

THE ENVIRONMENTAL EFFECTS OF MARINE FISHERIES

A Royal Commission on Environmental Pollution Seminar
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The Royal Commission's next Study will be on the Environmental Effects of Marine Fisheries. As part of the scoping of the Study, the Commission held a seminar to gather views from interested parties on the themes which it should address. The programme for the day is at **annex A** and a list of participants is at **annex B**.

What follows is a record of the presentations and discussion during the day.

Sir Tom Blundell, Chairman of the Royal Commission: Introduction

The Commission, having announced its intention to study the environmental effects of marine fisheries in June 2002, has been scoping the study, with this seminar being intended to contribute to that process. Currently the main focus for the Commission is its study of the Long Term effects of Chemicals on the Environment, which should be completed around April next year. The Marine Fisheries study will then become the Commission's main concern with invitations to give written and oral evidence, site visits and Secretariat papers. Around December next year we hope to begin drafting in order to bring the report together for publication in mid 2004.

The main theme of the study is shifting the focus from concern about depleted fish stocks to concern about the state of marine environment. There were several reasons for taking up the study, which takes place against a background of serious and widespread threats to the World's oceans. The growing intensification of fisheries has the potential to wreak as much damage on the oceans as intensive agriculture has on land over recent decades. The state of marine knowledge is a matter for concern: the extent and even the existence of damage by fishing is disputed and, despite the efforts of marine science, the marine environment is still poorly understood.

One of our objectives is to develop plausible scenarios for fisheries, which will include consideration of energy flows, resources flows and life cycles. This is a process which we have found very thought provoking in previous studies. We will also be examining the effect of new technology and considering the economic and social dimensions. Our reports are only useful if they form the basis for effective action, which will be another of our key concerns.

We want to go beyond UK to European waters but it will be impossible not to put the issues in a global context if we are to have effective report, so one of the questions we will address will be how we can focus on mainly European waters but bring in the consequences for other parts of world ?

Some questions to be addressed today include: how firm is the evidence of environmental damage; is it worsening; what should be the proper aims of marine policy and can European waters be considered in isolation ? We welcome your help today in scoping our study.

**Lord Jamie Lindsay, Scottish Quality Salmon:
Environmental Quality and the European Aquaculture Industry**

Seventy per cent of the world's fish resources are currently over-exploited, fully exploited or recovering from over-exploitation. Yet seafood is more popular than ever and consumer demand for fish products is projected to increase by another 30 million tonnes within the next 10 years. Hence the importance of European aquaculture to the "Fish Gap". Its high quality, affordable, nutritious and versatile products are critical in easing the pressure on wild fisheries as well as creating vital rural jobs and underpinning communities.

The most important finfish species in European marine aquaculture is the Atlantic salmon, with Norway being the largest European producer and Scotland the largest EC producer. Scottish salmon farming now accounts for 40% of Scottish food exports and has created 6,500 jobs, many in fragile and remote communities – all from a total seabed footprint of just a few hundred acres.

Scottish Quality Salmon (SQS) is a unique and widely-recognised quality scheme that has led the way in understanding that assuring environmental performance is as important as assuring product specification. Environmental issues vary, from those based on incomplete knowledge to those that deliberately avoid the facts. Nonetheless, however well or ill-founded the issues, they can affect perceptions, and perceptions can affect reputation.

Hence the commitment that SQS has focused on delivering environmental quality at all points in the chain, from feed sourcing through the fresh-water and marine phases to smokers and processors. Issues must be capable of being addressed wherever they arise and whatever their nature, from the sustainability of fish feed to sea loch carrying capacity, interactions with wild salmon and biodiversity.

SQS was guided by external advice from environmental consultants to adopt ISO 14001 accredited regime of Environmental Management Systems (EMS). They are specifically adapted to salmon aquaculture, mandatory for members and site-specific in their disciplines, monitoring and data collection. They can verify compulsory compliance with non-statutory codes of practice, deliver continuous improvement and integrate the needs of the precautionary principle. Importantly, they are independently audited and certified, they are independently accredited against international standards, and they provide the basis for significant collaborative initiatives with other interests and stakeholders, such as the Tripartite Initiative with wild salmon interests. They are also flexible in the range of issues they can address.

Delivering credible and measurable environmental quality depends upon a regime of measures, the right management culture and an independent means of verifying the whole. SQS has pioneered this and more. What is unprecedented, in aquaculture and elsewhere, is SQS' decision to bolt together the parallel requirements of an ISO 14001 accredited EMS with an EN 45001 accredited Product Standard into one mandatory quality regime that is applicable to all parts of the chain.

