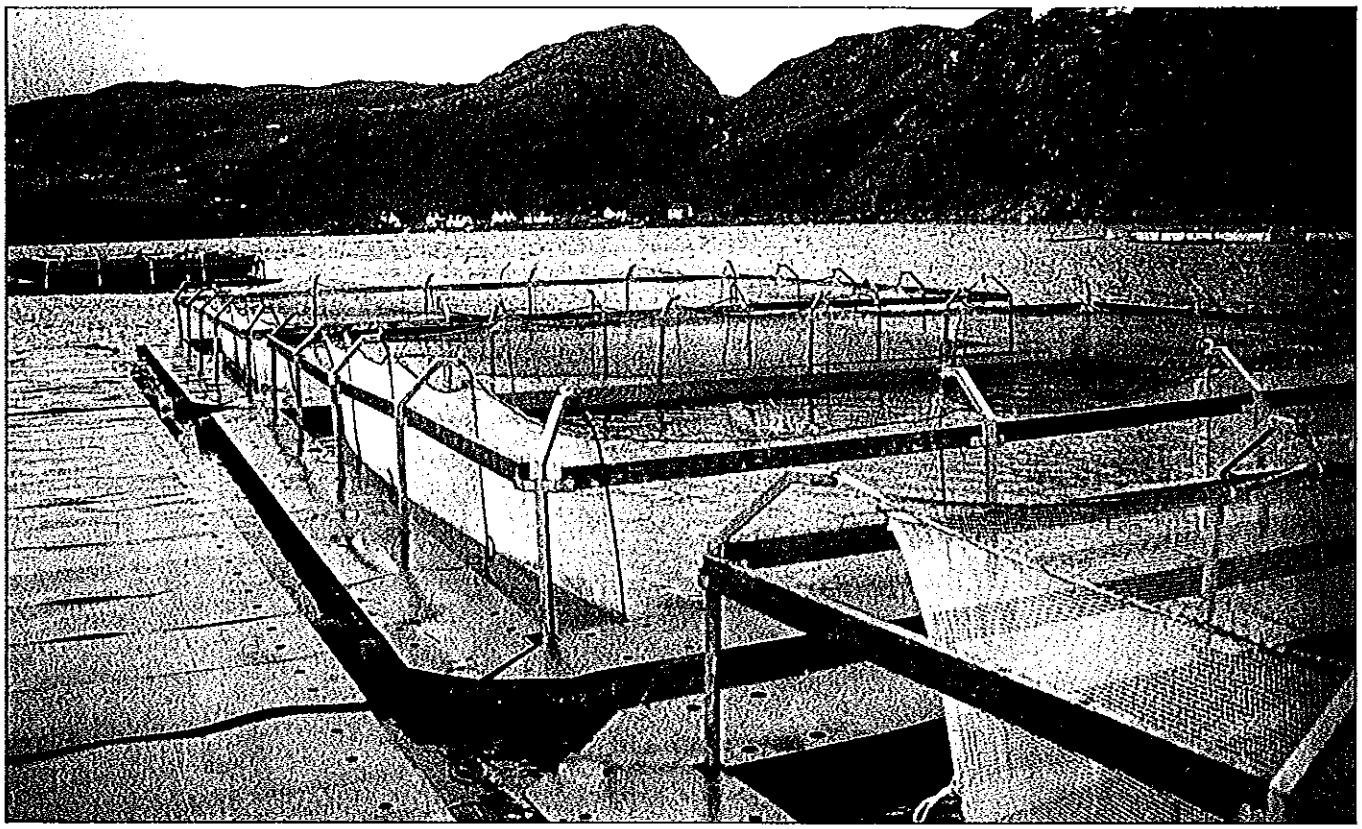
MARINE FISHFARMING in SCOTLAND



A Discussion Paper

Scottish Wildlife and Countryside Link

March 1988

MARINE FISHFARMING in SCOTLAND

A Discussion Paper

Prepared by a working group comprising the following member organisations of

SCOTTISH WILDLIFE AND COUNTRYSIDE LINK

Association for the Protection of Rural Scotland
British Association of Nature Conservationists
Friends of the Earth (Scotland)
Marine Conservation Society
National Trust for Scotland
Ramblers' Association Scotland
Royal Society for the Protection of Birds
Scottish Countryside Activities Council
Scottish Wild Land Group
Scottish Wildlife Trust
Vincent Wildlife Trust
World Wildlife Fund (UK)

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March 1988

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SCOTTISH WILDLIFE AND COUNTRYSIDE LINK was formed in February 1987 as an association of voluntary bodies concerned with wildlife and countryside conservation in Scotland. Its purpose is to provide a forum to help its member organisations bring together their views on issues affecting mutual interests.

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Cover Photo: Salmon farm at Diabaig, Torridon, Wester Ross (Rob Garner, NIS)

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SUMMARY AND MAIN CONCLUSIONS

SUMMARY

PART I BACKGROUND

Marine fishfarming has grown rapidly in Scotland. Production of Atlantic salmon looks set to rise from 1,000 tonnes (1981) to 54,000 tonnes in 1991. Although fishfarming is accepted in this Discussion Paper as an appropriate use of natural resources to benefit the local economy, especially in remote areas, its rapid growth raises real fears as to its adverse effects. The Paper reviews the main areas of concern and proposes measures for improved control.

PART II IMPACTS

GENERAL (Section 4)

Since marine fishfarming takes place in an environment of the highest quality, adverse impacts must be carefully assessed and controlled, especially as the industry grows.

POLLUTION (Sections 5, 6, 7, 8)

Sea lochs are being increasingly developed without adequate knowledge of carrying capacity. Restraint is required until research has assessed the cumulative effects of pollution caused by waste food and fish faeces. Certain chemicals used for the treatment of fish disease and parasites are extremely toxic to other organisms. Their use is not effectively controlled. Improved monitoring and research are required urgently, leading to clear and enforceable codes of practice. Control authorities are not properly empowered or resourced to safeguard the marine environment from fishfarm pollution. This should be rectified without delay.

WILD SALMON (Sections 9, 10)

Special caution is required over the effects of release and escape of farmed fish on wild salmon populations. The impacts of fishfarms on disease, parasites and homing of wild salmon also require research.

Wild salmon stocks must be protected by codes of conduct and, if necessary, legislation.

PREDATOR SPECIES AND CONTROL METHODS (Section 11)

Losses caused by predatory birds and mammals to fishfarm stock should be minimised by adequate prior survey and by improved design and management. Research is required into improved methods of predator exclusion and the role of predators in fish diseases. Legislation should be clarified. Scottish sea lochs support one of Europe's best otter populations. Survey and research is required to assess the impact of fishfarms on otters. Undeveloped coastlines should be retained and disturbance reduced to minimum. Environmentally sensitive working practices should be adopted.

IMPACT ON SEA FISH STOCKS (Section 12)

The impact of the rapidly rising demands of the fishfarming industry on 'industrial' stocks of fish, such as sand-eel, which are used in the manufacture of fishfeed pellets, should be monitored with care.

LANDSCAPE, TOURISM AND RECREATION (Section 13)

Tourism/fishfarm interactions and opportunities require study. Besides improving siting and design, special protection should be given to the few remaining wild landscapes which have not hitherto been developed.

WASTE DISPOSAL AND LITTER (Section 14)

Standards of litter control and waste disposal should be monitored and improved where necessary.

NAVIGATION AND THE INTERESTS OF OTHER WATER USERS (Section 15)

More respect should be given to the tradition of open access to inshore waters. This requires open assessment of requirements of other users. Authorities should be properly resourced to enforce compliance with marking and lighting requirements for safety purposes.

SOCIAL CONSIDERATIONS (Section 16)

Policies for sea-bed lease allocation should aim for a balanced structure in the industry (small vs large operators and salmon vs shellfish) to benefit local economies. This requires stronger preference to local interests, and more sensitive interpretation of HIDB remit.

PART III STRATEGIC CONSIDERATIONS

CONTROLS (Section 17)

Marine fishfarming is outside planning control. Such controls as do exist rely largely on legislation formulated for other purposes, or on the Crown Estate Commissioners' 'Consultation Procedure'.

CROWN ESTATE COMMISSIONERS' CONSULTATION PROCEDURE (Section 18)

This procedure is now quite inadequate to cope with the scale of issues raised by the growth of the industry. Problems include the lack of proper impact assessment, the difficulty of constructive participation by affected interests, the lack of democratic control and the lack of overall policy.

OPPORTUNITIES FOR IMPROVED CONTROL (Section 19)

Proposals include: extension of planning control to embrace marine fishfarming; preparation of forward plans by Planning Authorities; national planning Guidelines to provide a framework for local authorities to develop policies. Crown Estates Commissioners' role should be limited to that of landlord, with the additional duty to maintain a public register of all sea-bed leases.

GOVERNMENT CONSERVATION AGENCIES (Section 20)

Government still (Feb 1988) lacks the benefit of clear and unequivocal advice from its own conservation advisors. The Nature Conservancy Council and Countryside Commission for Scotland should give this matter high priority. Advice on the strategic requirements of landscape and nature conservation should be based on the best available knowledge of individual

and cumulative impacts of fishfarms on the natural environment. Adequate resources should be allocated for detailed survey and research to enable NCC to fulfil its statutory role.

RESEARCH AND ADVICE (Section 21)

In its responsibility to care for its own working environment, the fishfarming industry lacks advice based on adequate research. A service should be established to co-ordinate and undertake research, gather experience from overseas, and train and advise on the full range of problems facing fishfarmers and the environment.

INTEGRATION (Section 22)

A lead minister and department should be identified to take responsibility for improving the integration of resource use and conservation policies, adequate liaison between government departments, and a proper balance between economic and social goals and environmental safeguards. The lead minister should appoint a special committee to advise on these matters.

MAIN RECOMMENDATIONS

This Discussion Paper calls for major changes in the Government's handling of its responsibilities for 'good housekeeping' in relation to marine fishfarming. It presents the following main proposals for improvement in the overall management of the marine fishfarming industry in Scotland, based on a review of the industry's rapidly expanding scale and impacts.

* Increased and better co-ordinated **RESEARCH** into the capacities of sea loch systems to cope with pollution from fishfarms, and into the effects on other organisms of toxic substances used in fishfarming.

* **CAUTION** in the further expansion of the industry until these effects are known and properly controlled.

* The provision of **ADVICE** to fishfarmers on environmental matters, backed up by sound research.

* The exclusion of fishfarm development from a national series of **PROTECTED SEA LOCHS** for the purposes of protecting wild landscapes and sanctuaries for marine wildlife, and as a basis for comparison with the effects of fishfarming.

* **MEASURES** to reduce unnecessary destruction of predatory wildlife.

* The introduction of **FORWARD PLANNING** and **DEVELOPMENT CONTROL** by **LOCAL AUTHORITIES**, based on a full assessment of impacts backed up by **NATIONAL PLANNING GUIDELINES.**

* Appointment by government of a **LEAD MINISTER**, with an **ADVISORY COMMITTEE**, to ensure a balance between economic, social and environmental goals.

PREFACE

CONSERVATION: CONCERNS AND PRIORITIES

Although public interest in conservation of the environment has grown enormously over the last twenty years, it is clear that the word 'conservation' itself is interpreted in many different ways. There is therefore a need for some explanation of **our** interests as 'conservation organisations'.

First and foremost, we are concerned with much more than the narrow defence of specialist interests in wildlife.

During the 20th century, human demands on natural resources have risen rapidly to a level where they cannot be sustained on a global scale. The challenge, recognised internationally by the drawing up of the World Conservation Strategy eight years ago (IUCN, 1980), is to find a means of satisfying genuine human needs on a pattern compatible with the healthy survival of the living resources on which we rely. This is a global issue comprising many interlocking local issues.

In response to The World Conservation Strategy, a committee was set up by the leading conservation agencies in Britain to produce 'The Conservation and Development Programme for the UK' (Johnson 1983) which was endorsed by the UK Government (Department of the Environment, 1986).

To quote from the World Conservation Strategy:

> **"Conservation, like development, is for people; while development aims to achieve human goals through use of the biosphere, conservation aims to achieve them by ensuring that such use can continue."**

Conservation is not therefore an opponent of development, though it often appears so when conservation principles are not embodied at the outset in development policies.

The human goals to which the World Conservation Strategy refers include the whole range of human aspirations from the need to survive and prosper to the fulfilment of aesthetic and emotional needs (ie both the standard and the quality of life).

Therefore, as proponents of conservation, we wish to ensure:

a. that new development is established on an ecologically sustainable basis (ie not causing depletion or decline in the long term) both locally and regionally, and
b. that due account is taken of the need to protect natural ecosystems and species, the long-term viability of other enterprises, and other interests and values including those related to the quality of life.

1 INTRODUCTION

BACKGROUND AND AIMS

1.1 'Fishfarming' includes a variety of finfish and shellfish growing operations. Of these, we have focussed particularly on issues surrounding the farming of Atlantic salmon in Scottish coastal waters. These are currently of particular concern for two reasons.

a. The recent expansion in the farming of Atlantic salmon has outstripped other forms of aquaculture in Scotland in terms of rate, distribution and overall scale. The trend looks set to continue.
b. This development is taking place in an environment of high natural quality and in many cases disrupting a pre-existing balance of interests.

1.2 In a report entitled 'An Environmental Assessment of Fish Farms' Cobham Resource Consultants, (1987) (commissioned by the Countryside Commission for Scotland, the Crown Estate Commissioners, Highlands and Islands Development Board and the Scottish Salmon Growers' Association) reviewed the type and distribution of fishfarms in Scotland and the framework of authorisation and control procedures within which they operate. They also assessed both the visual impact and the effects of fishfarms on neighbouring activities and presented advice on good landscape design. Although in general we have found this an excellent report, it is not a complete treatment of the environmental issues.
CRC's brief did not allow a detailed investigation of the biological impacts of fishfarming; nor did it include more than a few comments on the wider strategic aspects of development.

1.3 The Marine Fishfarming Working Group of Scottish Wildlife and Countryside Link (SWCL) therefore undertook:

a. to take a broad look at the full range of impacts of marine fishfarming on environmental interests, from marine ecology to scenic quality, with particular emphasis on those aspects not considered in detail by CRC, and
b. to assess the strategic planning and regulation of the industry in terms of resource conservation and a balance of social, economic and environmental interests.

PRINCIPLES OF APPROACH

1.4 Our assessment of fishfarming is based on the following observations:

a. Sheltered and unpolluted Scottish sea lochs offer highly suitable natural sites for salmon and shellfish farming;
b. Marine fishfarming offers a valuable and appropriate opportunity for income generation to benefit communities in many parts of the Highlands and Islands;
c. The same marine areas are generally high in natural quality, harbour an undisturbed assemblage of flora and fauna and contribute significantly to the health and diversity of the coastal marine ecosystem;
d. The areas concerned are largely of high scenic and wildlife value, of importance to residents, visitors and tourists;
e. The tourist economy, which plays a significant part in sustaining rural

communities of the north and west, relies on the attraction provided by unspoilt landscapes and the flora and fauna associated with them;

f. The farming of fish and the pursuit of an economic enterprise inevitably involve some alteration in the natural state of affairs and some overlap or conflict with the pursuit of other interests;

g. It must be the aim of overall policy to reconcile these needs to produce a successful balance between local economic benefit and minimal adverse impact on the natural environment and other interests;

h. This balance is one of the keys to the sustainability (long-term viability) of rural development;

j. Genuine doubts had been expressed as to whether the measures currently in force were adequate to achieve this balance.

METHODS

1.5 We have based this Discussion Paper on a series of meetings, discussions and field visits during the second half of 1987, and on contributions from individual members of the working group following more detailed study of certain issues.

1.6 For a first-hand view of policies and concerns we have had meetings as a group with a wide variety of interested bodies during the latter half of 1987. We are grateful to staff/representatives of the following:

Clyde River Purification Board
Crown Estate Commissioners
Countryside Commission for Scotland
Department of Agriculture and Fisheries for Scotland
Highland Regional Council
Highlands and Islands Development Board
National Farmers' Union of Scotland
Nature Conservancy Council
Scottish Development Department
Scottish Marine Biological Association/Stirling University
Strathclyde Regional Council

Individual members of the group have also benefited greatly from visits to a variety of fishfarms and discussions with many helpful people in statutory bodies, in the industry and in the voluntary sector.

1.7 We would like to be the first to point out that this has not been a complete survey of a large and complex subject but we believe that this represents a constructive contribution to an important subject for debate.

STRUCTURE

1.8 Part I sets out the background by describing the status and structure of the industry, and the responsibilities of statutory bodies. Part II assesses the impact of the industry on a range of environmental interests and the relationship between social needs and conservation. Part III deals with present policies for planning and control of the industry, and proposes improvements in arrangements for forward planning, development control and the provision of advice, to assist in ensuring the beneficial integration of fishfarming with other interests. Recommendations are listed in bold print at the end of each section of the text.

PART I

THE CURRENT STATUS AND POSITION OF MARINE FISHFARMING WITHIN THE UK STATUTORY FRAMEWORK

2 THE MARINE FISHFARMING INDUSTRY

2.1 The nature, scale and distribution of fishfarms in Scotland are well reviewed in a report by Cobham Resource Consultants (1987).

2.2 Fishfarming is a rapidly expanding industry throughout the world, following technological advances in the early 1970s, which included the development of cages using rot-proof nylon nets. In recent years, salmon farming in particular has grown enormously in Scotland (Figure 1).

2.3 The map (Figure 2) shows the location of individual salmon and shellfish farm **sites**, based on information available in January 1988. It does not indicate the **scale** of the operation which in the case of salmon farms may vary at any individual site from one to one hundred cages producing up to 800 tonnes of salmon per year.

STRUCTURE OF THE INDUSTRY

2.4 As the map shows, all UK finished salmon production is concentrated on the northern and western coasts of Scotland. The two main island groupings (the Western and Northern Isles) each produce about 15% of the Scottish total, with the remaining 70% being grown on the west coast of the mainland and on the inner isles (figures from DAFS).

