisheries will remain an elusive concept unless we use all of the levers available to us to modify practices and limit overall levels of production. The onus is on the fisheries sector, environmental community and progressive national and European actors to see that all levers are indeed working for sustainable fisheries, so that the philosophy of the 2002 reforms is strengthened rather than undermined by the 'new' EU.

Appendix: Fuel Inputs to Contemporary North Atlantic Fisheries

(*EU-based fisheries in italics*)

FISHERY PURPOSE AND PRIMARY TARGETS	GEAR	YEAR	NATIONALITY OF FISHERY	FUEL USE INTENSITY (LITRES/TONNE)	SOURCE
Industrial fisheries					
Sand Eels	*Trawl*	*2000*	*Denmark*	*100*	*A*
Herring	*Mid-water trawl*	*1999*	*Finland*	*110*	*B*
Capelin	*Mid-water trawl*	*1998*	*Germany*	*110*	*C*
Herring	*Trap*	*1999*	*Finland*	*560*	*B*
Capelin	Purse seine	1997	Iceland	20	C
Menhaden	Purse seine	1999	U.S.	30	C
Herring	Purse seine	1999	Iceland	30	C
Blue whiting	Purse seine	1998	Norway	85	C
Sand Eels	Trawl	1998	Norway	95	C
Fisheries targeting demersal finfish for human consumption					
Cod	*Gillnet*	*1999*	*Sweden*	*340*	*D*
Redfish spp.	*Trawl*	*1998*	*Germany*	*410*	*B*
Cod	*Bottom trawl*	*2000*	*Denmark*	*470*	*A*
Flatfish spp.	*Bottom trawl*	*2000*	*Denmark*	*560*	*A*
Cod	*Bottom trawl*	*1998*	*Germany*	*1,000*	*B*
Cod	*Bottom trawl*	*1999*	*Sweden*	*1,410*	*D*
Flatfish spp.	*Beam trawl*	*1998*	*Germany*	*2,320*	*B*
Cod	*Beam trawl*	*1998*	*Germany*	*2,720*	*B*
Redfish spp.	Trawl	1999	Canada	370	C
Flatfish spp.	Mobile seine	1999	Canada	380	C
Redfish spp.	Mobile seine	1997	Iceland	440	C
Silver hake	Trawl	1999	Canada	450	C
Cod	Mobile seine	1998	Norway	470	C
Cod/Redfish spp.	Trawl	1997	Iceland	470	C
Cod/Saithe	Trawl	1998	Norway	520	C
Cod/Flatfish spp.	Mobile seine	1997	Iceland	530	C
Fisheries targeting pelagic finfish species for human consumption					
Mackerel	*Trawl*	*2000*	*Denmark*	*80*	*A*
Herring	*Trawl*	*2000*	*Denmark*	*140*	*A*
Herring	*Purse/mobile seine*	*1998*	*Norway*	*130*	*C*
Fisheries targeting invertebrates					
Mussels	*Hand gathering*	*2000*	*Denmark*	*10*	*A*
Prawn	*Dredge*	*2000*	*Denmark*	*540*	*A*
Shrimp	*Trawl*	*2000*	*Denmark*	*1,020*	*A*
Norway Lobster	*Trawl*	*2000*	*Denmark*	*1,160*	*A*
Scallop	Dredge	1997	Iceland	290	C
Crab spp.	Trap	1999	Canada	330	C
Scallop	Dredge	1999	Canada	340	C
Prawn	Trawl	1999	Canada	530	C
Shrimp	Trawl	1997	Iceland	1,000	C

Sources: A. Trane 2004, B. Lillsunde *pers. comm*. 2002, C. Tyedmers 2001, D. Ziegler and Hansson 2003.

REFERENCE LIST

Ágústsson, A Ragnarsson, E and Laxdal H (1978) Brennsluoliunotkun islenskra fiskiskipa (Fuel consumption of Icelandic Fishing Vessels). *Ægir* No 71(11) pp 462–486 (In Icelandic).

Alderman, D J (1999) Chemicals in aquaculture. Sustainable aquaculture. Balkema, Rotterdam

ANPA (2002) Linee guide per l'applicazione del Regolamento EMAs al settore della Piscultura. Manuali e linee guide 15/2002.

Asche, F and Bjorndal, T (1999) Demand elasticities for fish: A review. *Globefish Special Series* No. 9. Rome: Food and Agriculture Organization of the United Nations.

Asgard, T and Austreng, E (1995) Optimal Utilization of Marine Proteins and Lipids for Human Interest. In: Reinertsen, H. and H. Haaland (eds.) *Sustainable Fish Farming: Proceedings of the First International Symposium on Sustainable Fish Farming*, pp 79–87. Balkema A A, Rotterdam.