**Professor Ian Boyd, Sea Mammal Research Institute, University of St Andrews:
The Impact Of Fisheries On Marine Mammals**

Marine mammals are attractive to the public and are often seen as symbols of the state of our marine environment. In European waters there are an estimated 0.5-2 million small cetaceans and 0.25 to 0.3 million seals. In the case of some of the small cetaceans, populations are genuinely threatened. The counting techniques are difficult, however, making assessments of the direction of population change uncertain.

The impact of fisheries on marine mammals is only one of several anthropogenic stresses. Direct effects of pollution and harvesting both tend to act in a density-independent manner. Although the most noticeable effects of fishing are direct effects, involving entanglement of marine mammals in fishing gear or the killing of marine mammals as by-catch, perhaps the most difficult effect of fishing to assess is its indirect effect on marine mammals through the changes that fishing can cause in ecosystem structure. It appears that some of these indirect effects could be negative on marine mammals and others could be positive.

Indirect effects of fishing are likely to follow the rules of density-dependence and are, therefore, less likely to cause the total extinction of populations than direct effects, such as gear entanglement. However, the demographics of marine mammals (as with many seabirds) makes them very vulnerable to relatively small increases in the death rate. If this occurs because of reduced food availability, together with the added effects of disease epidemics, then other direct impacts of man in the marine environment could soon stack up to drive populations to extinction.

Although the presence of healthy marine mammal populations does not mean that marine ecosystems are stable or productive to man, it indicates that there is efficient energy transfer from lower to upper trophic levels. Since they are at the top of the food chain and thereby accumulate pollutants they also reflect the level of some pollutants in the oceans. Their presence indicates that the ecosystem is functioning in the broadest sense. The problem is that we may not be happy with this situation because the ecosystem products are not those that are most valued by man.

There is a danger that marine mammals could be a target for management to aid in the recovery of fisheries. In some circumstances, highly valued fish populations could be kept at low levels because of predation by marine mammals. This, together with the perception that marine mammals are direct competitors with fishermen, will cause pressure to manage marine mammals as part of a broad approach to maximising the commercial yield from fisheries.

**Ms Helen McLachlan, WWF Scotland:
Fisheries and the Marine environment - 20 years of the CFP**

Fisheries have had a significant impact on the marine environment both through direct and indirect effects. Direct effects include the removal of target and non-target species and the impact of fishing gear on seabed communities. Indirect effects embrace fishing related debris such as ghost nets and food web disruptions. When a fish stock declines to below harvestable levels the impact is not simply of biological consequence to that stock but it has an impact on the wider marine environment and its users.

In order to sustain viable fishing communities in the future we need to maintain a healthy marine environment. The Common Fisheries Policy has proven to be inflexible as a fisheries management system. The output control of annual Total Allowable Catches (TACs) has failed to follow scientific advice and there is a lack of adequate policing and enforcement. Long lived species have proved particularly difficult to manage. ICES' latest advice is that two thirds of European fish stocks are below safe biological limits. Yet up to 50% of the fish caught in the North Sea are discarded, including ten thousand harbour porpoises. There are disturbing parallels between repeated warnings and inaction concerning the collapse of Grand Banks fisheries and similar more recent events in the North Sea.

The CFP has had little concern for environmental conservation issues. The Darwin mounds, despite their importance and the damage already wreaked are still subject to demersal trawling.

We need a new way forward to secure a livelihood for the industry and a future for the marine environment. This will require investment in an ecosystem based management system for fisheries. This should place the emphasis of management on maintaining the long-term health of ecosystems alongside appropriate human use.

Fisheries management needs to move away from the short sighted measures of single species management and towards a system which involves immediate substantial investment for long term sustainable gain. In particular there need to be a move away from annual allocation of TACs towards multi-annual management plans, regionalisation of management involving involve key stakeholders and an end to subsidies for increased fishing capacity. Regeneration areas and permanent no take zones will be required together with financial incentives for use of more selective fishing gear, lay up schemes and more effective enforcement and deterrence.

Discussion

Views differed on whether there needed to be a shift to policies based on multi –species modelling or whether this was unrealistic in view of the state of the underlying science. The current multi-species models, for example in the North Sea, were considered to be rudimentary. While resources for fisheries research, even in the developed world, were inadequate, the failure of large and long term research programmes, such as that for the Antarctic, to understand key interactions between species suggested that the ecosystem is too complex to allow a realistic prospect of detailed modelling. We may know enough of the ecosystems, however, to identify key indicator species and the limits within which they should lie. Any successful approach would need to be highly focused and have clear objectives. Data shortfalls are also a crucial issue for modelling, though the requirements under the Water Framework Directive should improve the data for estuaries and coastal waters.

