

MARINE SALMON FARMING IN SCOTLAND

A REVIEW

SCOTTISH WILDLIFE AND COUNTRYSIDE LINK
October 1990

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.

Further copies of this Paper are available at a price of £3.00 (post free) from:

The Secretary, SWCL, Jennifer Anderson,
PO Box 64, PERTH PH2 0TF Tel: (0738) 30804

The original discussion paper, "MARINE FISHFARMING in SCOTLAND" (1988), to which this review refers, is available for an additional £3.00.

MARINE SALMON FARMING in SCOTLAND

1990

A Review

prepared by a working group comprising the following organisations of
SCOTTISH WILDLIFE AND COUNTRYSIDE LINK

Friends of the Earth (Scotland)
Royal Society for the Protection of Birds
Scottish Countryside Activities Council
Scottish Scenic Trust
Scottish Wild Land Group
Scottish Wildlife Trust
Vincent Wildlife Trust
World Wide Fund for Nature

With contributions from:
Association for the Protection of Rural Scotland
Atlantic Salmon Trust
Marine Conservation Society

Working Group Chairman:
Simon Pepper

October 1990



Printed on recycled paper

CONTENTS

SUMMARY AND MAIN RECOMMENDATIONS	1
1 Introduction	3
PART I THE CURRENT STATUS OF MARINE FISHFARMING	
2 The Marine Fishfarming Industry - Update	4
3 Statutory Responsibilities	5
PART II IMPACTS OF SALMON FARMING ON THE ENVIRONMENT	
4 Quality and Sensitivity of the Coastal Marine Environment	7
5 Pollution - General	7
6 Solid Pollution	7
7 Soluble Pollution	10
8 Chemical Pollution	10
9 Control of Pollution	12
10 Threats to Wild Salmon from Escapes	13
11 Other Impacts on Wild Salmon	14
12 Predator Control	14
13 Impacts on Wild Fish Stocks	15
14 Landscape, Tourism and Recreation	16
15 Waste Disposal and Litter	16
16 Navigation	17
17 Social Considerations	17
PART III STRATEGIC CONSIDERATIONS	
18 Introduction	20
19 Controls	21
Abbreviations	26
References	27

MARINE SALMON FARMING IN SCOTLAND - A REVIEW

SUMMARY OF RECOMMENDATIONS

SWCL bodies are increasingly concerned at the government's reluctance to establish a clear and responsible approach to the protection of the marine environment, as a proper context for fishfarming and other developments. (1.3)

POLLUTION

- Industry and pollution control authorities should take steps to improve standards in relation to *stocking densities*, for environmental as well as economic and welfare benefits. (5.2)
- Minimum standards of staff training, site planning and monitoring should be enforced to avoid *site souring*. (6.2)
- Areas of restricted water exchange such as lagoons, inlets, certain sea lochs and enclosed bays should be identified as at risk from *algal blooms* and should be given greater consideration for both protective and control measures. (7.6)
- The use of *antibiotics* should be more strictly controlled with a view to phasing out treatment via feed and emphasising preventive measures in farm management, siting and fish husbandry. (8.6)
- Pressure should be maintained on the industry to ensure that environmentally acceptable methods for the prevention or treatment of *sea lice* are developed quickly. (8.13)
- In view of the poor state of knowledge about pollutant loading and sea loch *carrying capacity*, precautionary limits should be imposed on production levels within each water body. (9.9)
- *Pollution control authorities* should co-operate more effectively to set consistent and high standards for consent conditions and monitoring requirements throughout Scotland. (9.10)
- The *resources* of River Purification Boards and Island Councils should be re-assessed to deal effectively with this major area of pollution regulation, and the research on which it should be based. (9.11)
- Where fish farmers are required to do their own monitoring, the data must be on the *public record*, as for RPB-generated data. Public scrutiny of the records will be as important as RPB scrutiny. (9.12)

EFFECTS ON WILD SALMON

- Consideration should be given to declaring the east of Scotland an *aquaculture-free zone* in accordance with the recommendation of an international conference in Norway (NASCO, April 1990). (10.3)
- Further research is required, alongside precautionary arrangements to protect certain *catchments* from the effects of salmon farming, until the impacts are better known. (11.3)