Bailey, P D (2000) Discourse and the Regulation of the Environment and Technology: Overfishing and Vessel Monitoring in European Fisheries *Institute for Fisheries Management Research Report* No. 54.

Barnett, A (2000) 'Illegal poison' used on salmon - chemical treatment at fish farms is hazard to health and marine life, claims ex-employee. *The Observer*, 30 April.

BBC (2000) Salmon producer kicked out. *BBC News*, 19th July http://news.bbc.co.uk/1/hi/uk/scotland/841811.stm

Beaugrand, G Brander, K M Lindley, J A Souissi, S and Reid, P C (2003). Plankton effect on cod recruitment in the North Sea. *Nature*, No 426, pp 661–664.

Berggren, P Wade, P R Carlström, J and Read, A J (2002). Potential limits to anthropogenic mortality for harbour porpoises in the Baltic region. *Biological Conservation*, No 103, pp 313–322.

Black Sea Commission (2002) *State of the Environment of the Black Sea – Pressure and Trends*. http://www.blacksea-commission.org/Publications/SOE_Eng.htm

Blythman, J (2001) Salmon farmers in for a grilling. *The Sunday Herald*, 11th March http://www.sundayherald.com/14198

British Marine Finfish Association (2002) Submission to the Scottish Transport and the Environment Committee. 5th Report 2002, Phase 1 of the Inquiry into Aquaculture, Volume 2: Evidence http://www.scottish.parliament.uk/S1/official_report/cttee/trans-02/trr02-05-vol02-01.htm

Brown J, Farmer A, Bevins K, Alvarez C (2003) Role of Fishing Vessel Licensing in European Environmental Management. IEEP: London.

Brown, J (2005) An Account of the Dolphin-Safe Tuna Issue in the UK. *Marine Policy*, 29(1): 39–46.

Brown, J (2004) Progress on EU stock recovery plans. *IEEP CFP Briefings 19*. Institute for European Environmental Policy.

Butler, J R A and Watt, J (2002) *Impacts of salmon on the Scottish west coast: priorities in conserving wild stocks*. Paper presented at the 6th International Atlantic salmon symposium in Edinburgh, 16–18th July.

Cameron, F (2002a) Shetland firm which used illegal chemical bows out of quality scheme. *Intrafish*, 30th January.

CEC (1997) *The EU compendium of spatial planning systems and policies*, Office for the Official Publications of the European Communities, Luxembourg.

CEC (1999) Communication from the Commission to the Council and the European Parliament. Fisheries management and nature conservation in the marine environment. (COM(1999)363).

CEC (2000) Council Regulation (EC) No 657/2000 of 27 March 2000 on closer dialogue with the fishing sector and groups affected by the common fisheries policy. Official Journal L 080, 31/03/2000, p. 0007–0008.

CEC (2000) Final report of a mission carried out in Malta from 12 to 17 July 2000 for the purpose of assessing the conditions of production of fishery products. DG SANCO, European Commission.

CEC (2001) European governance – a white paper. COM(2001)428 - final of 25.07.2001

CEC (2001) Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment. Official Journal L 197, 21/07/2001, p. 0030–0037.

CEC (2002) Communication from the Commission to the European Parliament, the Council, the Economic and Social Committee and the Committee of the Regions. Towards a global partnership for sustainable development. COM(2002)82.

CEC (2002) *Towards a strategy to protect and conserve the marine environment*. Communication from the Commission to the Council and the European Parliament. COM(2002)539 final.

CEC (2002) Communication from the Commission setting out a Community Action Plan to integrate environmental protection requirements into the Common Fisheries Policy. COM(2002)186.

CEC (2002) Communication from the Commission setting out a Community Action Plan to integrate environmental protection requirements into the Common Fisheries Policy. COM(2002)186.

CEC (2002) Communication from the Commission to the Council and the European Parliament. On a Community Action Plan to reduce discards of fish. COM(2002)656.

CEC (2002) Communication from the Commission on impact assessment. COM(2002)276(01).

CEC (2002) Communication from the Commission to the Council and the European Parliament. A Strategy for the Sustainable Development of European Aquaculture. COM(2002)511.

CEC (2002) Council Regulation (EC) No 2369/2002 of 20 December 2002 amending Regulation (EC) No 2792/1999 laying down the detailed rules and arrangements regarding Community structural assistance in the fisheries sector. Official Journal L 358, 31/12/2002, p. 0049–0056.