The recent Bergen Declaration advocated the use of the precautionary principle and ecosystems approach in fisheries. Groups of experts had been set up by governments to examine what this might entail. This had also been considered at the FAO conference in Reykjavik on Responsible Fisheries in the Marine Ecosystem. Some people attending the seminar thought that simple practical approaches and proven techniques, such as regional management of fisheries, could go most of the way to achieving the goals. There was argued to be a role for the use of Environmental Impact Assessment and Strategic

Environmental Appraisal, which were not currently applied to fisheries management. Without a wider perspective, decisions can be made to close down one fishery only to have fishing effort displaced into areas which cause more serious environmental damage.

The regulation of aquaculture was said to have grown in a way that lacks coherence: a subject currently being addressed by the Scottish Executive. The Water Framework Directive may help to bring greater coherence. Some were encouraged by the current salmon farm regulations, but there are potential problems with farming other fish which we need to foresee and prepare. It was noted that much of Scottish fish farming using other species is operated by SQS and claimed that the lessons learnt in salmon farming do read across. SQS and the Soil Association have developed an organic standard, but the future size of this segment of the industry would depend on consumer preferences.

**Professor James Muir, Institute of Aquaculture, Stirling University:
Environmental Aspects Of Global Aquaculture**

Global aquaculture has been consistently increasing over the past decades, for example between 1987 and 1997 global production of farmed fish and shellfish doubled in weight and value, and now accounts for approximately one quarter of fish directly consumed by humans. Aquaculture will expand geographically, in terms of species cultured and technologies used. By 2030, it is expected that aquaculture will dominate supply, with the role of capture fisheries in OECD countries reducing further as developing countries increase share of catches and processing. There will be a gradual process of intensification. As a result of this large expansion, concern has been expressed as to the overexploitation of goods and services provided by the environment for aquaculture, and questions made as to their sustainability.

Intensive fish and shellfish aquaculture provide both an alternative source of essential nutrients which are derived from fish and the potential for stock enhancement. However, this has often been seen as a “mixed blessing” by many, in that aquaculture may diminish fish stocks as the vital fish meal required for artificial diet formulation may cause increased pressure on dwindling wild fisheries. Much research at present is going into development of alternative sources of essential fatty acids for fish diets as a total or partial replacement for fish meal.

Culturing of aquatic organisms has implications for natural biodiversity. Aquaculture is perceived as potentially causing a loss of biodiversity through interaction between escaped farmed animals or inputs of waste into the wider environment. However, this is poorly understood and difficult to investigate and quantify. Aquaculture may also have the potential to increase or supplement fading biodiversity within aquatic environments. safety and bio-security.

The natural environment can process and dilute nutrient and chemical wastes from aquaculture. To achieve this in a sustainable manner depends on the ability of the environment to provide these “services” without hindrance, which ultimately depends on the health of the system. This suggests that the carrying capacity of the environment is an increasingly important concept for future environmental management in aquaculture.

**Professor John Beddington, Imperial College:
Natural Resource Management: Economic And Biological Perspectives**

Many exploited fish stocks are severely depleted with over 70% of the world's fish stocks being fully or overexploited. According to the United Nations Food and Agriculture Organisation, many of the world's fished areas are far less productive than they could be, due to extensive exploitation of fish. Chronic heavy fishing has caused a structural shift in the underlying ecosystem shown by the declining piscivore-zooplanktivore index, which indicates an increasing proportion of plankton-feeding fish in landings.

The main problems are open access to the oceans and a lack of effective regulation. The oceans have been traditionally regarded as common property and indeed, before the industrial revolution, fish resources were so abundant there was no reason to establish national jurisdiction of seas or oceans. Increasing catches, demand for, and conflict over fisheries following industrialisation of the industry, however, led many nations to declare 12-mile fishery zones. In 1973 the UN Conference on the Law of the Sea (UNCLOS) formalised a nation's right to the 200 mile Exclusive Economic Zone (EEZ) which roughly equates to the continental shelves - the most productive areas. Conflict over high seas fishery resources is still a problem, although many high seas stocks (e.g. tunas) are managed by international bodies

There are too many boats and too few fish. Open access leads to intense competition for resources and hence overexploitation in a classic *Tragedy Of The Commons*, resulting in over-capitalisation. World fishing capacity is estimated at up to 250% of the level needed to achieve sustainable fishing levels. Open access, unregulated fisheries can easily become over-capitalised and dependent on subsidy, which can then often work to perpetuate the over-capitalisation. Officially reported fishing subsidies are in the order of US\$13 billion per year, but the real figure is likely to be at least US\$15 billion per year. Subsidies often support fishing activities that directly contravene sound fisheries policy.