PREDATOR CONTROL

- *Legislation* on the destruction of predatory species must be reviewed, strengthened and enforced. (12.6)
- DAFS should require all shooting of predators to be subject to *licence*, which should be issued only where avoidance and preventive measures have been tried and shown to fail, and where serious damage has been proven. (12.7)
- Regular *monitoring* visits by properly trained and experienced DAFS staff, and a diagnostic and training service, should be introduced as part of this procedure. (12.8)

IMPACT ON WILD FISH STOCKS

- Government should increase its efforts to achieve international agreements and national management policies for the use and conservation of *wild salmon stocks* in a sustainable manner. (13.7)

- Government and fishmeal merchants should commit themselves to the importation and use of *fishmeal* only from sustainably managed sources within at most five years (by 1995). (13.8)

LANDSCAPE

- CCS should give higher priority to its work on *Locational Strategies*. (14.3)
- The industry should adopt higher standards of *site maintenance*. (14.4)

WASTE

- Research and development of alternative treatment and of re-cycling methods of dealing with *dead fish* should be accelerated, with the aim of replacing the unsatisfactory use of dead pits. (15.3)
- Local authorities should prepare to enforce new *litter control* powers being brought forward under the Environmental Protection Bill. (15.4)

NAVIGATION

- Navigational *markers* should be placed on the cages themselves, rather than the boundaries of the lease area. (16.4)

SOCIAL CONSIDERATIONS

- A thorough study should be undertaken of the opportunities and threats which the fishfarming industry presents to *rural communities*, as a basis for strategic planning. (17.11)

STRATEGIC PLANNING

- Preparation of a *marine conservation strategy* should be an urgent task for the conservation agencies in Scotland. The strategy should include the identification of areas which should be protected from all fishfarming development. (18.5)
- *Precautionary safeguards* on development should be designed to protect ecosystems of known or suspected vulnerability, and should be introduced without delay, to remain in place until superseded by protective measures based on adequate research. (18.6)
- A *lead Minister* should be identified, to take responsibility for restoring and overseeing the balance between economic, social and environmental objectives in marine fishfarming. (19.17)
- A *committee of experts* should be appointed to advise the Minister on the integration of these objectives within the principles of sustainable development. This committee should have resources to direct research and survey as appropriate, should advise on government policy, and should take over the role of the ill-fated CEC Advisory Committee in relation to contentious applications. (19.18)
- *National guidelines* should be produced by SDD to reconcile economic, social and environmental objectives, as a context for planning control. (19.19)
- Development control duties should be removed from the Crown Estate, and *planning control* powers for the local authority extended in their place. (19.20)
- A *licensing system* should be introduced (by DAFS) as a means of regulating standards of training, chemical use, predator control, waste disposal, husbandry practices, disease control, safety etc. (19.21)
- Duties as 'Competent Authority' under the *Environmental Assessment* Regulations should be transferred from CEC to Local Planning Authorities or DAFS. (19.22)
- The Crown Estate should prepare and publish a detailed Corporate *Environmental Policy*, outlining the standards of environmental care which it intends to meet in all aspects of its operations (especially, in this case, marine). This policy should be subjected to regular environmental audit, as recommended by government in the management of all other branches of industry. (19.23)
- *Environmental audit* procedures should be applied by government to the full range of control measures, from strategic policies to procedures for regulation of husbandry practices. (19.24)
- *More fundamental reforms* should be considered, including the formation of a single cross-sectoral authority, with responsibilities in both planning and management of marine resources, as recommended in the Conservation and Development Programme for the UK (Johnson 1983), and a recent report "A Future for the Coast?" (Marine Conservation Society, 1990). (19.26).