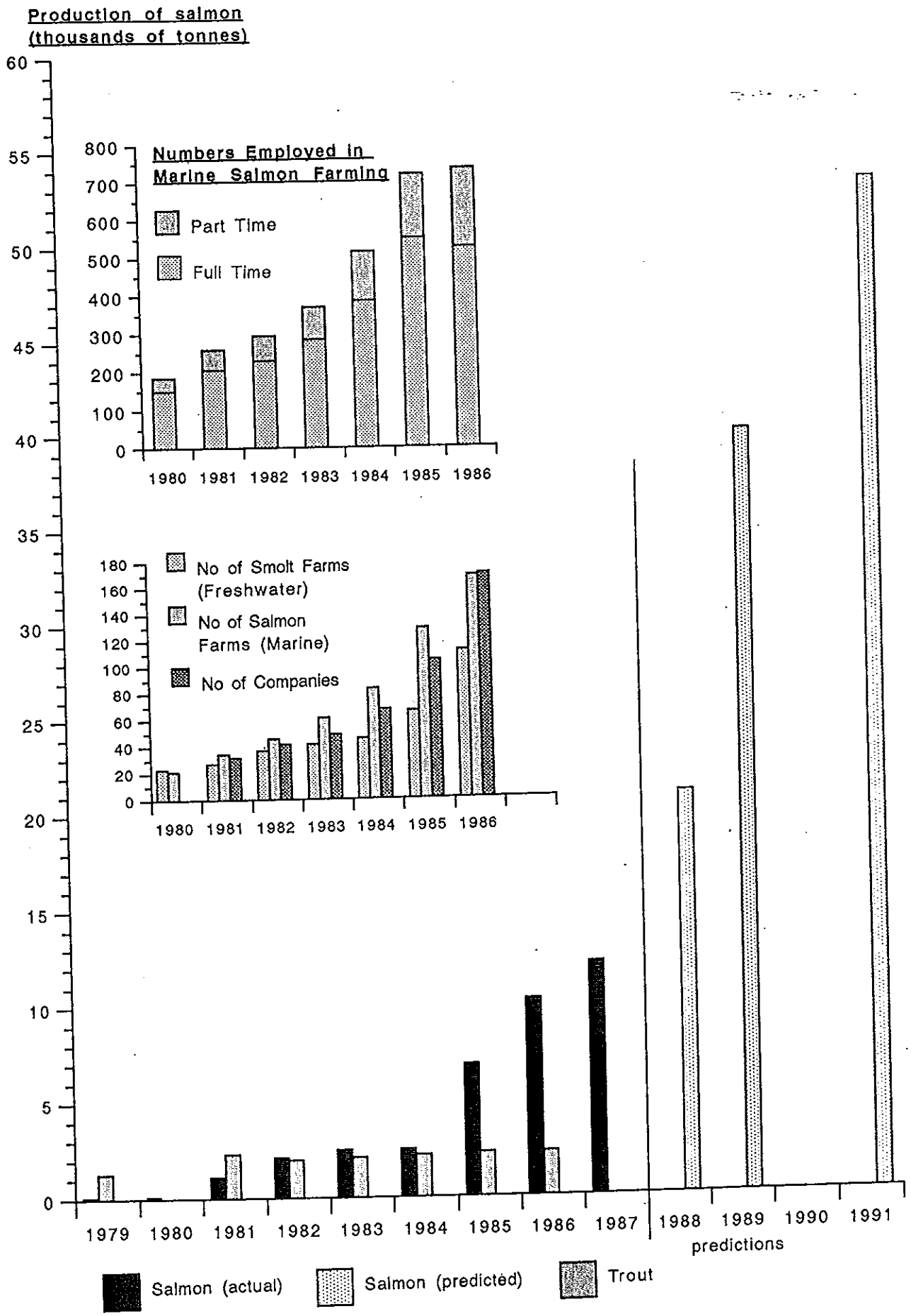
2.5 With the exception of a small number of research-based enterprises, all salmon farming in Scotland is in the private sector. Initial development of the industry has taken place as a result of substantial R&D investment since the late '60s by multi-national companies, notably Unilever, Booker-MacConnell, BP, Shell. Of these, Unilever (Marine Harvest) and Booker MacConnell (MacConnell Salmon) are now leading forces in the growth of the industry, along with Norwegian-owned Norsk Hydro. BP is the leading manufacturer of fish feeds.

OUTPUT

2.6 Of the 113 companies with sea farms, the leading five produced about 60% of total Scottish production of 10,337 tonnes in 1986. This figure at present accounts for less than one tenth of the world production of Atlantic Salmon, which is expected to reach 200,000 tonnes by the end of this century. Norway produced 47,000 tonnes in 1987 and the total production of eight countries of Western Europe is expected to rise from 70,000 tonnes of salmon (1987) to 107,000 tonnes in 1988 (Fish Farming International, Jan 1988). Other producing countries include Iceland, Canada and Chile.

Figure 1: SCOTTISH SALMON FARMING STATISTICS

(All data from DAFS and MAFF/DAFS)



2.7 By comparison, Scottish inshore netting of wild salmon accounts for approximately 1,000 tonnes per year. The total wild catch in 1987 from rod angling, net and coble and coastal netting stations in Scotland was 1271 tonnes.

2.8 According to its own figures, Marine Harvest, which claims to be the world's biggest producer of farmed salmon, was alone responsible for 2,800 tonnes (27% of total Scottish production) in 1986, in its 18 sea farms, supported by four hatcheries. It sells 45% of its output in the UK, 25% in US, 22% in France and 8% in the rest of Europe. MacConnell Salmon now owns 50% of production in the Western Isles.

2.9 Farmed salmon is marketed at approximately £4,000 per tonne, so that the 1987 production of 12,700 tonnes has a first sale value of approximately £50m (DAFS).

EMPLOYMENT

2.10 The pattern of employment compared with production in salmon farming is shown in Figure 1. This shows a total of 527 full time and 206 part time jobs in 1986 (figures from DAFS). The production side supports additional 'downstream' jobs in fish processing, boat-building, marine engineering, net and cage manufacture, feed compounding and haulage.

2.11 The total direct labour in fishfarming is small compared with manufacturing and service sectors in the Highlands and Islands as a whole, but it has special social value in supporting the rural economy by providing year-round employment particularly in remote areas.

ORGANISATION

2.12 The interests of those engaged in fishfarming are supported and protected, particularly in the political field, by the National Farmers' Union of Scotland (NFUS) which has a specialist fishfarming committee. The Scottish Salmon Growers' Association (SSGA) and growers' associations in Shetland, Orkney and Western Isles promote the interests of the industry in marketing and publicity. SSGA claims a membership of 90% of operators accounting for 95% of total salmon production on the Scottish mainland. The Scottish Shellfish Growers' Association acts likewise for the shellfish sector.

PROSPECTS FOR GROWTH

2.13 Figure 1 indicates the predicted output of the salmon farming industry to 1991. Demand for sites is clearly still expanding. At least 250 new applications for sea-bed leases in Scottish coastal waters were made in 1987 (Chairman, Royal Yachting Association, letter to Glasgow Herald, 23 Jan 1988).

2.14 We were told by staff of HIDB in July 1987 that production was expected to plateau in about 1990 at the estimated total of 40,000 tonnes, due presumably to site saturation in the context of present constraints. By February 1988 it was predicted that this total would be reached by 1989, rising to 54,000 tonnes by 1991.

2.15 It is difficult to predict the future growth pattern of the industry in Scotland. Figures for stock already in the water lead Marine Harvest to estimate their future production as follows:

Actual:	1986	Estimates:	1987	1988	1989	1990
Tonnes	2800		3900	5500	8500	11000

This rate of expansion accords closely with estimates of a quadrupling of 1986 figures for total Scottish salmon output in three years to 40,000 tonnes by 1989, rising almost to a six-fold increase by 1991 (see Fig 1). Marine Harvest output in 1990 is destined to exceed the entire Scottish production from existing fishfarms in 1986.

2.16 Future developments are sure to include growth in the farming of other species, such as turbot, cod and particularly halibut, which are the subject of successful early trials and continuing research. Considerable growth is expected also in the shellfish sector, where much research is underway. For example, UK production of mussels is expected to rise from 3,350 tonnes (1986) to 14,000 tonnes in 1991 (MAFF/DAFS).

2.17 World-wide, the Food and Agriculture Organisation of the United Nations expects fishfarm production to double to 22m tonnes in the next 12 years, against continued decline in capture fisheries. Business analysts Hewin International therefore forecast a booming market for fishfarm-related chemical products.

2.18 Present constraints referred to in 2.14 relate to spacing for disease control purposes, and dependence on sheltered sites, due to limitations in predominant cage designs. However, technological advances, especially in the design of more robust or flexible sea cages may lead to wider limits being determined by other factors which may include:

Impact on landscape, recreation, and wildlife interests;
Animal welfare considerations;
Health and Safety at Work considerations;
Infrastructure limitations;
Disease problems;
Market limits and competition;
Capacity of loch systems to cope with pollution.

3 RESPONSIBILITIES OF STATUTORY BODIES

CROWN ESTATE COMMISSIONERS (CEC)

3.1 Approval for the mooring of sea cages must be obtained from the CEC, whose Crown Estate Office in Edinburgh acts as the Crown's agents in administering its Scottish estate (which includes all coastal sea-bed below spring low water, and all foreshore between spring low and spring high water except in parts of the Northern Isles).

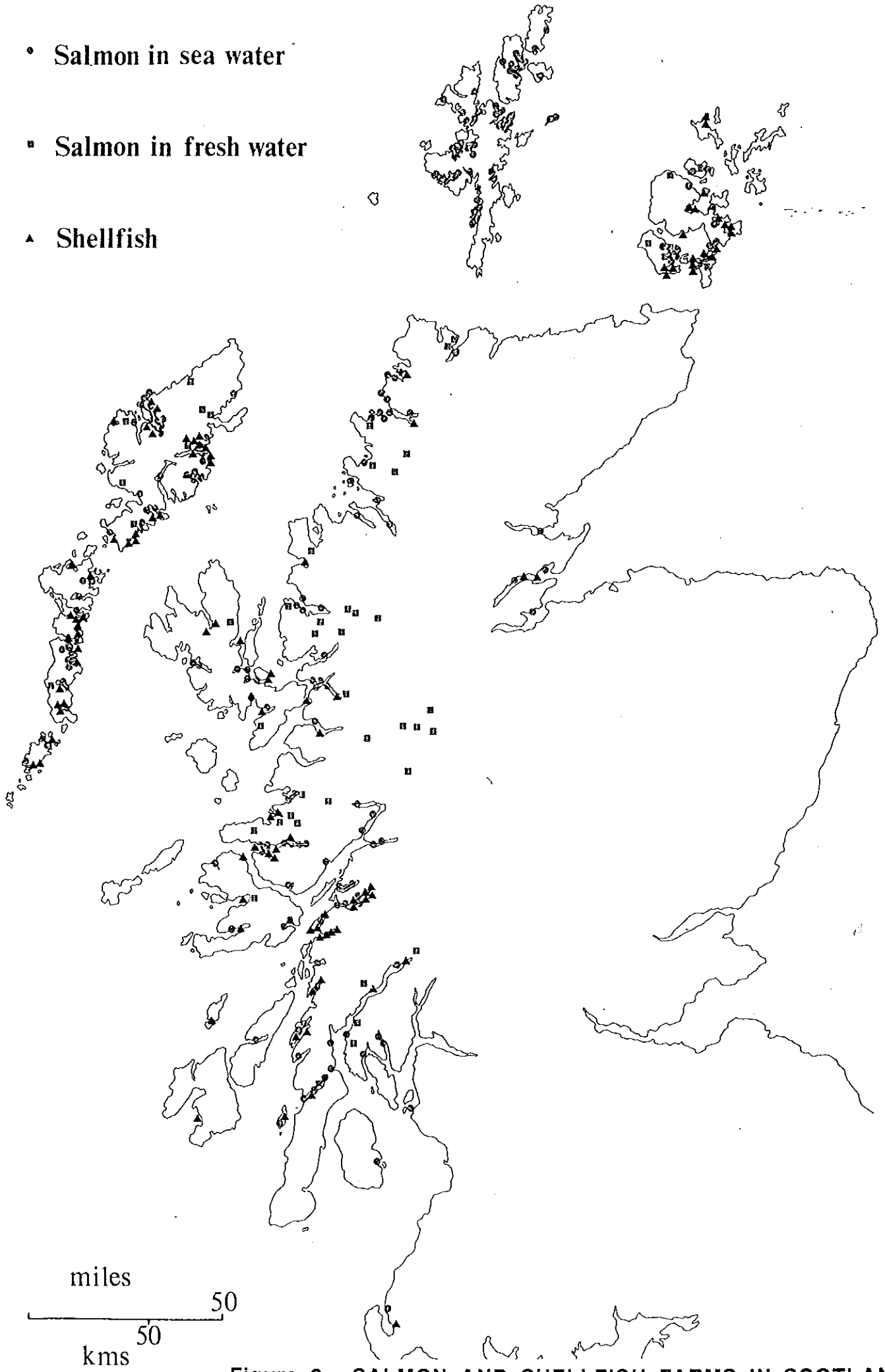


Figure 2. SALMON AND SHELLFISH FARMS IN SCOTLAND

3.2 Under the Crown Estate Act (1961), the Commissioners, who are appointed by the Sovereign, are charged with the management of the estate "to maintain and enhance its value and the return obtained from it, but with due regard to the requirements of good management". The estate itself is not government property but a part of the hereditary possessions of the Sovereign in right of the Crown. The net income is therefore paid into the Exchequer as part of the Consolidated Fund from which the Civil List is made up. This income includes rents charged for sea-bed leases.

3.3 Before 1986, about 350 fishfarm leases (salmon and shellfish) were granted by CEC, after consultations as judged necessary. The Montgomery Committee of Inquiry (1984) into the Functions and Powers of the Islands Councils of Scotland recommended the introduction of a form of control on developments in inshore waters which should "at the very least" involve consultation with the local authorities concerned. Accordingly, a new consultation procedure on fishfarm developments was instituted in October 1986, in which the views of a wide range of consultees are routinely sought by CEC on each application prior to a decision on the issue of the lease and conditions to be applied. In the absence of statutory planning controls this has become the principal regulatory procedure in the establishment of new marine fishfarming sites (see Section 18).

3.4 The CEC's consultative procedure does not operate in Shetland, where the Islands Council has powers under the Zetland County Council Act (1974) to control all developments between the low water mark and the three-mile limit, by the issue of Works Licences. It therefore operates its own policies relating to siting, allocation to local growers, separation distances, size limits, ownership limits, etc. All consents, including CEC's sea-bed lease, operate as elsewhere, but subject to the Works Licence.

DEPARTMENT OF TRANSPORT (DoT)

3.5 Approval from the CEC is conditional upon the consent of the DoT in London, which administers the requirements of Section 34 of the Coast Protection Act (1949) covering aspects of navigational safety (see Section 15).

RIVER PURIFICATION BOARDS (RPBs)

3.6 CEC approval is granted subject also to consent as required from the appropriate RPB (principally Highland, Clyde and the three Island Councils which carry RPB responsibilities) according to duties under the Control of Pollution Act (1974) to regulate the discharge of industrial waste and sewage into the marine environment by the issue of consents (see Section 8).

DEPARTMENT OF AGRICULTURE AND FISHERIES FOR SCOTLAND (DAFS)

3.7 The lead government department in promotion of the industry is DAFS, which participates in negotiations with EEC for grants for development (the Multi-Annual Guidance Programme for Aquaculture in UK), undertakes research into production methods and related matters, administers a fishfarm registration scheme and other requirements of the Diseases of Fish Act (1983) and the Fishfarming and Shellfish Farming Businesses Order (1985). DAFS also has responsibility for the discretionary issue of licences for the shooting of certain predators under the Conservation of Seals Act (1970) and the Wildlife and Countryside Act (1981) (see Section

As CEC's consultee on aspects of other fisheries interests affected by fishfarming proposals, DAFS consults Fishermen's Associations and its own Fisheries Officers as appropriate.

SCOTTISH DEVELOPMENT DEPARTMENT (SDD)

3.8 SDD has no direct statutory function in relation to fishfarming at sea, since all developments beyond low water mark are beyond the scope of planning control, but it does have a responsibility to oversee the relationship of the industry with other interests. SDD staff maintain a watching brief over development policy and have for example assisted the CEC with formulating its consultation procedure.

LOCAL AUTHORITIES

3.9 These likewise have no statutory means of control on seaward development, although the associated landward developments - jetties, storage buildings, road improvements etc - are, like freshwater fishfarm developments, generally deemed by SDD to be subject to planning control. However, some local planning authorities (especially Argyll and Bute District Council and Western Isles Council) take the view that fishfarms are agricultural installations and therefore exempt from planning control.

NATURE CONSERVANCY COUNCIL (NCC)

3.10 As statutory adviser to the government on all matters relating to the conservation of nature, the NCC is consulted by CEC on all applications for sea-bed leases for fishfarms.

COUNTRYSIDE COMMISSION FOR SCOTLAND (CCS)

3.11 Under the Countryside (Scotland) Act 1967, the CCS has responsibilities for the conservation and enhancement of the natural beauty and amenity of the Scottish countryside. It is therefore consulted by CEC on all applications for sea-bed leases for fishfarms.

HIGHLANDS AND ISLANDS DEVELOPMENT BOARD (HIDB)

3.12 HIDB has a two-fold remit:

"a) to assist the people of the Highlands and Islands to improve their economic and social conditions.

"b) to enable the Highlands and Islands to play a more effective part in the economic and social development of the nation.

Furthermore,

"In carrying out its work, the Board is required to observe the desirability of preserving the beauty of the area's scenery."

3.13 HIDB provides grants to assist the development of fishfarming (£20m since 1965, concentrating especially on small operations since mid-'85) and to support relevant research to meet the future needs of the industry. During the course of the EEC's Agricultural Development Programme (ADP) for the Inner and Northern Isles, as in its predecessor the Integrated Development Programme (IDP) for the Western Isles, HIDB will disburse grants for fishfarming developments. The Board operates as an enabling agency within the framework of controls such as are imposed and monitored by other bodies. HIDB justifies its grant-aid expenditure chiefly in terms of employment created or protected (see Section 16).

3.14 HIDB has also participated (along with other agencies) in the funding of research projects into limited aspects of the environmental effects of fishfarming, notably the Cobham Resource Consultants study and SMBA/Stirling University study, referred to in Part II of this report.

PART II

IMPACTS OF MARINE FISHFARMING ON THE ENVIRONMENT

4 GENERAL

QUALITY AND SENSITIVITY OF THE COASTAL ENVIRONMENT

4.1 Fishfarming represents a substantial, widespread and sudden new element in the ecology of Scottish sea lochs - an ecosystem of special importance as one of Europe's least disturbed and polluted natural habitats.

4.2 The coastal marine ecosystem is complex and little known. On the basis of available data, NCC has compiled an initial list of fourteen Marine Consultation Areas (see Appendix 3) as "deserving of particular distinction in respect of the quality and sensitivity of their marine environment". This designation confers no statutory protection; they are identified in order to assist the process of consultation. Justification is on the basis of special hydrographic features, variety of marine habitat and communities of benthic invertebrates and algae; no reference is made to fish or birds. There is one reference to otters.

4.3 By comparison with fully aquatic species, the status of sea-birds, coastal mammals and shoreline flora and fauna are better known. This data forms an important additional part of NCC's submissions to CEC on fishfarm applications, and there can be little doubt that evidence relating to for example birds and otters is more compelling to non-specialists than references to bryozoans and brachiopod molluscs. In ecological terms, this is a dangerous weakness.