The key to achieving sustainable fisheries is getting rid of subsidies, but there is also a need for effective regulation. Setting allowable catch levels is a poor regulator given the problem of detecting illegal fishing. Limiting the days at sea is more effective because it is easier to monitor whether a vessel is in port. We also need to learn from our ignorance, by setting levels of harvesting that have acceptably low probability of causing stocks being depleted.

**Mr Neil MacPherson, Department for International Development:
International Fisheries Agreements: The Consequences For Developing Countries**

In poor countries, fisheries involve lots of people and little infrastructure. Typically those involved are landless people with few alternative sources of employment and fish is very important nutritionally for them. Poverty and population growth are tending to increase the pressures on the fisheries of the developing world. Increasingly these communities are being marginalized politically. In general the risks to fisheries resources are increasing though the quantified information very poor.

When the UNCLOS formalised nations' rights to 200 mile Exclusive Economic Zones, it also legitimised outside access to any 'surplus' resources within these zones. The EU support for fleets operating in developing countries' EEZs, during the period 1993 and 1997 is estimated to be between 1 and 2 billion Euros. In some cases the payments made to a developing

country for access to their fisheries may be a substantial part of the government's annual budget, making it difficult for them to refuse access, whatever the consequences for local fishing communities. There are a diversity of contexts & agreements, but the losses incurred by the developed country tend to include missed opportunities for local economic development, increased dependence on external capacity, risk of resource depletion or damage, loss of local livelihoods and poorer quality diets for developing country consumers. Set against this, the agreements tend to assist national economic development and capacity building, can realise the value of unexploited resources, increase employment and revenues.

There are serious policy failures affecting these agreements. At the European level, fisheries trade policy is not coherent with environment and development objectives. The UK Government has expressed concern on the balance of costs between the EC and vessel owners, the poor scientific advice, a lack of accurate catch data, the inability to adjust effort within life of an agreement and the lack of effective management, control and surveillance. At the national level in developing countries, there is political and institutional marginalisation of the sector, an emphasis on short-term revenue generation over sustainability of resources and a low prioritisation for fisheries management capacity.

Within the current attempt to reform the Common Fisheries Policy, the EC stance on these issues is that "The current policy needs to adapt to changing circumstances and new challenges such as the emergence of new players, the legitimate aspirations of many developing states to develop their fishing industry and the requirements of sustainable development and responsible fisheries".

The funds associated with fisheries agreement are an incentive to ignore sustainability considerations in practice. A pre-condition of fisheries agreements should be independent environmental and social impact assessment.

Discussion

The growth of aquaculture appeared to suggest a fast growing demand for fish meal and oil, given the 3: 1 ratio between food input and the weight of the farmed fish produced. The demand which aquaculture will make, however, will depend on the market prices for meal and oil. In any case, only 30-40% of aquaculture makes partial or full use of meal or oil for feeding: the ratio of meal and oil used to total aquaculture production is around 0.2. Although new herbivore species are now being farmed, there is unlikely to be a massive shift away from carnivores.

Access agreements for mixed fish stocks could be managed by monitoring landings and being innovative. Satellite technology has partially solved the problem of preventing fishing in protected areas but could only monitor large vessels and only be effective in the developed world. There are different approaches to the regulation of bycatch which are worth considering, for example that used by Norway. Fisheries regulations must be practicable and understandable by fishermen, who arguably should be centrally involved in their design. Although the UK record in preventing illegal fishing was far from perfect, it was constrained by budgets and was thought to be far more effective than the regimes used in some parts of Southern Europe, where illegal landings seemed to be largely ignored by the authorities.

If fishing subsidies were to be removed, many fishing companies would go out of business, so it would be important to plan carefully, including providing alternative activities for

fishermen. There are, however, some easy targets for reducing subsidies, such as the sale of subsidised surplus Spanish fishing vessels to Argentina, where the consequent surplus capacity was threatening their fish stocks. Subsidies in the UK were generally lower than those in the USA, Russia, Japan and Southern Europe. It could, however, be argued that the UK fishing industry does not enjoy any access to fishing subsidies, which are directed to conservation issues and net changes.