INTRODUCTION

1

- 1.1 In our earlier discussion paper (Marine Fishfarming in Scotland, SWCL, 1988, referred to below as 'SWCL 88'), we assessed the impact of marine fishfarming on the environment, and made a number of recommendations relating to policy, planning and regulation. We identified a need for improvements in
- co-ordination of the different arms of government policy,
 - planning within the context of national guidelines, and
 - regulation of fishfarm practices, based on research, monitoring and advice.
- 1.2 The validity of these recommendations has increased with the passage of time. This review paper reveals that little has changed in the control framework, despite the continued rise in scale and extent of the salmon and shellfish industries.
- 1.3 **We are increasingly concerned at the government's reluctance to establish a clear and responsible approach to the protection of the marine environment, as a proper context for fishfarming and other developments.**

PART I

THE CURRENT STATUS OF MARINE FISHFARMING

2 THE MARINE FISHFARMING INDUSTRY - UPDATE

Production

- 2.1 The Western Isles and Northern Isles (mainly Shetland) now produce 10% and 28% respectively of the Scottish total, with the remaining 62% coming from the West coast of the mainland and the inner isles (DAFS).
- 2.2 Trends in production are shown in Figure 1. In 1989, 166 companies operated 292 sites and produced 28,553 tonnes of salmon. The predicted world production of Atlantic salmon for 1989 was 179,100 tonnes, Norway producing 120,000 tonnes, Scotland 33,000 tonnes, with the Faroes (8,000t), Ireland (7,200t), Canada (5,300t), Iceland (1,000t) and Chile (1,600t) being the other producing countries. Thus Scotland's Atlantic salmon production accounted for about 18% of world production.
- 2.3 By contrast, the total wild catch in 1988 from rod angling, net and coble and coastal netting stations in Scotland was 1,200 tonnes.
- 2.4 Scottish production in 1988 and '89 has fallen short of the predicted figure by about 4,000 t in each year. This is the result of three main factors, each of which has caused very significant losses - storm damage, disease and early marketing due to the price squeeze. These factors have not been quantified separately.
- 2.5 DAFS predicts a further increase in production in 1990 to 37,000 tonnes. However, figures for 1991-1992 suggest a plateau at around 40,000 tonnes, a lower level than previously thought. This reduction is due to overproduction on a world scale and reduced profitability, as a result of which the demand for new sites has declined in the past year.
- 2.6 Scottish production of farmed shellfish in 1990 is estimated as follows (Association of Scottish Shellfish Growers):
 - mussels 450 tonnes,
 - oysters 2.7m shells,
 - K scallops 50,000 shells,
 - Scallops 2.25m shells (princesses and queens)

Employment

- 2.7 In 1989, marine salmon farming directly supported 1,102 full-time and 316 part-time jobs in Scotland (DAFS), and an estimated indirect employment of 3,500 full-time job equivalents (SDA). These figures go some way towards justifying the SSGA's claims of over 6,000 jobs created by the industry.

Organisations

2.8 The Scottish Salmon Growers' Association (SSGA) supports the interests of the salmon farming industry, and provides a consensus view on issues on behalf of the industry. The SSGA has a three-fold remit:

- 1) generic marketing and promotion,
- 2) technical research and development funding,
- 3) a political and administrative role.

SSGA represents 86% of producers, who are together responsible for 75% of the Scottish total production (excluding Shetland - see below).

2.9 The Shetland Salmon Farmers' Association (SSFA) represents the interests of the companies farming salmon in Shetland, with a similar remit to that of the SSGA.

2.10 The Scottish Salmon Board (SSB) was formed in 1988 as a joint venture between the SSGA and the SSFA, supported by the HIDB. The SSB is a marketing directorate made up of representatives of the industry. Its remit is to promote the demand for Scottish salmon. SSFA withdrew from the SSB in 1989.

2.11 The Association of Scottish Shellfish Growers (ASSG) is equivalent to the SSGA for the shellfish sector. The ASSG represents approximately 80% of the Scottish shellfish farming industry.

3 STATUTORY RESPONSIBILITIES

3.1 Since 1988 there have been several developments in the responsibilities and functions of statutory bodies.

Crown Estate Commissioners (CEC)

Advisory Committee to CEC

3.2 In 1988 the Scottish Office conducted a review of CEC's consultation procedure and in December 1988 the Secretary of State announced the establishment of an Advisory Committee to serve the CEC. This would consider contentious cases that encounter objections from one or more of the relevant statutory bodies, and introduce an independent element into the decision-making process.