4.4 The contrast between marine and landward areas is instructive since first, land areas are well surveyed and second, the impact of most land-based activities is extremely local. Advice on minimising impact of land-based development is therefore relatively straightforward. In coastal waters the situation is altogether different; very much less is known and the impact of operations such as fishfarming within the aquatic environment can be widespread.

4.5 Conservation cannot be achieved in the sea by purchase and enclosure; it is a communal responsibility and must be a co-operative undertaking. The difficulty of establishing this is demonstrated by the fact that Scotland still lacks any statutory Marine Nature Reserves designated under Section 14 of the Wildlife and Countryside Act (1981), despite long-term negotiations.

SALMON FARMING AS A SOURCE OF POLLUTION

4.6 One of the principal attributes of the north and west Scottish coastline which makes it suitable for salmon farming is the unpolluted quality of the water. The salmon is sensitive to gross pollution and has as a result been eliminated from many river systems in the UK in which it was formerly abundant.

4.7 Intensive farming of salmon is itself a source of pollution which may cause local problems. The point is often made that fishfarmers will be extremely diligent in minimising pollution because of its adverse effect on salmon. However it was pointed out to us by staff of CRPB that salmon can thrive in much higher concentrations of nutrients and certain other chemicals than they would consider desirable for the general health of ecology of sea lochs. Other marine organisms are considerably more sensitive to certain kinds of pollution than salmon - indeed the selection of products for the treatment of parasites and disease pathogens in salmon relies on a selective toxicity which affects these organisms without harming the fish themselves. Among the sensitive species are certain molluscs and crustacea, some of which (eg, mussels, oysters, crabs, lobsters, prawns) are the subject of other economic enterprises.

4.8 Pollution from salmon farms takes the form of waste materials (unconsumed food and faeces) and chemical substances connected with husbandry. Of these, waste materials have both solid (see Section 5) and soluble (see Section 6) components. For every 100 tonnes of feed, approximately 10t of solid waste sinks to the sea-bed as a deposit. In addition, 5t of nitrogenous compounds enter the water as soluble waste (R Gowen, pers comm). Chemical pollution is considered in Section 7.

5 SOLID WASTE POLLUTION

GENERAL

5.1 Solid waste pollution (variously described as 'carbon' or 'suspended solids') affects the organisms living in and on the sea-bed, both the flora and fauna, collectively known as the BENTHOS.

5.2 Such pollution from salmon farms is acute and highly localised. This phenomenon has been studied in detail in relation to wood pulp and sewage pollution and has been the subject of a number of review papers (eg Pearson and Rosenberg, 1978). Its main effects on the benthic ecology are now well known.

5.3 Descriptive work on the effects around cages, coupled to sediment chemistry information, and broad cataloguing of sea lochs has been completed by the Nature Conservancy Council in a series of studies in the Western Isles (Earll et al., 1984) and Shetland (Dixon, 1986). The impact of cages can now be assessed and ranked quickly and cost effectively.

5.4 Detailed studies on the effects of organic pollution from fishfarms in relation to the benthic fauna (Brown et al., 1987) are being conducted by Pearson, and energetics and modelling are being undertaken by SMBA/Stirling University. This work is due to be reported in spring 1988.

Normal Conditions

5.5 Fishfarm surveys referred to above have revealed that the sea-bed under the cages is predominantly of sedimentary deposits, often with a high proportion of muds. In a minority of cases coarser sediments, sands, and rock are found, with algal cover in some shallow areas.

These habitats are widespread throughout the sea lochs of the region.

Preliminary Effects After Cage Installation

5.6 The vast majority of cages are located in very sheltered and often shallow areas of sea lochs with very limited water movement. This means that the bulk of the organic load accumulates directly under the cages. The benthos can metabolise this as long as oxygen is freely available, but the increasing demand for this leads to a decline in oxygen levels in sediments and overlying waters and death of benthic species. As these conditions develop, the build up of toxic products (hydrogen sulphide and methane) and physical smothering lead to further elimination of the normally occurring benthic species. This stage is usually reached within the first 3-6 months of operation.

Established Sites

5.7 When the cages are in operation, there is a continuous loading of both faeces and food; this is the most acute form of organic pollution which has so far been described in the marine environment. The Stirling group estimate that from the food:waste ratio quoted above, organic carbon loadings on the sea-bed amount to 2-7 kg/sq.m./yr. Depending upon the nature of the localised water movement this acute pollution can extend up to 40m from the edge of the cage site. Chronic effects which result in changes in species composition, and colonisation by tolerant opportunistic species, extend further.

5.8 Rate of organic deposition relates also to the type of operation and its style of management, in particular the sensitivity of the feeding regime. More sophisticated systems, designed to save labour costs, may also be more wasteful since they rely on time- or light-related control devices, not the behaviour of the fish. Likewise, we suspect that the hourly-paid and badly-paid are more inclined to feed wastefully, especially in adverse conditions, than the owner/operator whose profits relate more closely to the welfare of his fish.

5.9 The exact area affected will depend on the nature of the local currents, type of mooring used (single point moorings spread the load over a greater area), water depth, etc. As the deposit accumulates, spontaneous 'gassing' - the release of methane and hydrogen sulphide bubbles from decomposition in the absence of oxygen - causes concern as hydrogen sulphide is toxic to fish. Cages may be moved around, leaving over-pollute sites to lie 'fallow' for up to a year when this occurs, to allow the site to restore naturally.

5.10 A number of species can tolerate the conditions under the cages - notably shore crabs, and common starfish, along with a number of sea loch fish species which capitalise on the waste food. A very characteristic white growth of a bacterium (Beggiatoa) often forms in and around the worst polluted areas under the cages, providing a good visual indicator of lack of oxygen (reduced conditions) in the underlying sediments.

Recovery

5.11 Surveys of disused fishfarm sites suggests that, as with other forms of organic pollution, natural processes effect recovery once the pollution ceases. Colonisation by benthic species begins almost immediately and whilst it is likely that the exact community will never be precisely the

same again there is no reason as yet to suppose that long term damage will be done.

5.12 However, if the fishfarms are large or numerous in proportion to the size of the sea loch or the rate of tidal exchange of water, then two causes for concern arise:

a. significant ecological changes in the long term natural balance of benthic communities may result;
b. 'enhanced anoxic events' (episodes of severe oxygen depletion) may occur, especially in situations where fishfarm pollution adds to the effects of natural sinks of organic debris (eg seaweed) accumulating in basins in sea lochs.

RECOMMENDATION:

5.13 Research is required to establish guidelines for management regimes which reduce the impact of organic deposition to a minimum (for example by means of siting in relation to water depth and current, periodic re-siting of cages, improved efficiency of feeding regimes, etc).

6 SOLUBLE WASTE POLLUTION

NITROGEN

6.1 The main body of research relating directly to the enrichment effects of salmon farms on water quality has been conducted by the Scottish Marine Biological Association (SMBA), Stirling University, and the Institute of Aquaculture. Early work on toxic phytoplankton blooms began in 1980 at the SMBA and continued until 1983/84 when the HIDB became involved and funded further studies through Stirling University. During 1984 a further 4-5 year project was set up at Stirling University funded jointly by HIDB, CEC, NCC, and SSGA, with other interested bodies (DAFS, GCS) sitting on the project review committees. The aims of this project were expanded to cover a) toxic phytoplankton, and b) a general study of fishfarm pollution, which would lead to c) computer modelling to predict the size of farm compatible with a given water body.

6.2 Salmonid fishfarms give rise to an increase in nitrates, phosphates and nitrogenous waste products in the proximity of the cages. In adequate light conditions, this nutrient enrichment has the effect of stimulating increased productivity of microscopic plants (phytoplankton) in the water body. The two most important elements in phytoplankton metabolism are nitrogen and phosphorus, but since the latter is already abundant in sea water, nitrogen and light are the two limiting factors to marine phytoplankton productivity.

6.3 So called 'blooms' of phytoplankton species may therefore occur. Certain species produce toxic substances in these circumstances, which have been known to cause mass mortalities in some Scottish salmon farms. Blooms have been correlated with paralytic shellfish poisoning in humans, through consumption of shellfish in which the toxins have accumulated. In addition, the gradual settlement of these blooms may cause de-oxygenation of the water column. These effects are likely to

be worse in calm conditions when layering of the water column (stratification) occurs.

6.4 The dilution and removal of nitrogenous waste by tidal flushing have not yet been adequately studied. Nor are the hydrographic characteristics of individual lochs fully understood, though DAFS is conducting measurements on certain lochs to check the tables of flushing time available (DAFS, pers comm). However from evidence so far to hand, Gowen et al., (1983) suggest that increased dissolved nitrogen is unlikely to lead to eutrophication since any accumulation of a 'standing crop' of phytoplankton due to nutrient enrichment will be reduced regularly by tidal flushing and mixing.

6.5 Gowen and Bradbury (1987) deem it unlikely that eutrophication of sea lochs by fishfarms is going to be a major environmental problem, though the possibility of localised enhancement of primary production around the farm is not ruled out.

RECOMMENDATIONS:

6.6 Research into tidal flushing rates of individual lochs, and other factors affecting the dilution and mobilisation of inputs from fishfarming, should be accelerated to provide urgent guidance on 'carrying capacities'.

6.7 In view of the poor state of knowledge on 'carrying capacities' of lochs, the siting of cages in the small number of lochs which have not hitherto been used for fishfarming should be strongly resisted (see Recommendation 19.28).

7 CHEMICAL POLLUTION

THE PRESENT SITUATION

7.1 Commercial marine fishfarming necessitates the use of a wide variety of chemicals for reasons of husbandry, hygiene and welfare. These chemicals are obviously of value to the farmer in terms of increased output per annum but their persistence in the marine environment, and possible or known toxic effects on phytoplankton, zooplankton and benthos should also be considered.

7.2 Known chemical inputs may be categorised as follows:

a. Anti-foulants on nets and cages (see Section 7.3 to 7.17);
b. Chemical treatment of fish diseases (see Section 7.18 to 7.35);
c. Food additives : vitamins, minerals, pigments, hormones (see Section 7.36 to 7.38);
d. Disinfectants (see Section 7.39 to 7.46).

ANTI-FOULANTS ON NETS AND CAGES

7.3 The build-up of natural growth of algae etc on nets and cages is a major problem for fishfarmers, causing increased drag in the tidal flow, reduced 'ventilation' of the cage with clean oxygen-rich water, and possibly an increased likelihood of disease. The principal chemical (anti-foulant) used to prevent this has until recently been Tri-butyl Tin (TBT).

Control of Use of TBT

7.4 Government legislation banning retail sales of TBT-treated nets became effective in early 1987 (Control of Pollution (anti-fouling paints) Regulations 1987). Use of TBT was further controlled with effect from July 1987 when all anti-fouling paints and surface coatings (whether containing TBT or not) were brought within the statutory Pesticides Approval Scheme under Part III of the Food and Environment Protection Act (1985). Under these regulations, no anti-fouling treatment may be sold, supplied, stored, advertised or used unless the product concerned has been examined by the Independent Advisory Committee on Pesticides and approved by ministers.

7.5 However we are concerned that TBT treated nets may still be in use, although in most cases this is just the residue of past treatments. Freshly treated nets were observed in August 1987 (A Ross, pers comm), and the likelihood of continued use being subject to legal intervention appears to be very small, especially in remote places.

Trade Names for TBT Products

7.6 TBT has been sold under three trade names

a. 'Monopo' - a small amount used;
b. an imported preparation from the USA mainly by Tess Agriculture;
c. 'Norimp' - commonly used.

Toxic Effects of TBT

7.7 TBT is one of a group of compounds known as organotins, and is the active component of many modern anti-fouling paints. It is an extremely effective biocide due to its ability to penetrate biological membranes. Its method of use in anti-fouling preparations - such that it is released slowly from the painted surface - ensures a continuous low level input to the marine environment when used on fish cage nets or workboats.

7.8 TBT is known to have toxic effects at extremely low concentrations (0.1 micrograms per litre, ie one part per ten thousand million, or less), and a variety of acute and chronic effects of TBT on estuarine and marine organisms are given in a review by Wood (1986). These range from the initiation of imposex (development of male characteristics in females) in the dogwhelk (Nucella lapillus) at or below a concentration of 0.003 micrograms per litre (3 parts per million million) to a 96 hour LC50* of 2.1 micrograms per litre (2.1 parts per thousand million) for larvae of sole (Solea solea). Recent research has shown that a number of molluscs act as indicator species e.g. the Pacific oyster (Crassostrea gigas) exhibits shell thickening, meat reduction and reproductive failure; and the dogwhelk shows a decline in populations resulting from imposex.

7.9 The effects of TBT have also been firmly implicated in the decline and failure of a number of shellfish operations. It has also been shown that TBT accumulates in the muscle tissue of farmed salmon (Davies and McKie, 1987).

* LC50 of a toxic substance is the concentration which causes 50% mortality of a sample of a given species in a given time.

Advice on Disposal

7.10 The only published advice on TBT use and disposal appears to be in a leaflet entitled 'Shipyards and the Marine Environment' (Dept of Environment, 1987). Another leaflet entitled 'Don't Foul Things Up' (Royal Yachting Association, 1985) was written for the benefit of small boat owners but its advice is not now consistent with the law and it should be withdrawn and updated.

7.11 No advice on disposal was offered to the large number of fishfarmers at the time of the ban, when the use and storage of any remaining stocks became illegal. Some operators appear to have used their own initiative in disposing of these TBT stocks in ways which are themselves illegal and may cause serious damage. For example a 45-gallon drum containing TBT was dumped over a cliff in Shetland in May 1987, resulting in a £600 fine to a local fishfarmer (Shetland Times, 31 Dec 1987). We are concerned that advice on disposal of this extremely toxic substance had still not been circulated to fishfarmers in December 1987; some responsible companies have not yet disposed of remaining stocks for want of proper advice. We are told by DAFS officials that due to the urgency of the ban in February 1987, it was decided not to delay proceedings by instituting separate measures for disposal.

Alternatives to TBT

7.12 Enquiries have recently been made to a selection (5) of the major netmakers for the industry. One company ceased to use Norimp in September 1986 when the Scottish Salmon Growers' Association (SSGA) placed its own ban on TBT preparations, and stocks which they had sent out to fishfarmers for re-coating were recalled. Most report that they now use no anti-foulant whatsoever; one uses a copper-based anti-foulant on approximately 10% of nets sent out. Two companies coat a very small percentage with a bituminous product. Another company now coat nets with a new product - Netrex - made by Mobil Oil. This is not an anti-foulant, rather a wax emulsion providing a smooth surface which discourages marine growth and makes the nets easier to clean. They have always advocated frequent cleaning of nets and suggest that large companies (eg Marine Harvest, who are understood never to have used anti-foulants) are more able to do this than small operations because of man- and boat-power needed for net changing operations. Cleaning may be by way of drying, hosing with high pressure water jets or using a net cleaning drum. The net drum in particular has aroused concern as it is likely to discharge any toxic net treatments into the sea at far higher concentrations than would occur from normal day-to-day leaching.

RECOMMENDATIONS

7.13 Effective follow-up and enforcement of the TBT ban should be undertaken, with comprehensive advice on safe disposal of all unused stocks, and monitoring of TBT levels in salmon flesh and other environmental indicators.

7.14 Special scrutiny should be given to the use of net-cleaning drums and their effluent.

7.15 Action should be taken to ensure that in future proper arrangements are made for safe disposal in the event of a similar ban on toxic substances.

7.16 Attention should be given to the alternative outlets for TBT, and measures which may be necessary to prevent the 'dumping' of this highly toxic material, especially through sale into Third World markets.

7.17 Vigilance should be applied (through the Food and Environment Protection Act procedures) to the introduction and testing of new anti-foulant substances such as bi- and mono-butyl tin and copper-based alternatives.

CHEMICAL TREATMENT OF FISH DISEASES

7.18 The major disease problems encountered in finfish farming in the UK are caused by a number of viruses, bacteria, protozoa, fungi and helminth and crustacean parasites.

Group	Species	Disease
Bacteria	Aeromonas salmonicida	Furunculosis vibriosis
	Yersinia ruckeri	Enteric Redmouth (ERM)
	Myxobacteria group	Bacterial Kidney Disease (BKD)
Viruses		Infectious Pancreatic Necrosis (IPN)
Protozoa	Myxosoma cerebralis	Whirling Disease
Fungi	Saprolegnia	Saprolegnia infection
Parasites	Dactylogyrus sp	Flatworm
	Lepeophtheirus salmonis	Salmon louse

Antibiotics

7.19 A wide range of drugs has been used on fishfarms to control these diseases (Austin, 1984), although only a few compounds (oxytetracyline, oxolinic acid and potentiated sulphonomides) are supplied subject to Product Licences (under the Medicines Act 1968) for uses on fish in Great Britain. The cost of research in order to obtain an Animal Product Licence in UK is very high since the safety of each product to both target species and users (at concentrations well above the normal dosage) has to be demonstrated.

7.20 Drug companies tend not to seek Animal Product Licences for reasons of expense, or because the drug concerned might have important medical uses and therefore be unsuitable for wide use in other areas.

7.21 Although antibiotics themselves are not a problem to the environment since the quantities involved are small and quickly diluted (practically on the threshold of detectability), the area of concern lies with the potential increase in numbers of antibiotic-resistant bacteria. Antibiotic treatment causes a decline both in bacterial numbers and in the number of species present. However, when the dosage is removed, the count returns quickly to background levels, but the species composition is altered - sensitive bacteria have been knocked out and resistant ones

remain. The likelihood of transfer to other organisms, especially to filter-feeders or through the food chain and ultimately to humans, is not known. We believe this is a problem which should be addressed, since the risk increases greatly when antibiotics are used routinely to prevent rather than treat disease.

7.22 Particular concern relates to the use of medically important antibiotics; for example, chloramphenicol is the drug of choice for the treatment of typhoid fever (Butler et al., 1973), but despite the availability of suitable alternatives, chloramphenicol has been used extensively to treat a variety of fish ailments (Austin, 1984). Austin (1985) tables a list of about 30 suitable antibiotic products for the control of bacterial fish diseases - products which are not of medical importance - but it is not clear whether this advice is readily available to vets who prescribe drugs for use in fishfarming.

7.23 Application of antibiotics to fish is by incorporation in the feed. Such feeds are made up as 'specials' - covered by veterinary prescription. However, it appears that such use of antibiotics in feedingstuffs used in fishfarming is not permitted within the EEC (under Directive 70/524/EEC, as amended by 85/429/EEC).

RECOMMENDATION

7.24 Proper controls should be instigated and enforced on the use of antibiotics, with particular reference to relevant EEC Directives.