There was general support for more regional management of fisheries, with the involvement of all stakeholders. In Africa and Asia, there were many examples of co-management with industry. Concerns were expressed that, unless fishermen were the driving force or integral to such arrangements, they would simply become talking shops. Additionally some types of body which might appear to be stakeholders, such as the processors, have little real interest in local fisheries since they are able to buy from elsewhere if necessary. The Royal Commission is fully aware of the need to talk to fishermen and understand their viewpoint.

Mr Andrew Rosie, Scottish Environment Protection Agency: The Scope for Better Regulation

The overall purpose of regulation is to ensure that development is compatible with its surroundings, is sustainable and that performance meets set standards, so polluting effects are prevented, minimised, remedied or mitigated. Any impacts must be kept within acceptable limits and we must be able to demonstrate that our environment is adequately protected. We also have to regulate in order to meet our international obligations.

Permit conditions should be necessary, achievable, enforceable, unambiguous and comprehensive. Regulatory intervention into an activity should be proportionate to the degree of environmental risk. There may be scope to achieve better performance through voluntary means and the potential for a “carrot & stick” approach which normally relied on a more “hands off” approach, invoking powers only when necessary.

The standard UK model for industrial processes involves 2 separate stages: a first stage which decides whether the process should be present or absent and imposes development constraints, and a second stage which sets operational limits to meet expected environmental standards. These are separate tasks, requiring different expertise, yet there is an overlap. Currently for Scottish aquaculture, we “make-do” using Crown Estate lease as the first stage, then use a discharge permit regime which was primarily devised for sewer pipes. There are also special arrangements in Shetland and Orkney.

In caged fish farming, fish are held in floating net pen structures anchored to the sea bed, with the wastes carried into the receiving water by water flux through the mesh. There is no practical means to obtain a representative sample of this “effluent” and conventional cage rearing techniques provide no practical means of treatment of wastes arising. Development must therefore depend upon the environment’s capacity to assimilate wastes.

Pollution control is achieved through imposition of conditional discharge consents, limiting the emission of substances in the effluent, to achieve safe environmental quality standards. Objectives are also set for the degree and extent of the “near-field” benthic impact zone referred to as an allowable zone of effects. SEPA carries out inspections to check consent compliance, and audit monitoring to check self-monitoring is representative and the environment is adequately protected.

The present approach relies on the Control of Pollution Act 1974, the Environment Act 1995 and the Conservation (Natural Habitats etc) Regulations 1994. There are however prospective changes to the legislation which could assist by, for example, requiring Best Available Techniques to be used and Best Environmental Practice to be adopted. The planning regime would be more effective if formal planning controls were transferred to Local Authorities, with framework plans to guide what should go where and identify conservation and other areas requiring protection. Integrated Coastal Zone Management must also dovetail into the Water Framework system of river basin management.

There is a need for a strategic framework for aquaculture, which confirms that Scotland wants a sustainable aquaculture industry and sets out clearly a shared vision for the future, with milestones to gauge progress in achieving the vision, concentrating on what's important: to prevent unwanted and irreversible effects. It should set priorities for any legislative changes required, provide guiding principles for individual development decisions and promote an appropriate degree of precaution while we await research results. We have a long way to go to improve our regulatory approach in Scotland, but the basic principles are sound. Despite present problems, Scotland still leads the world in the regulation of fish farming activities.

**Dr Yemi Oloruntuyi, Marine Stewardship Council:
Creating incentives for environmentally friendly fisheries - A Role for Stakeholders**

Fisheries regulatory measures based on sound scientific advice have an important role in helping to reduce impact of fishing activities on the environment. However in many situations, command and control mechanisms do not take into consideration some of the constraints that fishers face in trying to implement conservation measures. The conflicting objectives of various players in the fishery, and management advice that overlooks the importance of individual motivations, continues to contribute to the less than satisfactory state of affairs in the preservation of the marine environment.

The use of incentives to generate change in individual and collective behaviour towards the environment is increasingly recognised as a tool with potential to help mitigate environmental impacts. Creating a suitable environment for incentive mechanisms that reward fishers for taking care of the environment can be an effective contribution to efforts aimed at addressing some of the environmental challenges faced in the marine sector.