CEC (2002). Communication from the Commission to the European Parliament, the Council, the Economic and Social Committee and the Committee of the Regions towards a global partnership for sustainable development. COM(2002)82(01).

CEC (2002) Communication from the Commission on an integrated framework for fisheries partnership agreements with third countries. COM(2002)637(01).

CEC (2003) Communication from the Commission to the Council and the European Parliament. Development of a Community Action Plan for the management of European Eel. COM(2003)573.

CEC (2003) Directive 2003/4/EC of the European Parliament and of the Council of 28 January 2003 on public access to environmental information and repealing Council Directive 90/313/EEC. Official Journal L 041, 14/02/2003, pp. 0026–0032.

CEC (2003) Directive 2003/35/EC of the European Parliament and of the Council of 26 May 2003 providing for public participation in respect of the drawing up of certain plans and programmes relating to the environment and amending with regard to public participation and access to justice Council Directives 85/337/EEC and 96/61/EC - Statement by the Commission. Official Journal L 156, 25/06/2003, pp. 0017–0025.

CEC (2004, draft) European Marine Strategy – Policy document. Commission of the European Community, DG Environment

CEC (2004) Communication from the Commission to the Council and the European Parliament. Stimulating Technologies for Sustainable Development: An Environmental Technologies Action Plan for the European Union. COM(2004a)38.

CEC (2004) Council Decision 2004/585/EC of 19 July 2004 establishing Regional Advisory Councils under the Common Fisheries Policy. Official Journal L 256, 03/08/2004, pp. 0017–0022.

CEC (2004) Communication from the Commission to the Council and the European Parliament. Improving the monitoring of industrial fishing within the EU COM(2004)167.

CEC (2004) Council Regulation concerning the mitigation of incidental catches of cetaceans in fisheries and amending Regulation 88/98. Official Journal L150, 30.04.2004.

CEC (2004) Council Regulation (EC) No 1421/2004 of 19 July 2004 amending Regulation (EC) No 2792/1999 laying down the detailed rules and arrangements regarding Community structural assistance in the fisheries sector. Official Journal L 260, 06/08/2004 P. 0001–0005.

CEC (2004) Proposal for a Council Regulation European Fisheries Fund. COM(2004)497(01).

Clifford, S McGinnity, P and Ferguson, A (1998) Genetic changes in Atlantic salmon (*Salmo salar*) populations of Northwest Irish river resulting from escapes of adult farmed salmon. *Canadian Journal of Fisheries and Aquatic Sciences*, No55(2), pp 358–363.

Costello, M J, Grant, A Davies, I M Cecchini, S Papoutsoglou, S Quigley, D and Saroglia, M (2001) The control of chemicals used in aquaculture in Europe. *Journal of Applied Ichthyology*, No 17(4), pp. 173–180.

Crozier, W W (1993) Evidence of genetic interaction between escaped farmed salmon and wild Atlantic salmon (*Salmo salar* L.) in northern Irish river. *Aquaculture*, No 113, pp 19–29.

Crozier, W W (2000) Escaped farmed salmon, *Salmo salar* L., in the Glenarm River, Northern Ireland: genetic status of the wild population 7 years on. *Fisheries Management and Ecology*, No 7(5), pp 437–446.

CSMP (2002) A guide to Oceans, Coasts and Islands at the World Summit on Sustainable Development.

Davidse, WP, H Harmsma, M O, van Wijk, L V, McEwan, N, Vestergaard and H Frost (1997) *Property rights in fishing: effects on the industry and effectiveness of fisheries management policy*. Agricultural Economics Research Institute, The Hague, The Netherlands.

Degnbol, P (2002). The Ecosystem approach and fisheries management institutions: the noble art of addressing complexity and uncertainty with all on board and on a budget. *IIFET Paper no 171*.

Degnbol, P (2003) Science and the User Perspective: the Scale Gap and the Need for Co-management. In Wilson, D C, J R Nielsen and P Degnbol (Eds) *The Fisheries Co-management Experience: Accomplishments, Challenges and Prospects*. Dordrecht, The Netherlands: Kluwer Academic Publishers.

Degnbol, P, A Cralberg, H Ellingsen, MTonder, R Varjpuro and D Wilson (2003) *Integrating fisheries and environmental policies – Nordic Experiences*. TemaNord 521. 148 p.

Delgado, C L and Courbois, C (1998) Trade-offs among fish, meat, and milk demands in developing countries from the 1970's to the 1990's. In Eide A and T. Vassdal (eds) *Proceedings of the biennial meetings of the International Institute of Fisheries Economics and Trade*, Tromso, Norway: The Norwegian College of Fishery Science.