Parasite control

Nuvan

7.25 Our principle concern relates to Nuvan, widely used in Scotland for the treatment of the salmon louse (Lepeophtheirus salmonis) a crustacean parasite. The environmental impacts of this chemical are the subject of current research by DAFS. The active chemical is the organophosphorus compound 'dichlorvos' and the product is available on the market as a pesticide - a contact and fumigant insecticide with directions for use in the control of insect pests in premises and animal houses (ie not on livestock), for stored product protection and for the purposes of controlling ecto-parasites of poultry.

7.26 Thus Nuvan is sold with instructions on methods of operator handling (to comply with Health and Safety at Work Act regulations) but without directions for its use in water for the treatment of salmon lice on the fish. Techniques have been developed for such applications aiming at a concentration of 1 ppm for 1 hour; the compound is mixed directly into fish cages which should have been surrounded by strong tarpaulins (Rae, 1979; Wootten, 1985). Certain companies prefer to apply Nuvan at slack tide without tarpaulins.

Legal requirements

7.27 The use of a chemical for the control of parasites on fish falls within the legal definition of medicinal use, for which a Product Licence is

required under the Medicines Act to permit its import, sale or supply onto the UK market.

7.28 We understand that Nuvan is the subject of a Product Licence application by the manufacturers, Ciba Geigy. In the meantime we are told by staff at the Animal Medicines Division of MAFF that, until the side effects of the chemical have been investigated and cleared, and a Product Licence issued, sale or supply of Nuvan for use as a medicine in this way is not legally permitted, except on prescription from a vet (an exemption clause in the Medicines Act allows vets to prescribe any product (licensed or not) for animals in their care).

Toxic effects of Nuvan

7.29 Nuvan is known to be very poisonous to other marine invertebrates in addition to the target parasite species. Recent experiments on three species of crustacea (Cancer pagurus, Carcinus maenas, and Homarus gammarus and a bivalve mollusc, the common mussel (Mytilus edulis) (Egidius & Moster, 1987) show that laboratory conditions mimicking those after treatment with Nuvan at a fishfarm are extremely toxic to all four species. Death occurred within 24 hours at Nuvan levels of 0.1 ppm and higher.

7.30 Clearly, this has serious implications for all nearby populations of shellfish including shellfish farms and probably for the reproductive success of species whose larvae may be affected over a wider area.

7.31 Given the prevalence of lice as a problem - few farms are not affected - the continued use of Nuvan could be a contentious issue. Infestation varies, but typically farms treat mainly in the summer months, usually 3 or 4 times per year, but sometimes as many as 8 or 9 times a year. Over such a limited period, areas where cage density is high must receive a substantial input to the water column and sediment.

RECOMMENDATIONS

7.32 Proper controls on the unprescribed use of Nuvan should be instigated without delay, to avoid illegal and undirected use of this substance. Also, use of Nuvan should be standardised without delay to conform with the best knowledge available on reducing load on the environment.

7.33 The availability and use of other compounds whose active ingredient is dichlorvos (eg Neguvon - currently used in Norway) should be investigated.

7.34 Research should be undertaken into alternative means of salmon louse control by improved management or medication.

FOOD ADDITIVES: VITAMINS, MINERALS, PIGMENTS, HORMONES

7.35 Vitamins and minerals are added as supplements to fish diets, typically in the order of 1% of the total composition. Vitamin C is one of the most susceptible to breakdown during and after production. Manufacturers overcome this in a variety of ways, mainly by incorporating in the product a much higher level of Vitamin C than required.

7.36 Unlike wild salmon, farmed salmon normally has grey flesh. This is made pink by adding a synthetically produced dye - canthaxanthin - to the feed for a twelve week period before marketing. Canthaxanthin is a carotene pigment which occurs in various items of the salmon's natural diet. UK feed manufacturers would prefer to use the carotene pigment astaxanthin which occurs more commonly in the marine environment. Legislation currently prohibits this, but it is expected to become legal practice in the near future. Norwegian fishfarms use astaxanthin which thus reaches current consumer markets throughout the EEC.

7.37 At present, it appears that no hormones are added routinely to feeds by the majority of companies. Use of hormones and other growth promoters in feedstuffs is (like antibiotics, see above) not permitted under EEC regulations. However DAFS is understood to be carrying out research into the use of hormones in salmon farming.

DISINFECTANTS AND FUNGICIDES

7.38 The following disinfectants are recommended for use in fishfarming (MAFF, 1978):

chlorine, sodium hydroxide, iodophors, quaternary ammonium compounds, calcium oxide.

These are applied to surfaces such as concrete, fibreglass, nets, footbaths, clothing, hands. While there is likely to be more need for disinfection in freshwater systems, it is thought that all above compounds will enter the marine system at some time.

7.39 Formaldehyde is widely used as a disinfectant and malachite green both as a fungicide and in higher concentrations as treatment for Bacterial Kidney Disease. Its impact on other organisms is the subject of current research. In addition to hygiene uses, iodophors may be used therapeutically to treat several common diseases such as IPN (MAFF 1978).

7.40 DAFS acknowledges that data is required on the levels of both nutrients and chemicals in sea lochs, their effects on productivity and their impact on species abundance and diversity. Much of this data is currently being gathered by the Department's scientists (DAFS, pers comm).

RECOMMENDATIONS

7.41 In view of the poor state of knowledge of nutrient/chemical impacts, high priority should be given to this research and its extension to include routine monitoring to assess the impact of chemical use especially in loch systems with a high density of fishfarms or low flushing rate.

7.42 Research on accepted chemicals should be aimed at establishing treatment regimes and practices which combine the maximum efficacy with the minimum of environmental impact.

7.43 A comprehensive and enforceable code of practice should be developed for all chemical use on fishfarms.

7.44 The rapid establishment of an inventory of chemicals in fishfarming and a voluntary code of conduct on chemical use should be prepared and

distributed by the industry as an interim measure for the better information of fishfarmers and other interested parties.

7.45 The provision of up-to-date advice for vets on suitable products in the treatment of fish should be assessed and improved if necessary.

8 CONTROL OF POLLUTION

RESPONSIBILITIES

8.1 In Scotland, control of pollution and the quality of all inland and tidal waterways within three miles of the coast falls within the jurisdiction of the River Purification Boards (Clyde, Forth and Highland RPBs) and the Island Councils of Orkney, Shetland and the Western Isles (the latter being guided by CRPB as consultant) under the Control of Pollution Act 1974 (COPA) and the Rivers (Prevention of Pollution) (Scotland) Acts 1951 and 1965.

8.2 Recent policy statements on the control of pollution from marine salmon farms have been issued by HRPB (1987) and Orkney Islands Council (1987). These policies have been developed on the basis of the following interpretations of the wording of COPA:

a. that the discharge from a fishfarm comes within the definition of "trade effluent" for which an application must be made to the RPB for consent, stating among other details the "premises" from which the discharge will be made, and
b. that the "premises" used for carrying on a trade or industry includes land used for the same purpose, and that "land" includes land covered with water.

8.3 These policies therefore assume that consent is required for discharges from cage sites in their areas.

CLYDE RPB

8.4 CRPB on the other hand is (Jan 1988) seeking clarification of the legal interpretations of these sections of COPA (formulated before fishfarm cages were of concern) and has therefore not yet assumed that its powers extend to caged sites. A number of fishfarms in the CRPB area (between the Sound of Mull/Loch Creran in the north and Girvan in the south) are therefore operating without consents.

8.5 At present, therefore, the CRPB can only attempt to exert control over discharges from cage sites by asking CEC to add appropriate conditions to their leases. This is apparently not being done and in any case would be unsatisfactory since the conditions would not be enforceable by CRPB.

ENVIRONMENTAL QUALITY OBJECTIVES AND STANDARDS

8.6 Since discharge from a cage cannot be sampled and monitored as from an outfall pipe, the RPB policies, where they have been prepared, set general principles in the form of Environmental Quality Objectives (EQOs),

and measurable parameters in the form of Standards (EQSs) which must be met. Seven EQOs are stated covering:

a. aesthetic considerations;
b. health of resident and migratory fish populations, shore-line and bottom-living communities of plants and animals;
c. compliance with existing EEC Directives on the discharge of dangerous substances, the quality of shellfish waters and the quality of bathing waters;
d. the absence of elevated levels of persistent toxic or tainting substances.

8.7 Eutrophication is also considered and limits placed concerning the growth of phytoplankton in relation to concentrations of toxic phytoplankton, dissolved oxygen, light, and phytoplankton blooms in relation to leisure activities.

8.8 A limit is placed on the total nitrogen load to be discharged from a cage site. This is designed to ensure that EQSs are achieved, and is imposed as a limit on annual fish production in tonnes (using the factor of 123 kgms nitrogen per tonne of fish produced, based on University of Stirling research).

8.9 The appropriate EQSs for coastal waters include specific standards for:

a. maximum levels of total nitrogen concentration, and maximum levels of ammoniacal nitrogen forming part of this total;
b. minimum levels of dissolved oxygen;
c. various aesthetically acceptable conditions, relating to flotsam, water turbidity, oil, scum, colouring and "sewage fungus".

8.10 However the "aesthetically acceptable conditions" defined as part of the EQSs for estuarine and coastal waters include the following statements:

> Condition (i): "... there should be no significant change in the natural characteristics of the sea-bed in the vicinity of the discharge due to deposited foreign matter".
>
> Condition (vi): "There should be no significant growth of 'sewage fungus' visible".

The term 'sewage fungus' refers to a conglomeration of micro-organisms of which the white bacterial growth Beggiatoa sp. is a frequent component. The occurrence of this phenomenon is such that every marine salmon farm in operation for more than 3 to 6 months would appear to contravene both of these conditions (see Section 5.10).

LACK OF KNOWLEDGE ON IMPACTS

8.11 Both these policies state that:

> "some of the chemicals used on fishfarms are known to be harmful to natural flora and fauna and man, but the effects when discharged into the aquatic environment are largely unknown at present".

These standards therefore represent the 'best guess' based on very limited available information, principally on the impact of nutrient enrichment.

8.12 With further research into this subject and the impact of potentially harmful substances used at fishfarms, as recommended in Sections 7.42 to 7.46, RPBs could exercise their powers to set conditions controlling the chemicals used, their precise mode of use and other husbandry practices as necessary.

MONITORING

8.13 In order to be effective, such regulations necessitate monitoring of water quality. HRPB state that water samples will be taken during the winter months November to February when the levels of nitrogen are expected to be at their highest.

8.14 No mention is made of summer water samples when sea temperatures rise, thermoclines often develop in sheltered bodies of water, and the effective volume of water available for dispersal of pollutants is thereby reduced. Routine water analysis for the presence of other chemicals is also omitted from discussion. Island Councils do not have analysis facilities, relying on the mainland RPBs to carry out analysis on their behalf. This appears to be a major obstruction to effective action.

RECOMMENDATIONS

8.15 A review of pollution effects should be made widely available for both the scientific and the commercial community; this should provide a summary of up-to-date knowledge of the subject as well as guidelines for rapid visual assessment of organic impact.

8.16 The scope of the Control of Pollution Act (COPA) should be clarified in relation to cage sites.

8.17 Regular monitoring of fishfarm inputs and resulting water quality should be undertaken in summer and winter alongside impact research, in order to:

a. check the validity of the River Purification Boards' Environmental Quality Objectives and Standards;
b. review and up-date estimates of 'carrying capacity';
c. refine monitoring programmes by identifying critical points of maximum impact (location, time of year, tidal state, treatment cycle, etc).

8.18 Environmental Quality Objectives and Standards should be regularly reviewed and more clearly defined as a meaningful operational guide to fishfarmers, and enforced.

8.19 River Purification Boards and Island Councils should be encouraged to use their powers to establish clear conditions for modes of use of chemicals, as the results of impact research become available.

8.20 Resources of River Purification Boards and Island Councils should be re-assessed to deal effectively with a vital and major new area of regulation.

9 THREATS TO WILD SALMON

9.1 Wild Atlantic salmon are a valuable resource to coastal and freshwater fisheries, tourism and not least as a source of genetic material for the future of salmon farming. As a food, 'Scotch' salmon has long had an international reputation for quality, upon which the new industry has based its own successful market growth. Any developments in salmon waters should treat conservation of the native salmon stock as highest priority. We therefore assess here a variety of threats which require careful consideration.

GENETIC IMPACT

9.2 This subject has been reviewed recently in a report by Maitland (1987) which is summarised below.

9.3 As salmon farming grows as an industry, alterations in the genetic constitution of fish are being and will be sought in order to establish more suitable types for the farming situation. These will include more placid behaviour, later sexual development, fast growth and greater uniformity in these characteristics. Threats to wild populations therefore arise when, as is often the case either accidentally or deliberately, farmed fish are introduced into the wild. The threat results from the established facts that:

a. farm fish perform less well than indigenous fish in the wild;
b. farm fish can depress the numbers and performance of wild fish when introduced into the wild in significant numbers;
c. even wild stock when transplanted from its own river performs less well than (and can have a detrimental effect on) native fish in another river.

9.4 In 1986 38 broodstock sites in Scotland produced over 7 million smolts.

Of 38.6 million eggs laid down:
32 million were from Scottish broodstock;
5 million ..... Scottish wild stock;
1.7 million ..... Norwegian sources.

9.5 It is known that substantial numbers of 'S2' parr (fish which do not develop into smolts at the end of their first year, and are therefore unsatisfactory for rearing) are released directly or sold to fisheries for release into the wild. In addition, escapes may take place as a result of predator damage, careless handling and accidents or collisions with vessels.

9.6 It is estimated that about 400 distinct wild stocks of Atlantic salmon survive in Scotland in spite of earlier widespread mixing caused both by 're-stocking' and a normal background level of straying from one river system to another.

9.7 Introduced or wandering stock will have had little genetic impact in the past due to the combination of relatively small numbers and their poorer performance than native stock.

9.8 Present-day releases are different from earlier re-stocking in two respects:

a. numbers are likely to be about 100 times greater (hundreds of thousands or millions rather than the earlier recorded thousands or tens of thousands);
b. the released fish are selected farm stock rather than wild fish from another system.

9.9 The present threat therefore relates both to the scale of releases/escapes and the type of fish being released. As farming proceeds, the type of fish escaping or being released will be less and less like the native stock, due to selective breeding of the farm stock to suit the needs of the industry. It is feared that such large scale inputs of unfit fish could obliterate the wild stock in a river by causing a short-term but critical over-competition for resources.

9.10 Recent legislation in Norway (where these issues are of great concern) has created an embargo on the transfer of stock from one river system to another and has prohibited the large scale release of smolts.

RECOMMENDATIONS

9.11 Data available to date indicates a need for:

a. extreme caution in the way the fishfarming industry relates to the management of wild fisheries;
b. further research to investigate this threat to an important natural resource.

9.12 Fishfarmers and freshwater fishery managers should review their activities and develop codes of conduct before irreparable damage is done.

9.13 Government should consider legislation to protect native salmon stocks from this threat.

9.14 Consideration should be given to the twinning of fishfarms with specific wild stocks, for their mutual advantage.

10 OTHER IMPACTS ON WILD SALMON

IN THE SEA

10.1 Caged stock are very susceptible to parasite and disease infestation, against which fishfarmers treat regularly with drugs and other products. Their experience and awareness of this problem is illustrated by their extreme concern at proposals to place other farms in their vicinity. Indeed, disease risk and the maintenance of a safe separation distance to reduce this risk form the main constraints on fish farm densities and have led to whole sea-lochs being allocated to single concerns.

10.2 Wild native fish in the same surrounding waters are not protected against the higher levels of infection-sources, and there is no record of their fate. Although they are possibly less susceptible than farmed fish which are subject to crowding and stress, infection rates in wild salmon will undoubtedly be raised by the existence of fishfarms in the waters which they traverse. This problem deserves careful investigation especially in relation to important salmon rivers. The reported dumping of diseased stock at sea (see Section 14) could increase the transmission of disease to wild and domestic stock.

IN FRESH-WATER (SMOLT-REARING)

Disease and Parasites

10.3 Freshwater operations must act as powerful sources of infection to native wild fish in the same way as in the sea. Again, fishfarmers bear this out by resisting any introduction of farming operations upstream of their own.

10.4 The Atlantic Salmon Trust has recently drawn attention to problems in Norway relating to infestations of an ecto-parasitic fluke (Gyrodactylus salaris) spreading from farmed fish parr to wild stock with the result that native stocks of salmon have been almost wiped out in affected river systems. Dolmen, (1987) reports that in the last decade it has been necessary to remove the entire wild salmon stocks of certain rivers with chemical treatment or barriers in order to eradicate the parasite and re-stock with un-infected salmon. Infections appear to have arisen from the poorly controlled import of infected stock from other areas; the parasite is now known from 28 different watercourses and eleven hatcheries in Norway.

10.5 We are pleased to note that DAFS has made this parasite notifiable under the disease control provisions of the Diseases of Fish Act 1937, in February 1988.

Veterinary Treatments

10.6 The wider impact of hormones, antibiotics and disinfectants - such as malachite green and formaldehyde - depends on husbandry methods which are not at present controlled by any code of practice within the industry. The effluent load to the water body will depend on whether treatments to different tanks or cages are sequential or simultaneous, but in either case the levels of pollution from these sources are neither monitored nor assessed for impact. The Highland River Purification Board make special mention of this anxiety in their policy statement on fishfarms.

Nutrient Enrichment

10.7 This takes the form of soluble nitrogenous compounds and insoluble compounds of carbon which may in the case of tank farms be settled out in special ponds before the effluent liquor is returned to the water body. This pollution has an unknown effect on wild salmon traversing these reaches to or from the sea.

Olfactory Cues

10.8 There is strong evidence to suggest that the same effluent from very large populations of enclosed non-native hatchery fish will contain misleading olfactory cues for returning salmon which rely (Nordeng, 1977) on specific substances (pheromones) released by fry and descending smolts of their own population, and that homing of mature salmon and grilse will thus be impeded. Again, the severity of this impact has not been studied.

Conflicts of Interest

10.9 Where smolt farms are established on water bodies containing populations of wild native salmon, the interests of the fishfarmer conflict with those of the fishermen, both in freshwater and in the sea. As described above, the wild salmon may be affected by competition, genetic mixing, disruption of pheromone cues, by pollution from veterinary products, and nutrient enrichment, and by parasites and pathogens. All of these may significantly reduce their fitness and therefore reproductive success.

10.10 Conversely, it is clear that smolt farms will suffer infection of parasites and pathogens from wild salmon upstream which will have been exposed to effluent bearing relatively high levels of infection from the fishfarm itself on their way up-river. Smolt farms established on watercourses without native salmon stocks tend to have very much lower incidence of pathogens. We are alarmed by the implications of this in the smolt farmer's attitude towards native stocks.