There is general consensus that other sectors of society and not just fishers and government alone are concerned about the current state of fisheries resources. Many of these stakeholder groups, which include consumers, businesses and NGO's, represent an avenue that has not been fully explored for a role in preserving the marine environment. Channelling the interest of these sectors can increase the effectiveness of incentive-based programmes as an environmental tool.

The inclusion of civil society in the creation of incentives provides an opportunity not only to increase the extent to which incentives may be effective, but where for instance the consumer is involved in paying some premium for the value of biodiversity, may also potentially help to reduce direct cost to government. Promoting initiatives that can harness the interest of various stakeholder groups as an instrument for maintaining a healthy marine environment should occupy some priority at national and international levels.

Appropriately applied financial-incentives and market-based incentives such as the Marine Stewardship Council's eco-labelling programme have been shown to have potential to assist in working towards environmentally friendly fisheries. Exploring them for a role in the protection of the marine environment on a much wider scale will generate significant benefits.

One aspect that is of critical importance in developing policies that support market-based, financial or other types of incentives, is to ensure that the instruments are properly qualified, appropriate to mutual objectives, fair to all concerned and non-pervasive.

**Professor Graham Shimmiel, Scottish Association for Marine Science:
Does Marine Science hold the key ?**

We believe the concept of sustainability upon which most quantitative fisheries management is based to be flawed,..." Daniel Pauly argues that fisheries have rarely been sustainable, and over the longer term that the RCEP is focussed on, radical approaches to marine ecosystem management are required. With the enormous effort directed to fisheries and aquaculture science, can there be found the "smoking gun" that unites politicians, conservationists, consumers and fisherman in recognising the finiteness of our living resources, and particularly those hidden from view? Without emotive images of burning rainforest and drought-desiccated savannah, how can the state of the world's fisheries be democratically debated?

Marine science is entering a new phase of exploration and quantification. Major programmes such as GLOBEC and the Census of Marine Life, approach fisheries and ecosystem function in innovative and exciting ways. Communication and explanation by scientists is mandatory in this new world of documented environmental change. Just as the mechanisation and commercialisation of the fishing fleets have ensured few areas of the continental margins and shelves remain unexploited, so the ability to visualise, quantify and communicate environmental impact by marine scientists has increased.

To review the entire breadth of the scientific arsenal in fisheries and aquaculture research is clearly impossible within the context of this presentation. However, taking the longer-term view helps to frame some important questions. What is the evidence for natural, versus anthropogenic, change in fisheries? How do natural climatic variations influencing recruitment and spawning, manifest themselves, and can man's influence on the relevant climate divers be quantified? What are the long-term effects of "fishing down the food web", and benthic habitat destruction? Can aquaculture compensate for capture fisheries, or will the demand for aquaculture raw materials exacerbate the demise of fragile resources? Does marine aquaculture point source impact lead to wider environmental degradation? Do we have the scientific knowledge to argue cogently for marine protected areas as safe havens for ecosystem and fisheries restoration?

The aim of this presentation has been to stimulate the discussion, rather than document the entirety, of marine science applied to the impact of fisheries on the environment. A closing remark might be addressed to the reticence of the UK funding councils to highlight this area of research, and to draw attention to the recent plethora of high quality papers on fisheries and environmental impacts appearing in major journals such as Science and Nature.

Discussion

The environmental field of influence for a farm varied considerably: for particulates it is a little larger than the farm; for nutrients the field can be quite wide. Sea lice are not regulated as a footprint but by setting maximum numbers which could be present. They can cause the death of wild salmon and so in theory the additional mortality could hold wild salmonids at low levels. They were not, however, the only factor affecting the size of these populations.

Stewardship involves monitoring, thus putting demands on organisations for developing countries which might be unachievable. The MSC, however, based its standards on those of the FAO Code of Conduct, which is acceptable to most developed and developing fishing nations of the world. Assessments in developing countries are often limited by the lack of data. The requirement for data in MSC assessments, however, is appropriate to the size, scale and nature of the fishery. The key issue, is how intensive the fishery is; the more intensive, the more the fishery will need to demonstrate that adequate management systems are in place.

The Nordic countries cooperated in fisheries, which are important in all their economies, as well as in all other political fields. Sound management of marine resources is particularly important to them, with the socio-economic aspect always being present in debates. It is vitally important to set sustainable quotas – research findings should be easily accessible to decision makers. Two very important tasks for researchers is to get adequate data and develop fishing gear which reduces bycatches and discards. The ecosystem and precautionary approaches are good tools to support understanding.