Delgado, C L Rosegrant, M Steinfeld, H Ehui, S and Courbois, C (1999) Livestock to 2020: The next food revolution. *Food, Agriculture, and the Environment Discussion Paper*, No. 28. Washington, D.C.: International Food Policy Research Institute.

Delgado, C L Wada, N Rosegrant, M W Meijer, S and Ahmed, M (2003) Outlook for Fish to 2020: Meeting Global Demand. International Food Policy Research Institute, Washington D.C. WorldFish Centre, Penang Malysia.

Dommen, C (1999) Fish for Thought. Fisheries, International Trade and Sustainable Development. *Natural Resources, International Trade, and Sustainable Development Series* No.1. Initial issues for consideration by a multi-stakeholder policy dialogue. International Centre for Trade and Sustainable Development (ICTSD) and IUCN-The World Conservation Union.

Douglas, J D M (1995) Salmon farming: occupational health in a new rural industry. *Occupational Medicine*, No 45, pp 89–92.

Edwards, R (1998) Infested waters - sea lice from salmon farms threaten Scotland's sea trout. *New Scientist*, No 159(2141), pp 23.

Edwardson, W (1976) The Energy Cost of Fishing. *Fishing News International*, No 15(2).

EEA (1999) *Coastal and marine zones in Environment in the European Union at the turn of the century*; European Environment Agency

EEA (1999) *Environment in the European Union at the turn of the century*. Environmental assessment report No 2, European Environment Agency

EEA (1999) State and pressures of the marine and coastal Mediterranean Environment. European Environment Agency

EEA (2002) *Europe's biodiversity – biogeographical regions and seas*: Seas around Europe (North-East Atlantic/Baltic Sea/Black Sea/North Sea/Mediterranean Sea). European Environment Agency

EEA (2002) Indicator: Trend in aquaculture. http://themes.eea.eu.int/Sectors_and_activities/fishery/indicators/FISH03,2002.10/index_html

EEA (2002) Late lessons from early warnings: the precautionary principle 1896-2000.

EEA (2003) Europe's water: An indicator-based assessment. European Environment Agency http://reports.eea.eu.int/topic_report_2003_1/en/Topic_1_2003_web.pdf

EEA (2004) Fact Sheet http://themes.eea.eu.int/Sectors_and_activities/fishery/indicators/FISH01a%2C2004.05 /FISH1a_StocksOutsideSBL_2002_140504.pdf

Egenhofer, C and P ten Brink (2003) *Les instruments des politiques de l'environnement*. Institut de l'Entreprise. 31 pp.

Ernst, W et al (2001) Dispersion and toxicity to non-target aquatic organisms of pesticides used to treat sea lice on salmon in net pen enclosures. *Marine Pollution Bulletin*, No 42 (6), pp 433–444.

European Communities (2004) CEC economic data pocket book, Quarterly 2. ISSN 1026-0846

European Environment Agency (2001a) Fishing fleet – trends. Indicator fact sheet.

European Environment Agency (2001b) Trends in Aquaculture. Indicator fact sheet.

European Parliament (2004) The Fishmeal and Fish Oil Industry its Role in the Common Fisheries Policy. *European Parliament Working Paper, Fisheries Series*, FISH 113 EN, Prepared by University of Newcastle Upon Tyne (UK) and Poseidon Aquatic Resource Management Ltd (UK)

Eurostat (2003) *Fisheries Yearbook 2003*. Data 1993-2002. ISSN 1609-4085.

FAO (2002) *State of the World Fisheries and Aquaculture*. Food and Agriculture Organization of the United Nations, Rome, ISBN 92-5-104842-8.

FAO (2003) *Overview of fish production, utilization, consumption and trade*. UN Food and Agriculture Organisation (Based on 2001 data) ftp://ftp.fao.org/fi/stat/overview/2001/commodit/2001fisheryoverview.pdf

FAO (2004) Technical Consultation to Review Progress and Promote the Full Implementation of the IPOA to Prevent, Deter and Eliminate IUU Fishing and the IPOA for the Management of Fishing Capacity. Action Taken by FAO Members to Implement the International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (IPOA-IUU). Rome, Italy, 24–29 June 2004.

Fleming, I A and Einum, S (1997) Experimental tests of genetic divergence of farmed from wild Atlantic salmon due to domestication. *ICES Journal of Marine Science*, No 54, pp 1051–1063.

Fleming, I A Hindar, K Mjolnerod, I B Jonsson, B Balstad, T Lamberg, A (2000) Lifetime success and interactions of farm salmon invading a native population. *Proceedings of the Royal Society of London*, No B 267 (1452), pp 1517–1523.