10.11 As a netsman in Wester Ross (W Muir, pers comm) has suggested, growth of this problem would be reduced by encouraging (perhaps through franchise schemes) future smolt rearing to take place only on water bodies which do not support salmon or flow into other freshwater bodies supporting their own native salmon stocks. This has implications of scale - smaller rivers and streams would only support small units - but this is entirely consistent with the economic, social and ecological desirability of forms of the industry which can be pursued at a scale relating to existing land-use and settlement patterns.

RECOMMENDATIONS

10.12 Insufficient knowledge of these impacts should be remedied by research along the following lines:

a. Incidence of parasite and pathogen transfer between farmed and wild stocks in both sea water and freshwater, especially in the light of Norwegian experience;

b. Effects of pollution from smolt farms (and trout farms) on the migration of salmon;

c. Measures to increase the efficiency, and therefore reduce the environmental load, of chemical treatments in freshwater smolt farms;

d. Effects of the secretion of olfactory cues from large numbers of farmed stock on homing of native salmon.

10.13 Powers and resources of the River Purification Boards should be strengthened and increased to monitor and enforce improved controls where necessary.

10.14 The policy to allow further smolt farming on watercourses which have native stocks of salmon should be urgently reviewed. Emphasis should be placed instead on the potential for small smolt units on watercourses without native salmon stocks, perhaps through franchising arrangements with crofters and others.

10.15 Strategies for smolt farming should be considered within the Structure Plan reviews undertaken by Planning Authorities to take Recommendation 10.14 (above) into account.

11 PREDATOR SPECIES AND CONTROL METHODS

11.1 Wild birds and mammals which are natural predators of fish and shellfish are attracted to fishfarms as a source of food. Species include:

a. On salmon farms — heron, cormorant, shag, common seal, grey seal, otter and mink

b. On mussel farms — eider.

11.2 The scale of damage caused by these species varies according to factors in the planning of the enterprise such as site selection and cage design. Methods used to reduce day-to-day damage by wild predators include protection of the cages with netting, deterrence by visual or acoustic scaring and destruction by shooting, trapping, poisoning and tangling (drowning). Active predator scaring and destruction have excited much public concern.

PREDATOR CONTROL AROUND SALMON FARMS

11.3 The following summary is based on the results of a survey of predator control at marine fishfarms in Scotland carried out during 1987 by the Marine Conservation Society (Ross, in press). This work was based on detailed questionnaires completed by fishfarmers and followed up by interviews on site. Responses were received from one-third of marine salmon farms in Scotland. This report, which is due to be published in March 1988, should be consulted for a full version of the results and conclusions. It represents the most comprehensive survey of bird and mammal predators at marine fishfarms carried out to date.

11.4 Over 80% of fishfarms surveyed claimed to suffer damage from seals, approximately 50% from herons, cormorants and shags, 20% from mink and 10% from otters. The scale of damage can be considerable, but is usually regarded as minor in relation to disease. However, the impact of predation on the incidence of disease, through stress, injury and disease transmission has not been assessed.

11.5 The high reported incidence of loss and damage shows that predator control is rarely fully successful, although performance varies widely from farm to farm.

Means of Control

Nets

11.6 Nearly all salmon farms use protective top nets, and most also use underwater nets enclosing the cage itself. Installation of these nets is not on its own sufficient protection against predators. Indeed there are examples of top-net installations which increase the risk of predation by herons. Effectiveness of nets depends on:

a. care in selecting an appropriate net type, and deployment to suit the features of the site (water current, exposure, predator problems, cage design and layout, husbandry practices);
b. commitment of operator time and energy to proper care and maintenance of predator nets, especially in regular cleaning to remove algae and mussels. The allocation of resources to this will need to be increased with the trend to larger cages.

Scaring

11.7 Various scaring techniques are used at about 30% of marine salmon farms, most being effective only in the short term. Even results with the acoustic seal scarer, which has been the subject of much research, are reported to be very variable. General harassment of predatory species, and displacement from the farm locality is common practice and may be extended to an area of several miles around the site. In some cases this represents the main part of predator control policy.

Shooting

11.8 Ross's survey shows that this occurs at many farms, usually because passive forms of predator control fail. 64% of respondents claimed to shoot seals (grey and common - few operators could distinguish the species). Otters are undoubtedly shot at certain farms, but the scale has been difficult to quantify. Of the birds, shags are shot most (probably because they are less timid), followed by cormorants and herons.

Trapping

11.9 Trapping is not widely used; the main target is mink. The use of legally accepted trap designs on mink appears to be the only suitable means of control. However there is evidence of illegal use of gin traps and snares, and trapping and even poisoning are known to be aimed also at otters in certain cases. There is also evidence of confusion between otters and mink in field identification.

Entanglement

11.10 Incidental entanglement and drowning of predators in nets is widespread. This is usually regarded as inconvenient and undesirable, but some operators deploy nets deliberately in such a way as to increase entangling in order to control predators.

Impacts on Predator Populations

11.11 Inadequate physical protection by nets can lead therefore to widespread shooting, scaring, trapping and disturbance of predatory species in the neighbourhood of fishfarms. The impact of this activity on local populations has not been assessed, but is likely to be considerable in some locations. A more accurate analysis of impact requires further knowledge of the scale of anti-predator activities and detailed figures on the status and distribution of predator species. For example, impact on regional

populations of the common seal is not known since existing data on status and distribution of this species are very approximate and out of date. Counts were last reported by the Natural Environment Research Council (NERC Reports, 1974, 1980). Too often problems are not foreseen when a fishfarm is proposed in a particular site, proper preventative measures are not taken, and unnecessarily destructive measures are then used in an attempt to reduce the damage to caged fish.

SHELLFISH FARMS

11.12 The great majority of predator problems are caused by eiders at mussel farms. Between March 1983 and March 1986 a detailed study of this problem was carried out by Milne and Galbraith (1986). This study considered the numbers, movements, attendance and behaviour of eiders at a selection of study sites on the west coast. An assessment of the type and extent of damage was made and various protection and scaring methods were tested at different types of farm.

11.13 The study established that the predation of mussels by eider can be considerable. At unprotected farms losses could be as high as 2.7 kg of mussels per bird per day, although only a proportion of these are consumed by the birds, many falling to the sea-bed during the feeding attempts.

11.14 Four ways of controlling such predation were considered:

Reducing Bird Numbers

a. With a high population of eider widely scattered throughout the west coast and the island groups, a large scale cull is clearly impractical. This study also demonstrated that local culling would be ineffective because of the change-over of birds that takes place at sites, particularly during spring and autumn, sometimes over short periods of time.

Excluding Birds

b. Physical protection for long-line mussel farms was found to be more difficult than for rafts. Protection can be achieved in the long term most effectively by the provision of hanging nets, but this must be backed up by effective localised scaring.

Deterring Birds

c. Shooting (to scare) and chasing by boat, appear to be the most effective ways of deterring eider.

Modifying Farm Design

d. A farm can be modified to reduce predator problems by concentrating the number of ropes in a given area to enable physical protection on a cost-effective basis. For long-line farms this has been achieved by using small bays with netting across the seaward side of the bay. Farms with unprotected long-lines can expect a high level of damage to stocks.

11.15 We find it very disappointing that despite the submission of this report to DAFS and HIDB in March 1986 the information and practical advice contained in it does not appear to have been widely disseminated.

11.16 Applications for long-line mussel farms with no protective measures are still coming forward for areas with high eider populations. We believe that the potential for conflict between birds and shellfish farms could be substantially reduced by the provision of guidelines on suitable design and operation.

PREDATOR CONTROL AND THE LAW

11.17 The destruction of predatory mammals and birds is governed by the provisions of the Conservation of Seals Act 1970 and the Wildlife and Countryside Act 1981. These give DAFS discretionary powers to grant licences for the shooting of certain species where this is deemed necessary for the purposes of preventing serious agricultural or fisheries damage.

DAFS POLICY

11.18 Under present policy, a small number of licences are granted for the shooting of seals during the limited close season when they are otherwise protected, but none are granted for the shooting of birds on marine sites. Although some returns are made of shooting under licence, the resulting figures do not represent the full situation. Thus there is neither adequate control nor record of shooting activities. Indeed the laxity of the system encourages fishfarmers to take their own initiative and tackle the predator problem by destruction rather than prevention.

11.19 This destruction is unlikely to be effective in reducing predation for the following reasons:

a. Removal of individual birds/mammals will merely lead to re-occupation of the area by other individuals from nearby;
b. The principal predators are widespread in their distribution and highly mobile;
c. It does not resolve the primary cause of predator presence - available access to abundant food supply.

Prevention is far better than an ineffective cure.

RECOMMENDATIONS

11.20 The industry should be encouraged to adopt an approach which is based on:

a. avoidance of predator problems through adequate survey at the planning stage;
b. prevention of predation by adequate design and management.

Both of these principles should be enforced by the regulating authorities.

11.21 Immediate arrangements should be made for the provision of detailed guidelines and advice to fishfarmers on all matters relating to predator control, based on current knowledge and updated in the light of research.

11.22 Research is urgently required in three areas:

a. Improvement of predator control through:
  i) Investigation of modes of predator attack (especially grey seal, common seal and mink) in relation to cage design and fish behaviour;
  ii) Improved design of cages, predator nets, deployment of nets (including the use of weights), mesh sizes, etc (in conjunction with the manufacturing industry);

iii) Resolution of problems associated with predator nets - water flow reduction, increased drag, net fouling, tangling etc.

b. The impact of fishfarming on populations of wildlife, especially predatory species, and vice-versa, including;

i) Detailed survey on status and distribution of main predatory species, including seasonal changes and breeding sites, to provide essential information for the selection of suitable sites for fishfarming.

ii) The role of predators in disease transmission, through direct contact or indirectly through faeces, or resulting from reduced resistance due to injuries and stress.

11.23 Improved measures for predator control should include training in these methods and in the accurate identification of predator species (especially eg grey seal/common seal, otter/mink, shag/cormorant).

11.24 Steps should be taken to learn from European experience in predator control.

11.25 Legislation on the destruction of predatory species must be reviewed, strengthened and enforced. Details of predator destruction licences should be publicly available.

OTTERS

11.26 Scottish otters form one of the two most significant populations in Europe and also the most thoroughly researched. Otters are common in the Highlands and Islands (Green and Green, 1980; 1987), especially in the sea lochs which are the focus of fishfarm developments. Otters and their holts are protected in law; the latter from disturbance as well as destruction (Wildlife and Countryside Act 1981).

11.27 Otter cubs develop slowly, dispersing at about 12 months, and natural mortality of young cubs appears to be quite high. Litters are small and recruitment is slow. Otter populations worldwide have shown themselves capable of rapid decline, but not of rapid recovery.

Impacts

11.28 Impacts of fishfarms on otters comprise direct and indirect effects, summarised below. Individual factors may interact to produce further change.

Predator Control

11.29 Artificially crowded, vulnerable prey forms a strong attractant which must be efficiently protected. Safeguarding caged fish against otters should not be a problem but protecting shore-based stock may involve greater cost. Unlicensed killing of otters occurs at present and live-trapping has been postulated as an authorised alternative. Neither would be a long-term solution and both could deplete local populations since other animals would be sure to move into any spaces left by destruction or removal.

Disturbance

11.30 This may be direct (eg shore base situated by an active holt or cages placed over favoured feeding grounds) or indirect (eg noise, lights,

guard dogs, boat and road traffic). Disturbance by fishfarms continues throughout the year, unlike tourist-related disturbance, and may affect a far wider area than that occupied by cages or conferred by lease. There is much concern about effects of fishfarms on otters but little hard evidence has been gathered to date (see also Section 11.37).

Pollution and Feed Waste

11.31 Several pollutants (PCBs, heavy metals and organochlorines) are held responsible for the post-war crash in the European population, and as a top predator the otter is likely to accumulate chemical pollutants. Availability of waste food may attract other species of fish below and around cages. This may draw in a range of predators, which (whilst not taking caged fish) may, by being more noticeable, heighten sensitivities about all predators, including otters.

Other Environmental Changes

11.32 The principal concern here is the increased casualty rate resulting from improved roads and increased road traffic, adding to what is already the largest single cause of non-natural otter mortality in Scotland.

RECOMMENDATIONS

11.33 The impact of fishfarming on otters must be assessed in terms of:

a. the significance of the Scottish otter population in national and international terms;

b. the needs of individual animals in terms of protection from disturbance and habitat damage.

11.34 Undeveloped coastlines should be retained for otter conservation to protect habitat and to provide a basis for comparison with the effects of development (see Recommendation 19.28).

11.35 A radio-tracking study should be undertaken on the interactions between otters and fishfarms.

11.36 Further work is required to refine otter population monitoring techniques.

DISTURBANCE TO OTHER WILDLIFE

11.37 Deliberate and sometimes wide-ranging disturbance of predator species, whether or not the individual animals are implicated in causing losses, is an activity which deserves careful scrutiny in terms of its effectiveness as a form of control. This activity is combined with other widespread forms of unnecessary noise pollution (high volume use of 'ghetto blasters' for entertainment at work on rafts, high speed motoring in boats between shore and cages etc) in affecting other sensitive species.

RECOMMENDATION

11.38 Development of and training in environmentally sensitive working practices should be undertaken, in acknowledgement of the extreme quality and value of this environment (see Recommendation 21.7 d.).

12 IMPACT ON SEA FISH STOCKS

12.1 We review here the impact of the aquaculture industry on the sea fish stocks upon which this industry relies as a source of feed components.

FISH FEED PRODUCTION

12.2 In a survey by the Marine Conservation Society of the impact of the Scottish finfish aquaculture industry on wild fish stocks, Bishop (1987) calculates that the forecast 1987 production of 16,000 tonnes of salmon would require at least 20,000t of feed, comprising 55% fish meal (plus fish oil, blood meal, soya bean meal, dextrinised starch, vitamins, minerals and binder).

12.3 Adding this to the feed requirements for the UK trout industry (over 16,000t), UK aquaculture would have used 21,000t of fish meal in 1987 (derived from 100,000t of raw fish). This however only comprises 7% of the combined total of 296,000t of fishmeal used in agriculture and aquaculture, of which 76% (225,000t) is imported. The remaining 24% (71,000t) is produced in the UK from a catch weight of 350,000t of raw fish.

COMPONENTS OF FISH FEED

12.4 A variable proportion of fishmeal is a by-product of the whitefish industry (offal, undersized fish and filleting waste). Other components are the 'industrial' species caught with small mesh trawls - sand-eels, Norway pout, sprat and capelin - along with herring and mackerel offal.

12.5 The latter source showed a 44% decline in the period 1974-85 and it is not clear how future feed requirements of a continued growth in fishfarming (see Section 2) will be met, except by importing an increased proportion of feed components. Some growth within existing supplies of fishmeal could be accommodated by:

a. a more efficient use of feed;
b. improved manufacture to give better food conversion ratios (FCRs);
c. use of alternative protein sources (eg soya).

CONCERNS

12.6 Fishfarming converts large quantities of low-price fish and fish by-products into relatively small quantities of high-price food, expending much energy in fishing effort, processing, compounding and transport. Although as a form of food production it is relatively wasteful of energy, fishfarming is justified economically by the high market value of Scotch salmon, and the willingness of the market to accept farmed salmon as the 'real thing'.

12.7 Use of fishmeal in feeds for fishfarms is only a small component of UK exploitation of 'industrial' fish stocks and is therefore only a part of the demand. However there is cause for concern that increased pressure on industrial species will have effects not so far properly understood. In particular, it is feared that further exploitation of the sand-eel fishery to meet industrial requirements will lead to further decline in this fish which is an important food source for sea birds. Reference should be made here to the predicted increase in salmon production (and therefore in feed requirements) by 1991 (see Fig 1).

12.8 The sand-eel fishery is not limited by mesh size regulations, although in order to conserve stocks of this species a limit has recently been announced by the organisations which represent fishmeal factories and fishermen in Shetland. The effects of this fishery on sea birds, and other factors affecting sand-eel availability, are being studied by researchers at Glasgow University.

RECOMMENDATIONS

12.9 Feed production, its components and their origins, should be monitored with assessment of the impacts of this on marine ecosystems around Britain and on exploited ecosystems (including soya-growing lands) overseas.

12.10 There should be continued monitoring of coastal industrial fisheries and their impact on sea bird populations.

13 LANDSCAPE, TOURISM AND RECREATION

GENERAL

13.1 In much of the West Highlands and Western and Northern Isles, the quality of the scenery is counted as a major natural asset of national and international importance. In addition to its importance to the quality of life for local residents, the scenery contributes significantly through tourism to the local and national economy. It is therefore important to ensure that benefits of fishfarming are not achieved at the expense of the landscape, since this would involve damage to an important asset and an economic loss.

Conflicts of Interest

13.2 We are not aware of any analysis of the relationship between fishfarming and tourism; indeed it is doubtful whether it can be separated from other factors and analysed in the short term, and this alone is good cause for caution. Tourism is dependent on abstract things such as 'reputation' which itself may be influenced by a wide range of factors such as the welcome and the weather, as well as the views.

13.3 Concern has been expressed by tour operators and hoteliers regarding the damage to tourism and property values as a result of the effect on landscape of fishfarms.

13.4 The impact on tourist-related interests is possibly most direct in the case of developments intruding on views which form an important part of the attraction of a particular guest house or hotel. One proprietor received 90 letters of support from his clients for his objection to a development near to his guest house (Scottish Scenic Trust, pers comm). Such a stance of open opposition is rare, despite the strong feelings often revealed in private conversation. Residents of small communities are seldom keen to expose such feelings to open debate.

13.5 The potential threat to a major earning industry should not be lightly dismissed. According to Scottish Tourist Board publicity material, tourism

is worth £1500 million annually, and supports 100,000 jobs in Scotland. Many of those who stop and spend money in the south and east of Scotland are on their way to the north and west. Scottish Tourist Board market research consistently shows "unspoilt scenery and peace and quiet" as a principal reason why visitors are attracted to Scotland. Visits to coasts and lochsides are also identified as the most popular activities of tourists in rural areas.

13.6 Tourist-related recreational interests such as walking, sailing, canoeing, birdwatching and field studies have in certain cases been adversely affected by insensitive fishfarming developments. Again, the severity of the impact is difficult to gauge and we are concerned that this has not been the result of any survey or research. (For effects on navigation see Section 15).

THE IMPACT OF CURRENT PRACTICES

13.7 The colour, geometric shape and visibility of cages attracts the observer's attention and these factors can be intensified by the light conditions and background against which cages are viewed. In many areas red and orange nets or buoys are used and these bright colours do not blend with the natural colours of the loch, loch shore or surrounding landscape. Other structures such as feed hoppers and feed storage huts are clearly visible, especially in silhouette, from some distance, due to their height above the water and the colours frequently used.

13.8 Landscapes vary in their capacity to accommodate fishfarms and this fact must be appreciated at the farm design stage. This would ensure that the presence of the farm in the landscape did not alter the character of that landscape.