There could be advantages if regulators moved from collecting data in order to satisfy regulatory requirements towards a partnership arrangement where data was contributed as part of a longer term strategy for management. With the Water Framework Directive, there would be more data, which hopefully will be publicly available if resources allow.

Dr Ian Graham-Bryce, Member of Royal Commission: Summing up

We have had heard a very interesting and stimulating set of contributions today, elegantly posing us some challenging questions. The whole programme while undoubtedly giving us much information and some answers, has generated even more questions and uncertainties.

This is a classic topic for a Royal Commission study – a tangled environmental web. The activity of fishing is undoubtedly a direct environmental impact – you cannot farm fish in aquaculture or remove fish from an ecosystem in capture fisheries without environmental consequences. That is undeniable - but when you want to go beyond that simple statement the difficulties begin.

The Commission needs to explore and understand better the consequences of fisheries and what might be done about those impacts which are unacceptably damaging: where we are exceeding carrying capacities, threatening biodiversity, disrupting key systems or causing structural shifts. Each element of that last general statement is problematic and that has been made abundantly clear today: each is riddled with uncertainty or controversy.

There are legitimate industrial and economic interests. In capture fisheries, there are in particular the age old interests of communities which have been underpinned by fisheries for centuries. Aquaculture is vital for the future of communities in remote regions and of major importance for the rural economy. Then there are consumers' interests and a highly contentious international, political and regulatory context. We have been told of the vicious circle of ineffective policies and subsidies, with linkages across the world and threats to the interests of developing countries.

There are also physical, chemical, biological and ecological issues which are made more thorny by the nature of the medium – the marine environment is peculiarly difficult to experiment in or observe. Fish stocks are not the primary focus of our study but provide a clear illustration of the difficulties of marine science. These stocks are probably the most studied aspect of the marine ecosystem, but there is still great doubt on the factors influencing them. Benthic processes in particular are only dimly perceived.

The aquaculture industry has a better defined process and we have heard a number of statements that industry is acting responsibly. Even here there are many unknowns and the question keeps coming back to the basic thermodynamics – are we putting in more than we are getting out ?

Given all these uncertainties and the fact that the consequences of any action are going to be very profound, the conventional approaches to management and regulation are seen by many as failing. Several of our speakers have advocated new thinking and the term ecosystem based management was repeatedly used. There is, however, considerable uncertainty on what that means. Speakers have emphasised the importance of incentives, motivation and involving all the stakeholders, especially the fishers themselves, and of the need for better collaboration.

The seminar has more than fulfilled its promise from a Royal Commission standpoint. Our view that there is work to be done has been confirmed. It is clear that our thinking should now be organised on a few inter-connected lines, on each of which we have received valuable guidance today:

- Firstly the state of science. How can we define and determine the key scientific considerations better, so that we can describe, measure, characterise the situation effectively. There is the question of whether there are particular scientific approaches or insights which would be most effective. This is not just a plea for more research.
- How can we best develop regulatory or management practices and regimes in a way which will work and command respect ?
- The institutional questions: what are the local, national and international arrangements which would genuinely involve the relevant parties, recognising their aspirations and ensuring that the environment is safeguarded in the long term ?

This is an ambitious agenda: if we do succeed it will be in no small measure due to those who have contributed today.

Programme

- 10.00 Registration and Coffee
- 10.30 Introduction – Sir Tom Blundell, Chairman, RCEP
- 10.45 Session 1: Environmental Challenges in European Waters
Chair: Sir Tom Blundell
- Lord Jamie Lindsay, Scottish Quality Salmon
Environmental Quality and the European Aquaculture Industry
Professor Ian Boyd, Sea Mammal Research Institute, University of St Andrews
The Impact Of Fisheries On Marine Mammals
Ms Helen McLachlan, WWF Scotland
Fisheries and the Marine environment - 20 years of the CFP.
- 11.45 Discussion
- 12.30 Lunch
- 13.15 Session 2: The Wider Context
Chair: Sir Brian Follett, RCEP
- Professor James Muir, Institute of Aquaculture, Stirling University
Environmental Aspects Of Global Aquaculture
Professor John Beddington, Imperial College
Natural Resource Management: Economic And Biological Perspectives
Mr Neil MacPherson, Department for International Development
International Fisheries Agreements: The Consequences For Developing Countries
- 14.15 Discussion
- 15.00 Tea
- 15.15 Session 3: Can we do better ?
Chair: Professor Janet Sprent, RCEP
- Ms Tricia Henton, Scottish Environment Protection Agency
The scope for better regulation
Dr Yemi Oloruntuyi, Marine Stewardship Council
Creating incentives for environmentally friendly fisheries:
A Role for Stakeholders
Professor Graham Shimmield, Scottish Association for Marine Science
Does Marine Science hold the key ?
- 16.15 Discussion
- 16.45 Summing up – Dr Ian Graham-Bryce, RCEP
- 17.00 Close