3.3 The chairman and vice-chairman of the Committee were appointed by the Secretary of State six months later, and a year after its announcement the Committee had not yet met to discuss procedures. This was despite requests by NCC and Highland Regional Council for cases to be referred to the Committee.

3.4 The Advisory Committee as proposed will still approach planning on a case-by-case basis and its remit does not include questions of policy and strategic planning. (see para. 18.2)

Environmental Assessment

- 3.5 The Environmental Assessment (Salmon Farming in Marine Waters) Regulations 1988 (under EC Directive 85/337) introduced new obligations on the Crown Estate to subject applications to EA procedures in certain circumstances. (see para. 18.6)

Development Strategy and Area Guidelines

- 3.6 In October 1989 CEC published 'Marine Fish Farming in Scotland - Development Strategy and Area Guidelines'. This document is described by CEC as an "indicative locational strategy" to provide a basis for a range of possible trends in the development of the industry. We are very concerned by the standard of this document, the views reflected in it and the willingness of government to allow the industry to develop with such inadequate guidance. (see paras. 18.3, 18.4)

Nature Conservancy Council (NCC)

Marine Consultation Areas

- 3.7 MCAs are a non-statutory designation by NCC, intended to identify areas where there is a significant conservation interest. NCC has reviewed the original list of fourteen MCAs and in January 1990 published a list of a further fifteen. The citations for MCAs have been revised to give more detail of nature conservation interest, distinguishing the sub-tidal and intertidal elements, and any important populations of birds and mammals.
- 3.8 To date they have made little if any impact on planning procedures. MCAs are not recognised in CEC's designation of Very Sensitive Areas, they do not feature in the criteria for environmental assessment, and they do not appear to have made any significant difference to CEC's development decisions (see NCC evidence to House of Commons Select Committee on Agriculture; Fishfarming in the UK, 1990).

HIDB

- 3.9 Financial assistance from HIDB is now deployed principally on aspects of processing and marketing, rather than the establishment of new fishfarming enterprises.

PART II

IMPACTS

4 QUALITY AND SENSITIVITY OF THE MARINE ENVIRONMENT

- 4.1 Our earlier paper (SWCL 88) emphasised the special qualities of the Scottish coastline, and the lack of detailed knowledge of the biology and ecology of marine systems. The exceptionally varied and pristine nature of Scotland's 12,000km (7,500 miles) of tidal coastline, much of it undisturbed and unpolluted, make it one of our richest and most valuable biological assets. At the same time it is undoubtedly one of the least explored and understood, and from a practical point of view the least accessible. Cause and effect are seldom easy to relate, and the need for stringent safeguards on potentially damaging activities is only now becoming appreciated. The North Sea Ministers Conference (1990) re-affirmed the importance of the 'precautionary principle' in policies affecting the marine environment.

5 POLLUTION - GENERAL

- 5.1 Increasingly, the importance of stocking density is being recognised as a major contributory factor to fish health, with lower densities achieving considerable reductions in stress, and higher survival and performance rates. This has significant economic and environmental implications, arising partly from lower use-rates of medications and chemicals. Current practice is extremely variable, with examples of severe over-stocking and excessive use of medications and chemicals. Standards should be improved throughout the industry.
- 5.2 * **Industry and pollution control authorities should take steps to improve standards in relation to stocking densities, for environmental as well as economic and welfare benefits.**

6 POLLUTION - SOLID

- 6.1 In SWCL 88, we concluded that the environmental threat posed by solid and soluble pollution from fishfarms was not well understood. Since then, Gowen et al (1988) have reported that the direct smothering effects of solid wastes are generally limited to an area of 60m radius from the cages. These effects are relatively short term, with sediments reverting to their normal state about one year after removal of the cages, although the macrofauna communities may take several years to re-establish. However, the build-up of solids under active cages and the consequent release of methane and hydrogen sulphide can lead to the 'souring' of the site, affecting fish health, farm viability and creating risks to human health, as well as possibly causing wider ecological changes. Souring can be prevented by careful site

+

Distribution of Salmon & Shellfish Farms in Scotland
(excluding the Northern Isles)