13.9 Sites required for cage and net maintenance frequently display a disregard for landscape and are kept in an untidy condition with nets, polystyrene blocks, oxygen cylinders and bags of feed, as well as general rubbish, presenting an eyesore to the public. In many cases the sheer size of the operation makes it impossible for sites not to intrude into the landscape.

13.10 These impacts of fishfarms on the scenery have been studied by Cobham Resource Consultants (CRC, 1987) under contract to CCS, CEC, HIDB and SSGA, with useful recommendations for improvement in the siting, design and management of individual fishfarms to reduce their visible impact on the landscape.

WILD LANDSCAPES

13.11 Whilst the CRC recommendations - if implemented - will serve to reduce the visible impact of a given development, they will not alter to any significant extent the wider impact of fishfarming on the quality of the landscape and its appreciation. The CRC study identified in particular three issues of special concern:

a. the acceptability of major fishfarm developments in open landscapes;
b. the cumulative landscape effects of numerous fishfarm developments;
c. the loss of wilderness character in areas of undeveloped landscape.

13.12 We emphasise - as CRC did not - that concepts of 'wild landscape' and 'wilderness character' are complex, even indefinable, phenomena which

go very much deeper than matters of 'visual impact'. They are central to the quality which is recognised internationally to be of such high value. The appreciation of wild landscape is affected by all intrusions which disturb the component wildlife (eg predator scaring), introduce technological noise (eg motor boats, radios and road traffic), give rise to litter accumulation (eg polystyrene from damaged floats) or even lead to unpleasant associations in the public mind (eg with harmful chemicals like TBT).

13.13 It is of course important everywhere, especially in tourist areas, to undertake such cosmetic improvements as are possible, but it should be clearly understood that where real wilderness character is still intact, its conservation deserves a very high priority in decisions relating to developments of any kind.

POSITIVE PROVISIONS

13.14 CRC identified possibilities for positive recreational provision, including shared slipways, and 'interpretive provisions', noting that many of the conflicts between tourists (especially water-borne) and fishfarmers would be obviated if the industry made more effort to inform the onlooker.

RECOMMENDATIONS

13.15 A survey is required of tourist interactions with fishfarming in different landscapes and in different areas of tourist activity, for the improvement of development control policies.

13.16 Proper consideration should be given to landscape conservation through the protection of whole landscapes, bearing in mind their importance as a national asset and the vulnerability of their special quality (see Section 20).

13.17 Cobham Resource Consultants' recommendations relating to siting, design and management should be implemented as a condition of lease (insofar as they are consistent with the requirements of predator control etc).

14 WASTE DISPOSAL AND LITTER

DEAD FISH

14.1 According to the National Farmers' Union of Scotland's 'Code of Recommendation for the Husbandry and Welfare of Farmed Fish', disposal of dead fish (diseased or damaged) should be by means of burial in a caustic pit or burning. However, there remain disturbing reports of dumping at sea, where dead fish are frequently netted by fishermen, or even open disposal on land where decomposition causes unnecessary offence. They may also be a source of disease infection affecting other fishery and fishfarming interests (See Section 10.2). Some companies are understood to have started disposing of dead fish by means of storage in tanks for collection by a waste disposal firm. There are also developments in the use of macerating units to convert dead fish into 'silage'.

DISUSED NETS

14.2 There are examples of disposal of badly fouled or damaged nets by dumping at sea (in one case about 40 nets over a period of two years - Ross, pers comm). This is a potential source of nuisance and danger.

POLYSTYRENE

14.3 This material is used widely in the manufacture of floats, marker buoys and and other flotation products, but in certain conditions relating to age or heavy wear the adhesive breaks down and indestructible expanded polystyrene granules are carried by wind and water to places where they accumulate to become a major litter problem.

RECOMMENDATIONS

14.4 Urgent action should be taken by the industry to control these problems by establishment and internal enforcement of codes of practice.

14.5 Research into appropriate design standards for flotation products for various applications in the fishfarming situation should be carried out if necessary.

14.6 Conditions of sea-bed lease agreements should include compliance with the industry's recommendations for good practice.

14.7 Adequate monitoring should be undertaken by control authorities, with sanctions against offenders.

15 NAVIGATIONAL CONSIDERATIONS AND INTERESTS OF OTHER WATER USERS

15.1 The mooring of cages in the sea interferes necessarily with the free passage of craft in that area. This is a subject of concern to yachtsmen who have hitherto enjoyed free passage, almost without restriction, in Scottish coastal waters.

15.2 However it is of greater concern where the cages obstruct a safe anchorage which may be sought in adverse conditions by leisure and fishing craft. The problem may be greater than at first appears, since cages are seldom lit and are moved from time to time to avoid undue build up of detritus below the cage. Also, this detritus itself becomes a hazard by reducing the anchor-holding potential of the sea-bed, with the result that yachtsmen and fishermen fear to anchor for risk collision with cages, causing damage for which they would be liable.

YACHTING

15.3 Cruising yachtsmen are looking particularly for safe passage and sheltered anchorages in what is recognised to be one of the finest and most beautiful cruising grounds in Europe. It is estimated that 15-20% of the best anchorages on the west coast are now out of use due to fishfarm installations. Assuming that the continuing rate of expansion in

sailing and fishfarming is maintained, any surplus of anchorages will soon disappear.

15.4 The traditional access to open water for boat owners and sailing club operators has been impeded by fishfarm developments through the siting of cages and the establishment of permanent anchorages for work boats. This situation is known to be particularly acute in some west coast lochs.

FISHING

15.5 From discussion with fishing interests including the Scottish Fishermen's Federation and the Federation of Highlands and Islands Fishermen, it is clear that there is considerable unrest concerning the following aspects of navigation:

a. the obstruction of fishing grounds, either by the cages themselves or by detritus which smothers the benthos;
b. obstruction of safe anchorages;
c. lack of marking and lighting of structures;
d. lack of recording of fishfarms on Admiralty charts.

SALMON NETTING

15.6 Interactions between salmon farming and the interests of wild salmon were discussed in Sections 9 and 10. It is also claimed by netsmen that the installation of cages interferes with the traditional exploitation of these wild stocks in certain areas by obstruction of netting sites or of the normal passage of wild fish along the coastline.

SHELLFISH FARMING

15.7 Salmon farming is in direct competition with shellfish farms for certain sites, calling into question the policy in sea-bed lease allocation, some aspects of which are considered in following sections.

RESPONSIBILITIES

15.8 Navigation aspects are considered for each sea-bed lease application in a complex consultation between CEC, DAFS and Department of Transport, involving also the Clyde Cruising Club, H M Coastguard, Local Harbour Authorities and the Northern Lighthouse Board (NLB) which is charged with the responsibility to monitor and enforce compliance with the resulting conditions.

CONCERNS

15.9 In practice NLB does not have the resources to carry out these duties, so most cages remain unmarked and unlit. These problems are compounded by the lack of charting, since although a decision has now been made to identify fishfarm sites with a special symbol on Admiralty charts, there is a severe up-dating problem where new leases are frequently being allocated, and the exact position of the cages could vary within the area of the lease, which will not be defined.

RECOMMENDATIONS

15.10 Improved consideration of conflicts with other users should include an open process of assessment, including access for:

a. fishing;
b. sailing;
c. safe anchorage;
d. salmon netting interests.

15.11 In view of the tradition of open access to inshore waters, information should be openly available on:

a. existing sea-bed lease areas (in map form);
b. numbers of cages permitted under lease conditions;
c. date of allocation and expiry of lease;
d. all changes in these details as applied.

15.12 Greater resources should be allocated to NLB to monitor and enforce marking and lighting requirements for the purposes of navigational safety.

16 SOCIAL CONSIDERATIONS

16.1 Clearly, in any assessment of the balance of interests, social benefits are critical - especially in such an area of severe economic stress. Yet we believe that this subject deserves more careful scrutiny than we have observed so far, since the same communities which stand to gain from a prosperous industry would be the tragic losers in the event of failure through mismanagement at company, industry or government level.

16.2 Sustained prosperity based on a natural resource of this kind depends on successful integration of economic goals with social and environmental priorities at all levels.

16.3 This alone is sufficient argument for an integrated planning approach, which is discussed below (PART III). It is also a good reason for caution in the current vogue of unquestioning applause for 'jobs', particularly where in the long term there may be damage to other interests such as inshore fishing which could result in more jobs being lost than gained. Moreover, in such areas a subsequent decision to close a fishfarm for economic reasons could reduce local prosperity to a level below that which existed before the farm was set up.

16.4 We support those who call for an explicit policy to favour a structure to the industry which matches the pattern of land-use and livelihoods in the north and west, for two reasons:

a. because certain types of fishfarming enterprise present ideal opportunities for strengthening the cherished but threatened way of life of these areas;
b. because this way of life is well-adapted to its environment and maintains a valid formula for balanced land-use; small scale, labour-oriented, and usually comprising a variety of part-time occupations.

COMPANY SIZE

16.5 We acknowledge the clear and valuable role of the multi-national companies in sponsoring and spearheading the development of the industry. Their investment in research and development has overcome many technical and biological problems which would otherwise have been a barrier to progress. Also, they have the resources to overcome short-term setbacks and to undertake training of personnel, many of whom have progressed to develop their own enterprises.

16.6 However, we advocate against domination by multi-national companies due to a number of adverse implications in ecological and social terms. A variety of factors tend to distinguish the motivations, policies and practices of large commercial operations from those of small-scale owner/operator enterprises, as follows:

a. Investment is transferable, and allocated internationally according to existing and potential profit levels;
b. Changes may be made which relate more to new opportunities elsewhere than to any failures in the existing pattern of investments;
c. Commitment to long-term social benefits in the employed community is often low since labour is just one of the exploitable resources in such an economic framework and labour reduction is a prime area for profit maximisation;
d. There is therefore no preference given to <u>local</u> labour for investment in training;
e. We understand (eg article in TGWU magazine, 'Landworker', Jan 1988) that rates of pay are low and other provisions (eg Health and Safety) are often below normal requirements;
f. The majority of profits are usually exported from the area.

16.7 It is therefore the **balance** between large and small companies, and indeed in the allocation of limited resources (sites, grants etc) between the salmon farming and shellfish farming sectors, which is vitally important if the industry is to provide the benefits whose potential is widely recognised.

16.8 We are concerned that with the wrong policies on this issue, fishfarming may only add to the economic and other threats facing small highland and island communities. Economies of scale and new technology already threaten widespread change. Examples from the specialist press include:

a. the development of more seaworthy cages;
b. seaward servicing without the need for nearby shore stations;
c. barge systems advertised with claims of "only two employees" producing 250 tonnes per year;
d. fully automated and centralised feeding systems claiming to reduce labour time for fish feeding on the average farm from 80% of two men's time to 20% of one man's time.

HIDB

16.9 Some recognition of the above factors and the desirability of a balance (though not defined) between large and small operators is evident in HIDB's policy - since mid 1985 - of preferring small operators in their allocation of grants. However, this is not a sufficient means of guaranteeing appropriate balance, especially since:

a. fishfarming activity of any kind is dependent on the granting of a sea-bed lease by Crown Estate Commissioners;
b. the allocation of sea-bed leases is made on a 'first come, first served' basis, with no preference for small operators;
c. the rapid and widespread uptake of sites by the most ambitious companies has led to the rapid depletion of suitable sites for local enterprises;
d. information about the extent of existing leases - and therefore about unleased areas - is not readily available for the benefit of local operators (see Section 18.13).

16.10 Many communities feel very hard done-by in the rapid uptake of available sites by large outside concerns which have the resources to keep well-informed and to place a large number of exploratory applications. Also, they consider - in our view rightly - that they should be consulted preferentially on any proposal to develop a fishfarm in their vicinity.

16.11 Likewise, we have met strong feelings regarding the acclaim for current policies based on job creation figures alone. It is widely felt that more consideration should be given to the potential in fishfarming for supporting existing livelihoods in fragile areas, as this is at least as important - often more so - in sustaining traditional communities.

16.12 Accordingly, we are concerned that the second part of HIDB's remit - "to enable the Highlands and Islands to play a more effective part in the economic and social development of the nation" - should not be interpreted to mean the opening up of natural resources for outside exploitation which infringes in any way on the first part of the remit - "to assist the people of the Highlands and Islands to improve their economic and social conditions".

RECOMMENDATIONS

16.13 In consultation with the affected communities themselves, guidelines to a structure of the industry should be identified (large vs small and salmon vs shellfish) which balance the economic imperatives of the industry with real long term benefits to these fragile communities.

16.14 Policies should be drawn up for sea-bed lease allocation to encourage and guide the development of such a structure, with the help of existing grant-aid measures. This may include a halt to the unhindered expansion of larger concerns where this militates against the interests of fragile communities. It should also take account of changes likely to follow technological improvements.

16.15 Means of measuring benefits to the local economy should be established in order to assist in the process of forward planning.

16.16 Measures for preferential consultation with local interests on any fishfarm proposal should be instituted.

16.17 Other policy options which specifically favour local interests should be assessed. Considerable scope for encouraging up-take of sea-bed leases for fishfarming by existing crofting, fishing and netting interests appears to remain unexplored.

16.18 HIDB's remit should be sensitively interpreted with particular reference to local needs.

16.19 Policies and their effects should be scrutinised to ensure that short-term benefits are not achieved at the expense of long-term balanced use of natural resources for the sustained prosperity of local people.

POSTSCRIPT TO PART II:

IMPACTS OF SHELLFISH FARMING VS SALMON FARMING

It is clear from the above review, forming PART II of this report, that salmon farming, relying on artificial feeding and sometimes intensive veterinary treatment, has a greater impact on the wider environment than the farming of shellfish which exploit naturally available food in the water and do not require medication. However, although a 'low input' system, shellfish farming may like salmon farming raise issues of conflict with other water uses, visual impact on the landscape, disturbance and predator control.

The smaller scale of the shellfish sector in relation to salmon means that at present its effects are of lesser general concern, although they require equally careful resolution in local terms.

PART III

STRATEGIC CONSIDERATIONS - CONTROLS, RESEARCH AND ADVICE

17 CONTROLS

17.1 The review in PART II is intended as a positive contribution to the process of identifying impacts and exploring options - a process which very properly accompanies the growth of any new industry. The aim should be to establish an appropriate framework of controls within which the industry may be allowed to flourish whilst benefiting the local economy and safeguarding the environment.

17.2 We assert that this is a critically important undertaking in view of:
a. the natural quality of the environment, itself the basis of the success of the salmon industry and of tourism;
b. the fragile character of the local economy and therefore community interests in these remote areas;
c. the prospects for continued growth of the industry.

17.3 We have outlined above the range of environmental and other issues which need to be considered and in some cases further researched. In this section, we review the existing control processes themselves and make proposals for improvement. Where changes are suggested, we believe these to be necessary in order to match the control process with the growing status of the industry.

OPERATIONAL CONTROLS

17.4 As a new industry, fishfarming is controlled to some extent at the operational level by existing legislation originally formulated to deal with other issues, whether in the control of certain types of pollution (see Section 8), the killing of predators (see Section 11) or the obstruction of navigation (see Section 15). In other areas such as in the use of certain chemicals, it remains uncontrolled except in principle by the conditions applied by the landlord (see Appendix 2 for CEC's relevant lease condition) or by voluntary codes of practice developed by the industry itself.

17.5 Whilst accepting the benefits of self-regulation, we believe this is not always possible, desirable or effective. We have therefore made proposals for this control to be strengthened and made more applicable to fishfarming in ways which we hope the industry itself would welcome - as support for the principles of good neighbourliness, care for the environment and quality of the product. However, such controls are only meaningful so long as compliance is monitored and enforced; the strengthening of statutory controls places this responsibility more firmly on the statutory authorities. Henceforth, we believe that the effectiveness of these controls should be open to public scrutiny.

17.6 The CRC report (1987) for CCS proposed methods of reducing visual impact. A report by the Institute of Aquaculture (1988) for NCC makes recommendations for reducing ecological impact. It is hoped that CCS and

NCC respectively will take steps to ensure that the recommendations in these reports are made available to fishfarmers in a readily useable form with the minimum of delay.

17.7 We shall be noting with interest the effectiveness of these purely advisory measures, in the hope that they will be followed by the industry and incorporated where possible in enforceable controls.

STRATEGIC GUIDANCE

17.8 A number of the points discussed in PART II of this report concern conflict with other interests which are not site-specific and therefore not amenable to control at the operational level. Various aspects of fishfarming itself, as well as community, fishery, tourist, recreational and wildlife interests, are sensitive to the number, type, size or even presence of fishfarming sites. It is important to assess issues such as where fishfarms should or should not be located, what size and type of farm, etc, in order to ensure the sustainability of both the fishfarming and the other affected interests.

17.9 We agree with CRC (1987) (page 98) that:

> "good practice in the siting, design and management of fishfarms will go a long way towards preventing and alleviating environmental problems. However" they add, **"public authorities also have important responsibilities for guiding development to those areas where there will be the optimum social and economic benefit and minimum environmental cost."** (Our emphasis)

17.10 Planning control does not apply to developments below Low Water Mark, and there are different interpretations as to whether on-shore developments relating to fishfarms (shore bases etc) are classified as agricultural and therefore exempt from planning control. CEC's consultation procedure therefore provides the only means at present available for reconciling these interests.

18 CROWN ESTATE COMMISSIONERS' CONSULTATION PROCEDURE

LEASES AND PROCEDURES

18.1 CEC leases give the right to occupy a stated portion of the sea-bed for a stated purpose and are valid for a stated period. Since the introduction of a new consultation procedure in October 1986, copies of applications for sea-bed leases (giving basic information such as location, species to be farmed and type of fishfarm) are circulated by CEC to all interested public bodies, nearby fishfarmers and a number of other interested parties. At the same time a formal notice is published in a local newspaper, indicating that a copy of the application can be seen at a local named post office or at the Crown Estate Office in Edinburgh.

18.2 In all cases, submission of comments to CEC is invited within 28 days. These are considered by CEC and a decision is made to:

a. grant a lease as applied for, or
b. grant a lease with adjustments, or

c. refuse to grant a lease, in which case the applicant has 14 days to "make representations".

18.3 Issue of a lease is dependent on appropriate navigational consents being obtained from the Department of Transport.

18.4 Leases are granted subject to certain conditions. Recently, these have been more tightly defined (eg areas leased, number of cages etc), the duration of new leases has been shortened (earlier leases were for 99 years), and development of the site must be undertaken within two years of the granting of lease.

18.5 CEC has appointed a planning adviser to manage these procedures and a part-time field officer is also employed on the west coast to monitor compliance with CEC's lease conditions and other requirements as landlord.