Folke, C (1988) Energy Economy of Salmon Aquaculture in the Baltic Sea. *Environmental Management*, No 12(4), pp 525–537.

Frid, C Hammer, C Law, R Loeng, Pawlak, J, Reid, P and Tasker, M (2003) *Environmental Status of the European Seas*. ICES Report Prepared for the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety.

GESAMP (1997) Towards the safe and effective use of chemicals in coastal aquaculture. Report No. 65. FAO.

Goetz, D Hoskins, R Paxton, and Dupee, G (1999) *Food Miles: still on the road to ruin?* Sustain: The alliance for better food and farming.

Gorez, B and B O'Riordan (2003) *An Examination of Fisheries Relations between the European Union and ACP Countries*. Submitted to the Joint COMSEC – CTA Meeting on ACP-EU Fisheries Agreement: Towards a Greater Sustainability 7-9 April 2003, ACP House Brussels.

Haeuber, R (1996) Setting the Environmental Policy Agenda: The Case of Ecosystem Management. *Natural Resources Journal* 36 (Winter): 1–28.

Hall, K (2000) *Impacts of Marine Debris and Oil Economic and Social Costs to Coastal Communities*, Kommunenes Internasjonale Miljøorganisasjon (KIMO), ISBN 0904562891

HELCOM (1998) Red List of Marine and Coastal Biotope Complexes of the Baltic Sea Area http://www.helcom.fi/a/proceedings/bsep75.pdf

Hilge, V and Halwart, M (2004) *Conventional and organic aquaculture in Europe: status and outlook*. Paper presented to Organic Aquaculture and Sea Farming, 15–17 June 2004, Ho Chi Minh City, Vietnam.

Hird, V Emerson, C Noble, E Longfield, J Williams, V Whittaker, S (2004) Industry Analysis and Regional Development: Analytical paper produced to support the report Net Benefits – a sustainable and profitable future for UK fishing. Prime Ministers Strategy Unit, UK.

Hites, R A Foran, J A Carpenter, D O Hamilton, M C Knuth, B A M and Schwager, S J (2004b) Global Assessment of Organic Contaminants in Farmed Salmon. *Science*, No 303, 9 January 2004.

Hites, R A Foran, J A Schwager, S J Knuth, B A Hamilton, M C and Carpenter, D O (2004a) Global Assessment of Polybrominated Diphenyl Ethers in Farmed and Wild Salmon. *Environmental Science & Technolog*, August 10, 2004.

http://www.gpa.unep.org/documents/WSSD/Oceans-Coasts-and-Islands-at-the-WSSD.pdf

http://www.sdnpbd.org/sdi/international_day/wed/2004/about/keyfacts.htm

Huntington, T Frid, C Banks, R Scott, C and Paramor, O (2004) 'Assessment of the Sustainability of Industrial Fisheries Producing Fishmeal and Fish Oil'. Report to RSPB.

ICES (1999) *Report of the ICES Advisory Committee on Fishery Management*. ICES Cooperative Research Reports No. 229, Copenhagen

ICES (2002) *Report of the ICES Advisory Committee on Ecosystems*. ICES Cooperative Report No. 254, Copenhagen, June 2002.

ICES (2003). Environmental Status of the European Seas. ICES Report Prepared for the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety.

Intrafish (1998) Using banned chemical - one of Shetland's biggest salmon firms was fined a thousand pounds yesterday for using the banned fish farm chemical Cypermethrin. Intrafish, 30th April.

ISO (2004) http://www.iso.org/iso/en/aboutiso/introduction/index.html#five

ITOPF Regional profiles (2003)- http://www.itopf.com/country_profiles/

Le Gallic, B (2004) The use of market-like instruments in OECD countries: key insights from an organisational framework. Paper presented at IIFET 2004 Japan.12 pp.

Leach, G (1976) *Energy and food production*. IPC Science and Technology Press, Surrey.

Lequesne, C (2004) The politics of fisheries in the European Union. *European Policy Research Unit Series*. Manchester University Press. 170 p.

Lloyd's Register Engineering Services (1995) *Marine Exhaust Emissions Research Programme*. A report prepared for Lloyd's Register of Shipping.

Lorentzen, G (1978) Energibalanse i den norske fiskerinaering. *Meldingen SSF*, M2:5-9 (In Norwegian).

Matthews, E. and Hammond, A. (1999) *Critical consumption trends and implications: Degrading Earth's ecosystems.* World Resources Institute. ISBN 1569734100.