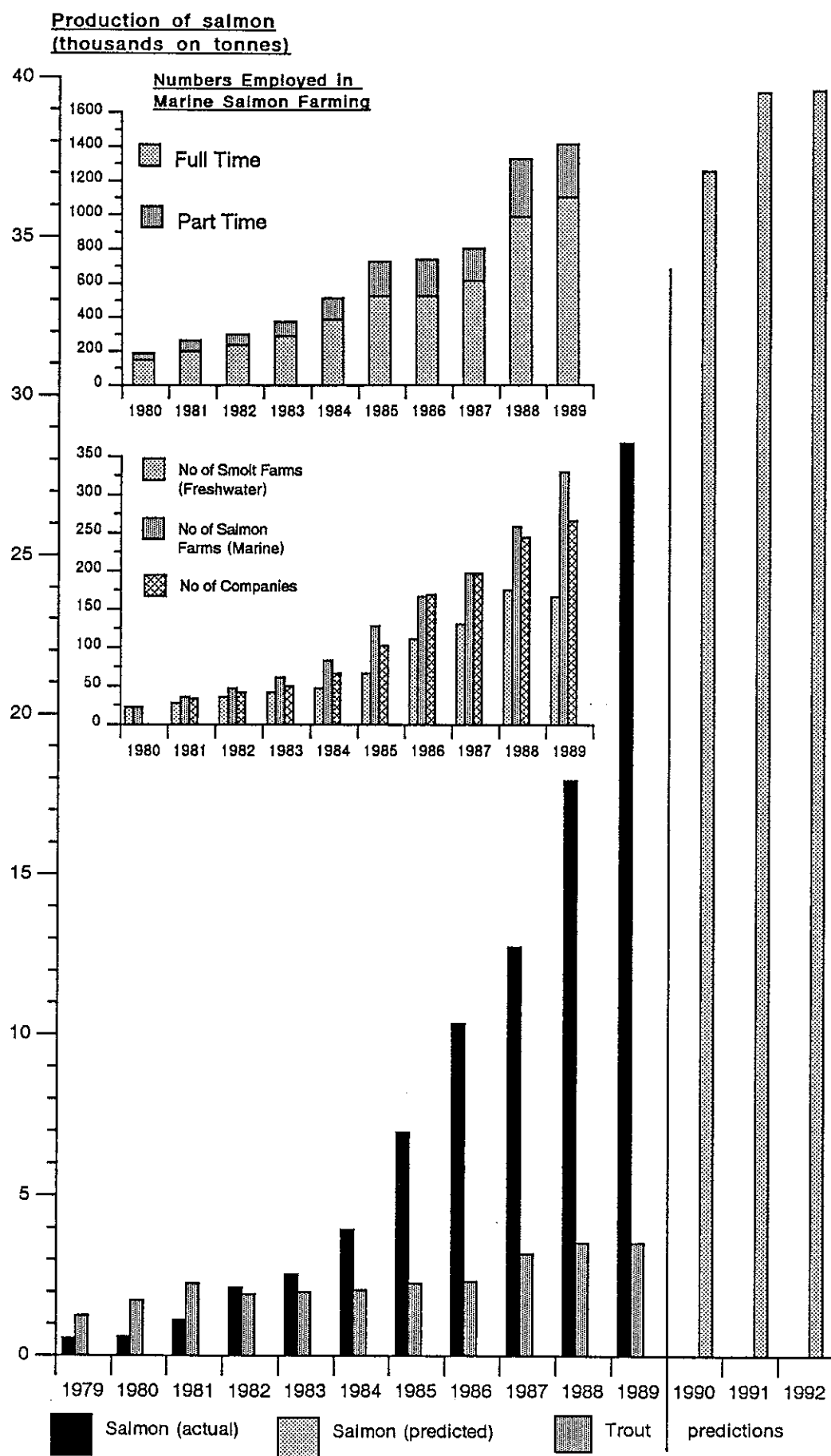
- +
- Salmon Farm
Leases in Scotland
- 337 (31.03.89)
 - Shellfish Farming
Leases in Scotland
- 500 (31.03.89)

(Data from Crown Estate)



Figure 1: SCOTTISH SALMON FARMING STATISTICS

(All data from DAFS and MAFF/DAFS)



selection and by adjustment of farm size and husbandry practices, but this should not be left to trial and error.