18.6 Within the overall policy of CEC as described in (see Section 3.1 to 3.4), the subject of fishfarming is discussed on page 11 of the Commissioners' report for the year ended 31 March 1987:

> "One of the attractions of fishfarming is that it can be successfully integrated with many other activities in coastal areas, but there are some conflicts which need to be foreseen and resolved. Under the new consultation procedures, we seek to strike a balance between development and conservation, allowing the industry to develop in a way wholly compatible with its uniquely beautiful surroundings and existing fishing and tourism."

18.7 We endorse these aims whole-heartedly, but we cannot agree with the First Commissioner, the Earl of Mansfield, who in the Foreword to the CEC report seriously underestimates the contentious status of these procedures when he refers to:

> "widespread support for the new procedures and the way in which they are being operated to take into account legitimate commercial aspirations whilst reconciling these with the protection of the environment and susceptibilities of local communities".

18.8 We report that the widespread feeling amongst those whose interests are affected is that the consultation procedures are a step in the right direction, being an improvement on the previous lack of consultation, but that they fall well short of establishing a fair and sensible system for achieving these aims.

18.9 CEC staff habitually proclaim the effectiveness of the consultation procedures with reference to the proportion of applications refused or altered, the length of the list of consultees, or a demonstration that the cages themselves occupy a small percentage of the Scottish coastline. With respect, we find these criteria inappropriate, particularly the latter. Earlier sections in PART II of this report show that chemical, genetic and disturbance effects may be very much more significant and widespread than visual impact.

18.10 Our view is that the effectiveness of the procedure should be judged by standards of even-handedness, exposure to public scrutiny, the

possibility of meaningful contribution from any interested party, as well as by results (eg how it balances multi-national and local interests).

SHORTCOMINGS OF CONSULTATION PROCEDURE

18.11 The current procedure has many shortcomings. These relate to the following:

a. Interested parties have difficulty in participating constructively and meaningfully in the consultation process;
b. The Commissioners are appointed by the Crown and their procedures are not subject to democratic control;
c. There is no framework of policy to guide interested parties as to what may or may not be approved by CEC.

These aspects are considered in turn below.

Participation by Interested Parties

Lack of Response

18.12 Reference back to the consultee for further details or discussion of conflicting advice is very rare, despite the necessarily technical nature of some of the submissions.

Inadequate Information

18.13 The information supplied by the applicant is often insufficient to enable the consultee to judge the proposal and make a proper response. We have seen application forms completed with name and address and no more than 65 words supplying all the information required by CEC for the consultation process. (See 'Contrasts With Other Countries' below).

Unavailable Data

18.14 Certain other data (for example existing leases and lease areas in the vicinity) are not readily available from CEC due to ill-defined requirements of "commercial confidentiality".

Poor Publicity

18.15 Many complaints have related to the limited publicity given to applications for a sea-bed lease. These applications are advertised once in the appropriate local paper, referring to the availability of the application for inspection by interested parties at the nearest post office. Complaints have also been made regarding inappropriate post offices being selected by CEC for display of the application.

Inadequate Time for Response

18.16 Only 28 days are allowed from the date of the advertisement for the submission of comments. This is too short to allow the necessary site survey and secondary consultations.

Weak Imposition of Conditions

18.17 Consultees' comments, if accepted, are usually added to the grant of lease letter as advice, rather than incorporated in the conditions of lease.

Poor Resources

18.18 CEC is insufficiently resourced to enter detailed discussions, respond to detailed enquiries or monitor and enforce effective lease conditions.

18.19 The above shortcomings could be solved by reorganisation of the procedures and improved resourcing of CEC. However, other difficulties (below) are less simple.

Lack of Democratic Control

Sole arbiters

18.20 The decision regarding the granting of a lease, with or without conditions resulting from the responses of consultees, is made exclusively by CEC.

No public scrutiny

18.21 Under the Crown Estate Act (1961) transactions of the CEC are not open to question.

No appeal

18.22 There is no procedure of recourse for parties claiming a grievance or injustice on lease allocations.

18.23 These considerations lead us to join others in questioning whether CEC is the proper authority to be conducting this procedure. CEC is not a government department; it is almost by default that the Commission has become the main agent of government in the development of marine fishfarming. CEC was established by the Crown Estate Act (1961) as agent for the Crown's estate, not as an industrial development authority, planning authority or agent of the government's social or environmental policy. CEC was never intended or designed to supervise, control and monitor the establishment of an important new industry scattered along 4000 miles of remote Scottish coastline.

18.24 We also echo the severe concern widely expressed in relation to the conflict of interests exercised by CEC as both control authority and beneficiary of the rental income accruing from lease allocations.
We observe that this conflict of interests has severely damaged CEC's public image.

Lack of Policy Framework

No Public Policy

18.25 There is still no policy open to public scrutiny which takes into account the views of other legitimate interests in relation to principles of location, type, size, quantity, etc. CEC's recently published Guidelines offer operational guidance only.

No Forward Plan

18.26 Each sea-bed lease application is considered separately, without details of what has already been approved, where any limits may be set, or where certain types of development may be encouraged/discouraged.

Workload

18.27 Consideration of each separate application without the benefit of a policy and forward plan, places extra burdens on consultees, since lack of comment must be taken as approval of the application. The pace of development has now outstripped the ability of various bodies to meet consultation deadlines (28 days). Copies of over 250 applications (comprising only the barest information) have been sent out to CEC's consultees in the past year - certain voluntary bodies recently receiving

as many as thirteen in a single post.

CEC GUIDELINES ON SITING AND DESIGN OF MARINE FISHFARMS IN SCOTLAND

18.28 This document was published on 23rd December 1987. We were not consulted on the draft but we understood from CEC staff that, besides promoting the main conclusions of the CRC study (1987) on siting and design, this document was to propose strategic guidelines, taking account of wider interests including the "protection of the environment and the susceptibilities of local communities" to which the First Commissioner referred in the annual report. However, in the single page dealing with such considerations, (page 3), developers are urged to explore new areas where fishfarming is not yet established (ie remote areas), "despite the apparent disadvantages of such areas".

18.29 The guidelines identify the sheltered sea lochs of Argyll and the West Highlands as "Sensitive Areas", where special note should be taken of CEC's advice on siting and design. It goes on to identify ten "Very Sensitive Areas", based on "several reasons... such as outstanding landscape and conservation value, multiple other interests, a significant amount of existing fishfarming and limited space for expansion."

18.30 Thus Loch Sunart, with six separate salmon farms and extensive shellfish enterprises is designated as a Very Sensitive Area.

18.31 This document is vigorously promotion-oriented, as should be expected from an enterprising landlord, and would be acceptable as such if CEC were not also the control authority. **It fails to establish any strategic policy which takes wider environmental interests into account;** indeed it proposes further incursions into the few remaining sanctuaries.

18.32 The map shown on page 2 of the Guidelines is described on page 3 as showing the "existing pattern of fishfarming in Scotland" (December 1987). However, although CEC as landlord has the most up-to-date figures available anywhere, the figures used on this map are 15 months old and taken from DAFS and HIDB. Since September 1986 we estimate that over 280 new applications for sea-bed leases have been made, of which over 100 have been granted. At least one hundred dots should therefore be added to the Guidelines map to give the "existing pattern" in December 1987.
In August 1987 we requested and were promised up-to-date details of fishfarm numbers and distribution from CEC staff. At the time of going to press these had not yet been made available (Feb 1988).

CONTRASTS WITH OTHER COUNTRIES

18.33 CEC's Annual Report to 31 March 1987 states:

> "It has been found that our experience in planning for growth in a manner compatible with other interests is helpful also to other countries where fishfarming is developing on broadly similar systems of policies and constraints. We have had useful contact in this respect with British Columbia, Norway and Eire."

18.34 We note that a single application for a fishfarm in British Columbia requires submission of a lengthy and detailed environmental impact statement (some running to 150 pages) before it can be considered; CEC requires completion of a form on two sides of A4 paper.

18.35 Norway controls the domination of large concerns by insisting that all operators own 51% of their company's equity and by limiting farm size by cage volume. As for Eire, Udaras na Gaeltachta (the state body which fosters development in the remote western parts of the country) referred to Scotland's experience in allowing outside domination as "an awful warning to us" (Fish Farming International, June 1986).

RECOMMENDATIONS

18.36 The interests of the Crown Estate Commissioners should be limited to CEC's own purposes as a responsible landlord under the Crown Estate Act "to maintain and enhance the value of the estate and the return obtained from it, but with due regard to the requirements of good management".

18.37 Advertisement of sea-bed lease applications should be made in one central publication to allow easier monitoring of applications and organisation of responses by representative bodies; application details to be made available at a selection of nearby post-offices; and publication of details for all new leases in agreed central source, at time of allocation.

18.38 CEC should be required to make available and regularly up-date a public register of sea-bed leases including details such as their purpose, extent and expiry date.

18.39 Applications for sea-bed leases should be extended to ensure that adequate information is provided to allow the assessment of likely environmental impact.

18.40 The requirements of 'commercial confidentiality' should be clearly defined as regards the scope of data on fishfarms which may and may not be released by CEC.

19 OPPORTUNITIES FOR IMPROVEMENT

PLANNING CONTROL

19.1 With the exception of Shetland, where inshore fishfarming developments are under the control of the Islands Council through the operation of Works Licences, there is widespread concern expressed by Planning Authorities regarding their lack of control. Indeed it is widely held that the contrast in the framework of controls as between freshwater and saltwater fishfarming is the illogical product of historical factors. Essentially the same operations are undertaken, giving rise to a similar if not greater conflict of interests, but under radically different control procedures. This situation requires to be clarified and the control framework made consistent.

19.2 Both Highland and Strathclyde Regional Councils and the Western Isles Council have recently made appeals to the Secretary of State in pursuit of improved planning controls.

19.3 The Convention of Scottish Local Authorities (COSLA) has (Nov 1987) committed itself to the demand for planning control to be extended to

marine fishfarming, adding that this was essential if such developments are to be integrated successfully with other coastal activities.

19.4 Planning control would enable Local Authorities to assess and approve individual proposals, but in a wider context it would also bring fishfarming more effectively into consideration within the hierarchy of policies and forward plans, from local and structure plans though to national planning guidance.

19.5 In addition, the extension of the long-established democratic planning system in this way would ensure that those interests affected by marine fishfarming would benefit from the normal statutory procedures for neighbour notification and consultation, representative and open decisions, rights of appeal, enforcement systems, etc. CEC would of course continue as landlord, but the shortcomings noted in the previous section would be avoided.

INTERIM MEASURES

19.6 It is clear that any legislation to extend planning control would take considerable time to enact and implement. We therefore appeal for interim arrangements to:

a. improve the process of assessment (including opportunities for meaningful participation by interested parties);
b. extend public accountability and democratic control;
c. introduce strategic planning;
d. integrate this with Local Authority plans and policies.

19.7 One particular improvement could be made forthwith. Under present arrangements there have been complaints that the grant of a sea-bed lease by CEC may prejudice a planning application for a shore base or vice versa. Where a sea-bed lease and planning consent for a shore base are required for a fishfarm, both should be applied for concurrently. This would ensure that complete information was available to CEC, the planning authority and to other consultees, on which to judge the impact of the full development. The decisions on each application should be conditional on the approval of the associated shore base or sea-bed lease. Such a system would be less confusing than the present arrangements and would save time and cost for consultees.

EC Directive on Environmental Assessment (EEC/85/337)

19.8 We have not yet seen SDD's proposals for implementation of the above Directive, due to be in force by July 1988. However, according to a draft circular issued by DoE and the Welsh Office on 26/1/88, reference to "Salmon Breeding" in Annexe II of this Directive will be interpreted as salmon farming generally. The circular states:

> "Offshore developments are subject to the granting of a lease by the Crown Estate Commissioners, who will require an Environmental Assessment in the case of **major developments** in areas of **particular conservation value.** The Commissioners will establish, in consultation with the Government, criteria which will indicate the type of development for which Environmental Assessment will be required." (Our emphases).

19.9 Until planning control is extended to cover inshore development, this Directive offers the possibility of considerable improvement. We therefore look for an early opportunity to discuss with the staff of SDD their interpretation of "major developments" and "particular conservation value" emphasised in the above extract.

FORWARD PLANNING

19.10 We believe that the case is amply made for a strategic approach to the planning and control of use of our coastal waters, due to the large number and importance of other interests affected, the prospect of continued rapid growth of the fishfarming industry and the need for this to take place in an atmosphere of consensus, good neighbourliness, and environmental care, not of secrecy, hostility and conflict. The existing consultation procedures do not fulfil this need.

19.11 It has been fairly pointed out that if government had waited to develop a comprehensive strategy for fishfarming, before allowing any development to take place, the establishment of the industry would have been critically hindered and few of its benefits would have materialised. However, salmon farming is now more than well-established; the conflicts and problems are in certain cases clear; we believe the time for strategic planning is overdue.

19.12 There is now an urgent need for future options to be discussed openly and a strategy produced which sets down general policy guidelines to take account of important ecological, social and economic priorities. Policies to guide fishfarming developments in this way have hitherto been almost entirely absent (except in Shetland); there is no longer any justification for ad hoc consideration of each application without agreed policy guidelines.

CCS Consultants' Report

19.13 We are puzzled by the conclusion on page 97 of the Cobham Resource Consultants report (1987) that "existing control measures are adequate to permit public consultation and a full consideration of environmental matters". On the contrary, our conclusion has been that existing control measures have now become quite inadequate to deal with the scale of issues raised by the growth of the industry. The CEC's consultation procedure is the result of recommendations of the Montgomery Committee of Inquiry (1984) based on information gathered in 1982/83, since when the output of the Scottish salmon industry alone has increased tenfold.

19.14 However, we agree with their conclusion that "public authorities have a clear duty to prepare planning and siting guidance" for intending fishfarmers and for the benefit of all concerned, including guidance on questions of scale, numbers and location of new farms, "including the possibility of broad zoning to identify areas where fishfarms will or will not be considered acceptable".

19.15 In the marine situation, CRC suggest that this should be the duty of "CEC, in conjunction with the relevant agencies and planning authorities". We do not find this sufficiently clear and we praise the initiative of Highland Regional Council, who despite the lack of formal powers, have produced a Strategy document proposing criteria by which fishfarming developments should be judged and announcing the Council's

intention to prepare 'Area Framework Plans' for guidance of the type proposed by CRC.

Highland Regional Council's Strategy for Fishfarming

19.16 This Strategy is a very worthwhile contribution to the growing debate. It begins by expressing the need for more caution now in the development of the industry, with economies of scale meaning proportionally less local employment but potentially greater environmental impact. It acknowledges the present inadequacy of research into and control of pollution and the cumulative effects of aggregations of fishfarms. It goes on to explore a variety of useful principles including (Section 2.4 of the Strategy):

> "that a balance must be struck between the unfettered expansion of the industry and the need for careful conservation of important scenic, tourist and natural resources".

Section 3.11 of the Strategy states that

> "there are now only isolated stretches of coast with no expressed fishfarm interest. Such wild areas have conservation value for scientific study, recreation and tourism and are an important part of the character of the region"

and announces a policy to

> "consult with NCC, CCS and with other agencies to consider the merits of special protection areas for the purposes of nature or environmental conservation".

19.17 We also welcome the Council's initiative in preparing a draft of the first of its proposed Framework Plans (for Loch Sunart) although we have strong reservations concerning its content. We believe that it should pay more heed to the elements of the Strategy quoted above.

Other Planning Strategies

19.18 Strathclyde Regional Council is also considering the production of a forward planning strategy. Western Isles Council has recently discussed the application of works licences as in Shetland for the purposes of exerting local control on development and forward planning.

19.19 The Shetland policy has guided the growth of fishfarming in Shetland to:

a. encourage the industry;
b. give preference to local operators;
c. establish minimum separation distances on the basis of best available knowledge;
d. limit size of farms;
e. limit number of site ownerships or shareholdings to two per person;
f. identify quarantine sites.

19.20 The effects of these policies on wildlife and landscape interests require further study but in response to arguments relating to the burden of regulation, the experience of Shetland indicates that such procedures

need not be unduly burdensome and are compatible with the principles of Crown immunity under which CEC operates.

19.21 We believe it is for government, not CEC, to take charge of this problem without delay.

RECOMMENDATIONS

19.22 Normal planning control should be extended to embrace marine fishfarming, in order to introduce consistency (as between freshwater and marine activities), local control and democratic accountability.

19.23 Planning Authorities should prepare policy guidelines for the exercise of planning control. These should include framework plans as proposed by Highland Regional Council.

19.24 The needs of commercial confidentiality should be respected within this procedure as in the normal planning process.

19.25 A right of appeal to the Secretary of State for affected parties should apply, as in the normal planning process.

19.26 The status of fishfarming-related developments on land should be clarified as being subject to planning control.

19.27 National planning guidelines should be prepared, to draw together the main policy requirements of the various affected interests and establish broad guidelines within which planning authorities may develop their own planning strategies.

19.28 Such guidelines should include the designation of a national series of lochs to be kept free of development.

20 ROLE OF GOVERNMENT CONSERVATION AGENCIES

COUNTRYSIDE COMMISSION FOR SCOTLAND

20.1 CCS supported the recommendations of the CRC report on siting, design and management in June 1987. However, the Commission has not yet (Feb 1988) committed itself to a statement of policy on the wider aspects of strategic planning although it is understood to be giving consideration to the making of a policy statement in spring 1988 on the development of fishfarming (Chairman, CCS, pers comm). We expect this to give special emphasis to protection of CCS's designation of National Scenic Areas, with particular reference to the fact that:

> **"our landscape is valuable - sometimes of such special value that, on occasion, any form of development has to be resisted.** This applies particularly to remote and wild landscapes. They are a dwindling and precious resource where the wrong kind of development may, at a stroke, diminish and devalue their quality for all time." (CCS, 1987)

20.2 It is unfortunate that government still does not have the benefit of a clear policy from CCS. More than 85 new leases have been agreed by CEC since the CRC study was commissioned in late 1986.

RECOMMENDATION

20.3 CCS should delay no further in making its views known on the subject of strategic guidelines, and should give clear and unequivocal advice to government on the requirements of landscape conservation.

NATURE CONSERVANCY COUNCIL

20.4 NCC has not produced a formal policy on fishfarming. The Council has received a report commissioned from the Institute of Aquaculture which we understand should lead in due course to the publication of guidance notes on site selection and management to reduce environmental impact.

20.5 We understand that this exercise will lead also to a policy statement which we hope will place special emphasis on strategic implications, including the cumulative effects of fishfarms on habitat diversity and species abundance and distribution.

20.6 Such considerations will also highlight the need for intensified survey, monitoring and research to enable the Council to respond effectively to the kind of strategic questions which we predict will increasingly be raised by the further growth of the industry. It is clear that serious resource problems arise if this work is left to be tackled within the existing budget of NCC. It must be seen as a responsibility of government as a whole to resource this effort adequately.