List of Participants

Sir Tom	Blundell	Chairman	Royal Commission on Environmental Pollution
Dr Ian	Graham-Bryce		Royal Commission on Environmental Pollution
Mr John	Flemming		Royal Commission on Environmental Pollution
Sir Brian	Follett		Royal Commission on Environmental Pollution
Professor Brian	Hoskins		Royal Commission on Environmental Pollution
Professor Richard	Macrory		Royal Commission on Environmental Pollution
Mr John	Speirs		Royal Commission on Environmental Pollution
Professor Janet	Sprent		Royal Commission on Environmental Pollution
Dr Peter	Hinchcliffe		Royal Commission on Environmental Pollution
Mr Howard	Morrison		Royal Commission on Environmental Pollution
Mr Andy	Deacon		Royal Commission on Environmental Pollution
Lord James	Lindsay	Chairman	Scottish Quality Salmon
Professor Ian	Boyd	Director - Sea Mammal Research Unit	University of St Andrews
Ms Helen	McLachlan		WWF Scotland
Professor James	Muir	Assistant Director and Professor of Aquaculture Development	Institute of Aquaculture, University of Stirling
Professor John	Beddington	Renewable Resources Assessment Group	Imperial College
Mr Neil	MacPherson	Sea Fisheries and Aquatic Resources Advisor	Department of International Development
Mr Andy	Rosie	Chief Executive	Scottish Environment Protection Agency
Dr Yemi	Oloruntuji		Marine Stewardship Council
plus assistant			
Professor Graham	Shimmiel	Director	Scottish Association for Marine Science
Mr Doug	Beveridge	Asst. Chief Executive	National Federation of Fishermen's Organisations
Ms Andrea	Carew		English Nature
Mr Steve	Colclough	Officer for Sea Fisheries Policy & Development	
Dr Robin	Cook	Chief Executive and Director	Fisheries Research Services Marine Laboratory
Mr Emily	Corcoran	Executive Director	United Nations Environment Programme
Mr Dominic	Counsell		Scottish Natural Heritage
Mr Mike	Cowling		Glasgow Marine Technology Centre
Mr Willam	Crowe		Federation of European Aquaculture Producers

Mr	Greg	Donovan	Head of Science Policy	International Whaling Commission
Mr	Paul	Du Vivier	Chief Executive	Scottish Fisheries Protection Agency
Mr	Mark	Gray	Fisheries Officer	Countryside Council for Wales
Ms	Karen	Green		Fishmeal Information Network
Mr	Jonathan	Green	Environmental Officer	Northumberland Sea Fisheries Committee
Mr	David	Griffith	General Secretary	International Council for the Exploration of the Sea (ICES)
Dr	Simon	Jennings		CEFAS
Mr	Darren	Kindleysides	Marine Policy Officer	Royal Society for the Protection of Birds
Mr	Asmund	Kristoffersen		Nordic Council
Dr	Richard	Luxmoore	Senior Nature Conservation Adviser	National Trust for Scotland
Mr	David	Mack		UFP
Mr	P	MacMullen	Manager, Marine Technology	Sea Fish Industry Authority
Ms	Elaine	Offedal		Nordic Council
Mr	Colin	Penny		DEFRA
Mr	Jim	Portus	Chief Executive	South Western Fish Producer Organisation Ltd
Mr	J B	Read		Atlantic Salmon Trust
Mr	John	Roberts		Department for the Environment, Food & Rural Affairs
Ms	Ali	Ross	Fisheries Consultant	Whale & Dolphin Conservation Society (WDOS)
Mr	Jean-Luc	Solandt	Biodiversity Policy Officer	Marine Conservation Society
Ms		Sveinsdottir	Icelandic MP	Environmental & Nature Resources Committee Nordic Council
Mr	Mark	Tasker	Head of Marine Advice	Joint Nature Conservation Committee
Captain	A H F	Wilks	MBE, FNI Chairman	Scottish Coastal Forum
Mr	John	Williams	General Manager	Boyd Line Ltd
Dr	Merriweather	Wilson	Marine Ecologist and Planner	c/o Department of Geology, University of Edinburgh