Mediterranean Action Plan: http://www.unepmap.org/

Mediterranean Action Plan – Tourism and Sustainable development: http://www.planbleu.org/pdf/tourismea.pdf

Milner, N J and Evans, R (2002) *The incidence of escaped Irish salmon in English and Welsh rivers*. Poster presented at the 6th International Atlantic Salmon Symposium in Edinburgh, 16–18th July.

Mitchell, C and Cleveland, C J (1993) Resource Scarcity, Energy Use and Environmental Impact: A Case study of the New Bedford, Massachusetts, USA, Fisheries. *Environmental Management* No 17(3), pp 305–317.

Mongruel, R and G Pálsson (2004) Le propriétaire, l'exploitant, le salarié et l'exclu: les conséquences sociales de la gestion des pêches par des systèmes de marches de droits. *Revue Tiers Monde*, No XLV/177, pp 29–59.

Moore, A and Waring, C (2001) The effects of a synthetic pyrethroid on some aspects of reproduction in Atlantic salmon. *Aquatic Toxicology*, No 52, pp 1–12.

Nautilus Consultants (2003) FIFG Processing Study. *Study on the Impact of FIFG Measures on the fish processing industry*. Report to the European Commission.

Naylor, R L Goldburg, R J Primavera, J H Kautsky, N Beveridge, M C Clay, J Folke, C Lubchenco, J Mooney, H Troell, M (2000) Effect of aquaculture on world fish supplies. *Nature*, No 405, pp 1017–1024.

NERA (2004) Evaluation of the Feasibility of Alternative Market-Based Mechanisms To Promote Low-Emission Shipping In European Union Sea Areas. A Report for the European Commission, Directorate-General Environment

Nomura, I (2004) *What are Responsible Fisheries? State of World Fisheries and Future Sustainability Issues.* Paper presented at The Twelfth Biennial Conference of the International Institute of Fisheries Economics and Trade, IIFET 2004 Japan.

North Sea Secretariat (1997) *Intermediate Ministerial Meeting on the Integration of Fisheries and Environmental Issues*. 13–14 March 1997, Bergen, Norway. Ministry of Environment, Norway. Also available on http://www.odin.dep.no/nsc/meeting1997/conclusions.html.

OECD (1997) Processes and Production Methods (PPMS): Conceptual Framework and Considerations on use of PPM-Based Trade Measures. OCDE/GD(97)137

OECD (2003) Liberalising Fisheries Markets, Scope and Effects.

O'Neill, RV, D L DeAngelis, J B Waide and T F H Allen (1986) *A Hierarchical Concept of Ecosystems*. Princeton: Princeton University Press.

OSPAR (2000) *Quality Status Report 2000 for the North-East Atlantic*. OSPAR Commission, London 2000 http://www.ospar.org/eng/html/qsr2000/QSR2000welcome.htm

Pacific Northwest Pollution Prevention Research Center 1993. *Pollution Prevention Opportunities in the Fish Processing Industry*. A Northwest Industry Roundtable Report.

Pauly D (2002) Fisheries Management: Sustainability vs. Reality. *Production Systems in Fisheries Management. Fisheries Centre Research reports*, No 10(8). Fisheries Centre, University of British Columbia, Canada. ISSN 1198-6727.

Pauly, D and V Christensen (1995) Primary production required to sustain global fisheries. *Nature*, Vol. 374, 1995, pp 255–257.

Pitcher, T J (1977) An energy budget for a Rainbow Trout Farm. *Environmental Conservation*, No 4, pp 59–65.

Porter, T M (1995) *Trust in Numbers: The Pursuit of Objectivity in Science and Public*. Life Princeton NJ: Princeton University Press.

Rae, A N (1998) The effects of expenditure growth and urbanization on food consumption in East Asia: A note on animal products. *Agricultural Economics*, No 18, pp291–299.

Rawitscher, M A (1978) *Energy Cost of Nutrients in the American Diet*. Unpublished Doctor of Philosophy Thesis. University of Connecticut, Storrs, USA.

Rawitscher, M and Mayer, J (1977) Nutritional outputs and energy inputs in seafoods. Science, No 198, pp 261–264.

Ritter, E (1997) *Livscyklusvurdering for marineret sild i glas* (Life Cycle Screening of marinated herring in glass jars). Hirtshals, Denmark, DTI Miljö and DIFTA. (in Danish).

Rochereau, S P (1976). Energy analysis and coastal shelf resource management: Nuclear power generation vs. sea-food protein production in the Northeast region of the U.S. Ph.D. Dissertation. Cornell University.

Ross, D and Holme, C (2001) Split on use of fish farm drugs - shellfish producers call for halt on expansion because of unease over increasing use of chemicals. *The Herald*, 5th April.