20.7 Environmentally responsible decisions regarding future growth of the industry require adequate baseline survey data together with the monitoring of change. Until these data are available, advice must be accepted (as in the case of River Purification Board criteria) on the basis of best professional judgement.

20.8 The tendency, evident in some quarters, to press ahead with development until others present concrete evidence of harmful effects, is unsound if not reckless, and goes against the principles of responsible development.

20.9 NCC has a vital role to play in the preparation and execution of sound policies for the development of fishfarming. This requires more than the present allocation of one member of staff in Scottish Headquarters to this major issue.

Marine Conservation Review

20.10 It is important also to address the question of site safeguard - the specific protection of areas of special known value in conservation terms. The best guide at present available is the series of Marine Consultation Areas (see Appendix 3). However, NCC is currently engaged in a 'Marine Conservation Review', a long-term exercise identifying areas of special conservation value in coastal waters around the UK. Once they are identified, it is important that special status be accorded to these areas to protect them from harmful developments.

RECOMMENDATIONS

20.11 Early assessment by NCC of the strategic aspects of conservation policy required to ensure adequate safeguards for the coastal marine habitat in the north and west of Scotland against the cumulative effects of fishfarming developments.

20.12 These safeguards should be incorporated into the Planning Guidelines proposed in Section 19.27.

20.13 Additional resources should be allocated for adequate marine environmental survey and monitoring and to allow NCC to fulfil its role as the government's adviser on conservation matters, and the government thus to pursue an environmentally responsible policy.

21 RESEARCH AND ADVICE FOR THE FISHFARMING INDUSTRY

21.1 Consistent with the generally accepted principles of the World Conservation Strategy, we believe that environmental considerations should be integrated into development policy from the start. Fishfarm development therefore requires an integrated research and advice base, able to support the growing industry with advice which is, among other things, environmentally sound.

21.2 In a speech at the major annual fishfarming conference in Inverness in Feb 1987 the then Minister of State for Fisheries at the Scottish Office expressed support for the industry and its important role in the West Highlands. He highlighted the need to pay attention to marketing, urged the industry to be good neighbours and considerate users of our coastline, and referred to the "environmental and other aspects which are increasingly coming into play". However, he did not outline how DAFS would ensure that environmental considerations would be taken into account.

21.3 In general we wish to echo the frustrations expressed to us from various quarters within the finfish and shellfish industries, government agencies and representative organisations that as the appropriate government department DAFS could be doing very much more to match the needs of the growing industry with effective survey, research, advice and other measures, especially (as concerns us) in relation to the industry's wider obligations which were referred to by the Minister. For example, in the important areas of chemical use and predator control, we find DAFS to be lagging far behind the present needs of the industry in terms of awareness of problems and research-based advice to meet these wider obligations.

21.4 The provision of a research-based advice service is never more urgently needed than in the early stages of development of an industry, when working practices are being established, relationships with other interests can be made or marred by the care with which interactions are assessed and managed. Yet in three years when output has increased six-fold and the number of farms has more than doubled, the resources

allocated by DAFS to advice and training in the whole salmon farming industry has increased only from ¾ man year to one man year. (Hansard, 9 Dec 1987)

21.5 We urge DAFS to take an early, positive and constructive lead in co-ordinating necessary research and reconciling the needs of the industry with the interests of those whom it affects.

RECOMMENDATIONS

21.6 A multi-disciplinary research/advisory service on fishfarming and the environment should be established urgently with adequate resources to:

- keep closely in touch with the progress and needs of the industry;
- undertake research and survey work to explore solutions to new problems;
- supply advice on the same basis as has for many years been available from the agricultural colleges in Scotland for farmers.

21.7 During the growth phase of the industry, this service should be free of charge and its remit should be to:

a. give special (but not exclusive) attention to the small operator whose needs may be different from and not covered by the research efforts of the large concerns;
b. co-ordinate survey, research, monitoring work by other bodies to ensure maximum benefit from all research;
c. gather and implement lessons from overseas experience in the management of marine fishfarming;
d. supervise the introduction of adequate measures in the education and training of fishfarmers to equip them in the proper safeguard of environmental interests;
e. liaise with the fishfarming industry in planning for its future needs;
f. assess in advance the social, economic and ecological implications of new technological advances such as open sea cages in order to advise government on appropriate measures to maintain a desirable balance of benefits.

21.8 We would like to encourage greater co-operation between the industry and conservation interests in seeking mutually beneficial solutions to problems.

22 INTEGRATION

22.1 One of the repetitive themes running through various assessments of the use of marine resources in the UK is the lack of integration even between government departments, in a medium which - more than on land - requires a co-operative approach to its management. The situation surrounding the fishfarming industry is no exception.

22.2 We have repeatedly made enquiries with the representatives of government departments and agencies on the subject of overall responsibility for policy but it appears that no department or minister has this lead responsibility.

RECOMMENDATIONS

22.3 A lead department and lead minister with responsibility for overseeing the integration of government policies in relation to fishfarming should be identified by the government.

22.4 An advisory committee should be appointed by this lead minister to keep a watching brief on the development of fishfarming and advise on such matters as

a. the integration of resource use and conservation policies
b. liaison between government departments
c. strategic planning issues, including the balance of social, economic and environmental interests.

FOOTNOTE

Our proposals are consistent with the principles of the World Conservation Strategy (IUCN, 1980) and the recommendations of the Conservation and Development Programme for the UK (Johnson, 1983), which was endorsed by the UK government in Conservation and Development - The British Approach; The UK Government's response to the World Conservation Strategy (DoE, 1986).

APPENDIX 1

WORLD CONSERVATION STRATEGY

Reference is made in this Paper to the UK's response to the World Conservation Strategy - The Conservation and Development Programme for the UK (Johnson, 1983), in which detailed consideration was given to marine and coastal resources (Part 4) by a Review Group of professionals and practising experts covering a wide range of concerns. We quote here some of the Review Group's conclusions.

The Chairman of the group in his introduction refers to

> **"a surprising lack of long term aims and anticipatory environmental management", an "urgent need for increased scientific work to strengthen the factual basis from which sound policies can stem".**

He also states that the group was making proposals

> **"not only to strengthen the hands of controlling bodies, but also to simplify that control and make it more effective. The demand of industrial, recreational and fishery activity on the one hand and the need for sensible conservation on the other require to be met by a simplified pathway through the present plethora of overseeing bodies."**

Fishfarming is mentioned only in passing; it is significant that only four years ago this industry had not reached the scale which would qualify it to be considered as a further complication in the already complex pattern of demands on our coastal resources.

Bearing this in mind, the group's proposals are all the more noteworthy. They identified a wide range of statutory bodies with powers to control activities below Low Water Mark. These could not be expected to balance the conflicting interests in a way which satisfied the community as a whole, and some form of democratically accountable body should be available. They proposed that planning control be extended three miles out to sea.

They recognised the increased pressure on NCC which would result from any pressure to give greater consideration to marine conservation. They therefore recommended that NCC should be given the resources needed to increase its level of expertise in the marine and coastal environment.

They expressed a view that the large number of statutory bodies with an interest in the marine environment reflected an era when exploitation was not considered in the context of conservation, indeed "when the need for conservation and development to be closely integrated was not appreciated". They therefore recommended that serious consideration be given to re-organisation of statutory responsibilities under a Department of Maritime Affairs which properly reflected this new and very necessary perception. Seeing this to be a major undertaking, they offered the alternative but less desirable option of a Standing Committee on Marine Affairs, at high level in the government, preferably only as an interim measure.

APPENDIX 2

CROWN ESTATE COMMISSIONERS' LEASE CONDITIONS

In Item 6.2 of CEC's standard lease, the lessee is required:

> "to use his best endeavours to avoid any unnecessary interference with, damage to or destruction of wildlife, flora and fauna and their natural habitat whether on land or at sea; including without prejudice to the foregoing generality to refrain from the use of any chemical, liquid, substance, commodity, treatment or otherwise which may be proscribed by an authority having the power to do so or which the Commissioners in their sole discretion shall regard as toxic or noxious; declaring further that in the event that the tenant or anyone acting as his employee or agent shall be convicted of any offence or commit any act which in the sole opinion of the Commissioners constitutes a breach of the obligations imposed by this clause the Lease shall upon the Commissioners reaching the said conclusion be null and void."

APPENDIX 3
Extract from:

NATURE CONSERVANCY COUNCIL
INITIAL MARINE CONSULTATION AREAS: SCOTLAND

Fourteen coastal marine areas have been identified initially by the Nature Conservancy Council as deserving of particular distinction in respect of the quality and sensitivity of their marine environment. These include two proposed statutory Marine Nature Reserves and twelve other areas where the scientific information fully substantiates their nature conservation importance and where the response to consultations on development should give special weight to this. It is envisaged that this list will be added to and amended in the light of future survey work and consequent on the findings of the Marine Nature Conservation Review.

The areas have no statutory locus but will be made known to bodies with which the NCC has consultations on marine conservation issues.

The initial MCAs are:

Loch Eynort (South Uist)
Loch Torridon (Wester Ross)
South of Iona (Argyll)
Firth of Lorne (Argyll)
Loch Carron (Lochalsh)
Loch Roag (Lewis)
Loch Indaal (Islay)
Loch Etive (Argyll)
Loch Maddy (North Uist)
The Obbe (Harris)
Loch Obe (Barra)
St Abb's Head (Borders)
Loch Laxford (Sutherland)
Loch Sween (Argyll)

The character of the marine environment is such that conservation of its quality cannot be achieved simply by the identification of areas of particular significance and the Nature Conservancy Council will continue to be interested in, and advise upon, matters affecting the quality of the marine environment outside these particular areas.

ABBREVIATIONS

ADP	Agricultural Development Programme
CRPB	Clyde River Purification Board
CRC	Cobham Resource Consultants
COSLA	Convention of Scottish Local Authorities
COPA	Control of Pollution Act
CCS	Countryside Commission for Scotland
CEC	Crown Estate Commission
DAFS	Department of Agriculture and Fisheries for Scotland
DoE	Department of the Environment
DoT	Department of Transport
EQO	Environmental Quality Objective
EQS	Environmental Quality Standard
EEC	European Economic Community
FCR	Food Conversion Ratio
HIDB	Highlands and Islands Development Board
HRC	Highland Regional Council
HRPB	Highland River Purification Board
IDP	Integrated Development Programme
IPN	Infectious Pancreatic Necrosis
IUCN	International Union for the Conservation of Nature and Natural Resources
MAFF	Ministry of Agriculture, Fisheries and Food
NCC	Nature Conservancy Council
NERC	Natural Environment Research Council
NFUS	National Farmers' Union of Scotland
NLB	Northern Lighthouse Board
pers comm	personal communication (ie not published material)
PCB	Polychlorinated Biphenol
ppm	parts per million
RPB	River Purification Board
RENC	Rural Environment and Nature Conservation Division (of SDD)
SDD	Scottish Development Department
SMBA	Scottish Marine Biological Association
SRC	Strathclyde Regional Council
SSGA	Scottish Salmon Growers' Association
SWCL	Scottish Wildlife and Countryside Link
TBT	Tri-butyl tin
TGWU	Transport and General Workers' Union
WCS	World Conservation Strategy

REFERENCES

AUSTIN, B (1984) The control of bacterial fish diseases by antimicrobial compounds. In: Antimicrobials and Agriculture, Benefits and Malefits (Ed. M Woodbine), pp. 255-258. Butterworths, London.

AUSTIN, B (1985) Chemotherapy of Bacterial Fish Diseases. In: Fish and Shellfish Pathology (Ed. A E Ellis) pp. 19-26. Academic Press, London.

BISHOP, G M (1987) The Impact of an Expansion of the Scottish Fin Fish Aquaculture Industry on Wild Fish Stocks Used to Supply Fishmeal Components of Feedstuffs. Unpublished Report to World Wildlife Fund (UK), Godalming, Surrey, 14 pp.

BROWN, J R, GOWEN, R J and McLUSKY, D S (1987) The Effect of Salmon Farming on the Benthos of a Scottish Sea Loch. J. Exp. Mari. Biol. Ecol. 109: 39-51.

BUTLER, T, LINK, N N, ARNOLD, K and POLLACK, M (1973) Chloramphenicol resistant Typhoid Fever in Vietnam associated with R factor. Lancet ii: 983-985.

COBHAM RESOURCE CONSULTANTS (with Fisheries Development Ltd) (1987) An Environmental Assessment of Fish Farms. Final Report to Countryside Commission for Scotland, Battleby (and others), 100 pp.

COUNTRYSIDE COMMISSION FOR SCOTLAND (1987) Towards the Nineties. (Promotional Newspaper). Countryside Commission for Scotland, Battleby.

THE CROWN ESTATE (1987) Report of the Commissioners for the year ended 31 March 1987. The Crown Estate, HMSO, London, 28 pp.

THE CROWN ESTATE (1987) Fish Farming: Guidelines on Siting and Design of Marine Fish Farms in Scotland. The Crown Estate, Edinburgh, 13 pp.

DAVIES, I M, and McKIE, J C (1987) Accumulation of Total Tin and Tributyltin in Muscle Tissue of Farmed Atlantic Salmon. Mar. Poll. Bull. 18(7): 405-407.

DEPARTMENT OF AGRICULTURE AND FISHERIES FOR SCOTLAND (1979-1986) Salmon and Trout Farming in Scotland. Reports of DAFS Annual Surveys.

DEPARTMENT OF THE ENVIRONMENT (1986) Conservation + Development: The British Approach. The UK Government's Response to the World Conservation Strategy. London.

DEPARTMENT OF THE ENVIRONMENT (1987) Shipyards and the Marine Environment: Guidelines for Applying and Removing Antifouling Paint. Leaflet.

DIXON, I (1986) Fishfarm Surveys in Shetland, August 1986. Volume I. Report to the Nature Conservancy Council and Shetland Salmon Farmers' Association from the Field Studies Council (Oil Pollution Research Unit), Dyfed, 17 pp.

DOLMEN, D (1987) Gyrodactylus salaris (Monogenea) in Norway; Infestations and Management. In: Proc. Symp. Parasites and diseases in natural waters and aquaculture in Nordic countries. (Ed. R Stenmark and G Malmberg) pp. 63-69. University of Stockholm, Stockholm.

EARLL, R, JAMES, G, LUMB, C and PAGETT, R (1984) A report on the effects of fish farming on the marine environment of the Western Isles. Report to the Nature Conservancy Council. Marine Biological Consultants Ltd, 45 pp.

EGIDIUS, E and MOSTER, B (1987) Effect of Neguvon and Nuvan treatment on crabs (Cancer pagurus, Carcinus maenas), Lobster (Homarus gammarus) and blue mussel (Mytilus edulis). Aquaculture, 60: 165-168.

GOWEN, R J, TETT, P and JONES, K L (1983) The Hydrography and Phytoplankton Ecology of Loch Ardbhair: a small sea loch on the west coast of Scotland. J. Exp. Mar. Biol. Ecol. 71: 1-16.

GOWEN, R J and BRADBURY, N B (1987) The Ecological Impact of Salmonid Farming in Coastal Waters: A Review. Oceanogr. Mar. Biol. Ann. Rev. 25: 563-575.

GREEN, J and GREEN, R (1980) Otter Survey of Scotland 1977-79. The Vincent Wildlife Trust, London, 46 pp.

GREEN, J and GREEN, R (1987) Otter Survey of Scotland 1984-85. The Vincent Wildlife Trust, London, 40 pp.

HANSARD (9 Dec 1987) Mr Michael Forsyth: Written Answer to question from Dr Norman Godman (CBU 46301.127).

HIGHLAND REGIONAL COUNCIL, Director of Planning (Sept 1987) Fishfarming: Draft Development and Control Strategy.

HIGHLAND REGIONAL COUNCIL, Director of Planning (Dec 1987) Loch Sunart: Fishfarming. Draft Framework Plan.

HIGHLAND RIVER PURIFICATION BOARD (1987) Policy for Controlling Pollution from Fishfarms. Technical Report TR4/87.

INSTITUTE OF AQUACULTURE (1988) The Reduction of the Impact of Fish Farming on the Natural Marine Environment. A Report prepared for NCC. University of Stirling, 167 pp.

IUCN (International Union for the Conservation of Nature and Natural Resources) (1980) The World Conservation Strategy. Gland, Switzerland.

JOHNSON, B (1983) Conservation and Development Programme for the UK; An Overview - Resourceful Britain. Kogan Page, London, 104 pp.

MAFF (1978) Disinfectants in fish farming. Fisheries Notice No 59. MAFF Directorate of Fisheries Research, Lowestoft, 7 pp.

MAFF/DAFS (1987) Multi-Annual Guidance Programme for Aquaculture and Protected Marine Areas in UK (drawn up within the framework of Council Regulation EEC/4028/86).

MAITLAND, P S (1987) The impact of farmed salmon on the genetics of wild stocks. Report to the Nature Conservancy Council.

MILNE, H and GALBRAITH, C (1986) Predation by eider ducks on cultivated mussels. Final report to DAFS and HIDB. Department of Zoology, University of Aberdeen, 161 pp.

MONTGOMERY COMMITTEE OF INQUIRY (1984) Committee of Inquiry into the Functions and Powers of the Islands Councils of Scotland. (Chairman: Sir David Montgomery Bt.) Report. HMSO, Edinburgh, 106 pp.

NORDENG, H (1977) A Pheromone Hypothesis for Homeward Migration and Anadromous Salmonids. Oikos 28: 155-159.

NERC (1987) Seal Stocks in Great Britain: Surveys conducted in 1985. NERC News, March 1987, pp 11-13.

NATIONAL FARMERS' UNION OF SCOTLAND (1986) Codes of Recommendation for the Husbandry and Welfare of Farmed Fish. Edinburgh, 12 pp.

ORKNEY ISLANDS COUNCIL, Environmental Heralth Department (1987) Draft Policy for Controlling Pollution from Fish Farms.

PEARSON, T H and ROSENBERG, R (1978) Macrobenthic Succession in Relation to Organic Enrichment and Pollution of the Marine Environment. Oceanogr. Mar. Biol. Ann. Rev. 16: 229-311.

RAE, G H (1979) On the trail of the sea lice. Fish Farmer 2 (6): 22-25.

ROSS, A (1988) Controlling Nature's Predators on Fish Farms. Marine Conservation Society, Ross on Wye, 100 pp.

ROYAL YACHTING ASSOCIATION (undated) Don't foul Things Up. Guidelines the antifouling user. Leaflet.

WOOD, E (1986) Organotin Antifouling Paints - An Environmental Problem? Report to the Marine Conservation Society, Ross on Wye, 19 pp.

WOOTTEN, R (1985) Experience of Sea Lice Infestations in Scottish Salmon Farms. International Council for the Exploration of the Sea: CM 1985/F:7, 6 pp mimeo.