Roth, M (2000) The availability and use of chemotherapeutic sea lice control products. *Contributions to Zoology*, No 69 (1-2), pp 109–118.

Saegrov, H et al (1997) Escaped farmed Atlantic salmon replace the original salmon stock in the River Vosso, western Norway. *ICES Journal of Marine Science*, No 54 (6), pp 1166–1172.

Salter, L (1988) Mandated science: Science and Scientists in the Making of Standards. Dordrchet Holland: Kluwer Academic Publisher.

Schlager, D B and W A Freimund (1996) *Institutional and Legal Barriers to Ecosystem Management* [Online] Available: http://www.fs.fed.us/land/c-basin/doc/social/barrier.htm.

Schnick, R A et al (1997) Worldwide aquaculture drug and vaccine registration progress. *Bulletin of the European Association of Fish Pathologists*, No 17(6), pp 251–260.

SEERAD (2003) Information provided by the Scottish Executive on 23rd June 2003 to Salmon Farm Monitor. http://www.salmonfarmmonitor.org/pr010803.shtml

Seppälä J, Silvenius F, Grönroos J, Mäkinen T, Silvo K and Storhammar E (2001) Rainbow trout production and the environment. *The Finnish Environment*, No 529. 166 p. (in Finnish).

SFIA (1999) Guidance for Fish Processors on Water and Effluent Minimisation 1st Edition, April 1999 Sea Fish Industry Authority, UK.

SRU (2004) Marine Environmental Protection for the North and Baltic Seas. The German Advisory Council on the Environment

Staniford, D (2002a) Sea cage fish farming: an evaluation of environmental and public health aspects (the five fundamental flaws of sea cage fish farming). Paper presented at the European Parliament's Committee on Fisheries public hearing on 'Aquaculture in the European Union: Present Situation and Future Prospects', 1st October 2002.

Staniford, D (2002b) *A big fish in a small pond: the global environmental and public health threat of sea cage fish farming*. Paper presented at "Sustainability of the Salmon Industry in Chile and the World" – a workshop organised by the Terram Foundation and Universidad de los Lagos in Puerto Montt, Chile, 5–6th June.

Stewart, JA (1995) *Assessing Sustainability of Aquaculture Development*. Ph.D. Dissertation. University of Stirling, Stirling, Scotland.

Stokke, O S and C Coffey (2003) Precaution, ICES and the Common Fisheries Policy: a study of regime interplay. *Marine Policy* 28: 117–126.

Thrane, M (2004) Energy Consumption in the Danish Fishery. *Journal of Industrial Ecology*, No 8(1-2), pp 223–239.

Troell, M Tyedmers, P Kautsky, N and Rönnbäck, P (2004) Aquaculture and Energy Use. In: Cleveland, C. (ed.) Encyclopedia of Energy. *Elsevier Science*, No. 1, pp 97–108.

Tudela, S and García, R (2004) Tuna farming in the Mediterranean: the bluefin tuna stock at stake WWF Report, June 2004.

Tuominen, T and Esmark, M (2003). Food for Thought: the Use of Marine Resources in Fish Feed. WWF Norway.

Tyedmers, P (2000) Salmon and sustainability: The biophysical cost of producing salmon through the commercial salmon fishery and the intensive salmon culture industry. Ph.D. Dissertation. University of British Columbia, Vancouver, Canada. pp 255.

Tyedmers, P (2001) Energy Consumed by North Atlantic Fisheries, in "Fisheries Impacts on North Atlantic Ecosystems: Catch, effort and national/regional datasets" (D. Zeller, R. Watson, and D. Pauly, eds.), *Fisheries Centre Research Reports*, No 9(3), pp 12–34.

Tyedmers, P (2004) Fisheries and Energy Use. In: Cleveland, C. (ed.). Encyclopedia of Energy. *Elsevier Science*, No 2, pp 683–693.

UNEP (1997) *Global Environmental Outlook 1: Global Sate of the Environment Report.* http://www.grida.no/geo1/ch/ch2_7.htm

UNEP (2001) Cleaner Production Assessment in Fish Processing.

UNEP (2004) World Environment Day

UNEP/GPA (2001) The Global Programme of Action for the Protection of the Marine Environment from Land-based Activities – Key outputs of the first intergovernmental review meeting. Montreal, Canada. http://www.gpa.unep.org/igr/documents/final%20key%20outputs%20kl21.pdf

UNEP/WCMC (2003) Global Marine Assessments: A survey6 of global and regional marine environmental assessments and related scientific activities. UNEP-WCMC Biodiversity Series No.16

Varadi, L Szucs, I Pekar, F Blokhin, S and Csavas, I (2001) Aquaculture Development Trends in Europe. In: Subasinghe R P, Bueno P, Phillips M J, Hough C, McGladdery S E and Arthur J R (eds.) *Aquaculture in the Third Millennium*. Technical Proceedings of the Conference on Aquaculture in the Third Millennium, Bangkok, Thailand, 20-25 February 2000. pp. 397–416. NACA, Bangkok and FAO, Rome.

Watanabe, H and Okubo, M (1989) Energy Input in Marine Fisheries of Japan. *Bulletin of the Japanese Society of Scientific Fisheries/Nippon Suisan Gakkaishi*, No 53(9), pp 1525–1531.

Watanabe, H and Uchida, J (1984). An estimation of direct and indirect energy input in catching fish for fish paste products. *Bulletin of the Japanese Society of Scientific Fisheries/Nippon Suisan Gakkaish*, No 50(3), pp 417–423.

Wijkstrom, U (2001) Policy making and planning in aquaculture development and management. In R P Subasinghe, P Bueno, M J Phillips, C Hough, S E McGladdery and J R Arthur (Eds.) *Aquaculture in the Third Millennium*, pp15–21. Technical Proceedings of the Conference on Aquaculture in the Third Millennium, Bangkok, Thailand, 15–21 February 2000. Bangkok and Rome.

Wilkinson D, M Fergusson, C Monkhouse, C Bowyer, A Ladefoged, J Brown and A Zdanowicz, (2004) *Sustainable Development in the European Commission's Integrated Impact Assessments for 2003*. IEEP: London.

Wilson, D C and P Degnbol (2002) The Effects of Legal Mandates on Fisheries Science Deliberations: The Case of Atlantic Bluefish in the United States. Fisheries Research 58:1–14.

Wilson, D C, J R Nielsen and P Degnbol (Eds) (2003) The Fisheries Co-management Experience: Accomplishments, Challenges and Prospects. Dordrecht, The Netherlands: Kluwer Academic Publishers.

Wiviott, D J and Mathews, S B (1975) Energy Efficiency Comparison between the Washington and Japanese Otter Trawl Fisheries of the Northeast Pacific. *Marine Fisheries Review*, No 37(4), pp 21–24.

WWF (2003) *North East Atlantic and Baltic Health Check.* http://www.panda.org/downloads/marine/neabaltichealthcheck.pdf

Ziegler, F and Hansson, P A (2003) Emissions from fuel combustion in Swedish cod fishery. Journal of Cleaner Production, No 11, pp 303–314.

Ziegler, F Nilsson, P Mattsson, B and Walther, Y (2003) "Life Cycle Assessment of frozen cod fillets including fishery-specific environmental impacts." *International Journal of LCA*, No 8 (1), pp 39–47.

REGIONAL SEAS CONVENTIONS

OSPAR Convention
http://www.ospar.org/

HELCOM
http://www.helcom.fi/

BARCOM – the Barcelona Convention and Mediterranean Action Plan
http://www.unepmap.org/

Black Sea Convention
http://www.blacksea-commission.org/

UNEP Regional Seas
http://www.unep.ch/seas/index.html

OTHER RELEVANT INTERNET ADDRESSES

The International Council for the Exploration of the Sea (ICES)
http://www.ices.dk/

North East Atlantic Fisheries Commission (NEAFC)
http://www.neafc.org/

Convention on Future Multilateral Co-operation in North-East Atlantic Fisheries
http://www.oup.co.uk/pdf/bt/cassese/cases/part1/ch03/512.pdf

General Fisheries Commission For The Mediterranean (GFCM)
http://www.fao.org/fi/body/rfb/GFCM/gfcm_home.htm

International Commission For The Scientific Exploration Of The Mediterranean Sea (CIESM)
http://www.ciesm.org/

WWF North East Atlantic Programme
http://www.ngo.grida.no/wwfneap/overview/overview.htm

FISH
FISKESEKRETARIATET
THE FISHERIES SECRETARIAT

The Fisheries Secretariat (FISH)
Svartviksslingan 28
167 39 Bromma
Sweden

Tel: +46 (0)8 704 44 84
Fax: +46 (0)8 795 96 73

Email: info@fishsec.org
Website: www.fishsec.org

ISBN 1 873906 49 8

Institute for European Environmental Policy

Institute for European Environmental Policy (IEEP)
28 Queen Anne's Gate
London SW1H 9AB
UK

Tel: +44 (0)20-77 99 22 44
Fax: +44 (0)20-77 99 26 00

Email: central@ieeplondon.org.uk
Website: www.ieep.org.uk