- 6.2 * **Minimum standards of staff training, site planning and monitoring should be enforced to avoid site souring.**

7 POLLUTION - SOLUBLE

- 7.1 The nutrifying effects of soluble wastes have not yet been modelled, but this is the subject of current research leading, it is hoped, to guidance on the carrying capacities of sea lochs. Our concern is that this research is post hoc and industry-centred; development has proceeded ahead of the research, and the guidance will relate to capacities for fishfarms only. Despite its 'sensitive' image the salmon is relatively tolerant of impaired water quality. Even minor nutrient level changes may however have subtle ecological effects and it is important that the implications of such changes are properly understood before all sea lochs are indiscriminately subjected to rising levels of nutrification.

Algal Blooms

- 7.2 Since the soluble nutrients released from salmon farms may stimulate the growth of phytoplankton, they may contribute to an increased risk of algal blooms which can have a devastating affect on stocks of fish and other marine life.
- 7.3 For example, nutrient loading was implicated when an algal bloom occurred along the coasts of Denmark, Norway and Sweden in 1988. This event cost the Norwegian fish farm industry over \$10 million. There have been two major outbreaks of PSP (paralytic shellfish poisoning) in 1990, caused by algal blooms in UK coastal waters.
- 7.4 There are also reports (Western Isles) of blooms of mucilaginous algae which cause froth up to 2m high and can accumulate on beaches resulting in a highly unpleasant smell.
- 7.5 A Task Force set up by the 1987 North Sea Ministerial Conference is researching nutrient dynamics with particular emphasis on exceptional algal blooms and general ecosystem effects on the plankton. It is due to report in 1992.
- 7.6 * **Areas of restricted water exchange such as lagoons, inlets, certain sea lochs and enclosed bays should be identified as at risk from algal blooms and should be given greater consideration for both protective and control measures.**

8 POLLUTION - CHEMICAL

Antibiotics

- 8.1 Increasing incidence of diseases in the salmon farming industry is leading to greatly increased use of antibiotics. Outbreaks of furunculosis rose from 91 cases in 1988 to 142 cases in 1989. Furunculosis, bacterial kidney disease



and pancreas disease are causing particularly severe and persistent problems in 1990, resulting in massive losses and abandonment of sites.

- 8.2 Concerns about the potential effects of antibiotics in the environment relate to effects on the benthic microfauna, antibiotic resistance in salmon pathogens and potentially in human pathogens, and residues of drugs in wild fish and shellfish stocks.
- 8.3 Treatment with antibiotics in medicated feed is controlled by the Medicines Act 1968 and the Medicines (Medicated Animal Feeding Stuff) Regulations 1988. Only three antimicrobials have product licences under these regulations - oxytetracycline, oxolinic acid and potentiated sulphonamides. Others, like Erythromycin, are being prescribed without licence.
- 8.4 Vaccines are being developed against some diseases but experience with furunculosis this year has demonstrated that they are not fully effective.
- 8.5 The SSGA has issued Guidance Notes for the Use of Medications covering use, storage, withdrawal periods and record-keeping. Treatment records are accessible to RPBs and Islands Councils.
- 8.6 * **The use of antibiotics should be more strictly controlled with a view to phasing out treatment via feed and emphasising preventive measures in farm management, siting and fish husbandry.**

Nuvan/Aquagard

- 8.7 Sea Lice (*Lepeophtheirus salmonis* and *Caligus elongatus*) infestations also appear to be increasing, with treatment occurring more frequently and throughout the year.
- 8.8 After many years of uncontrolled use against sea lice, Nuvan 500EC was granted a product licence as a prescription - only medicine under the name Aquagard Sea Lice Treatment in June 1989 for one year. This resulted in the chemical being supplied for the first time with appropriate instructions and warnings, the establishment of training courses for its "safe and effective use", and increased research effort into its environmental fate and impacts.
- 8.9 In June 1990 the product licence was renewed for two more years subject to some modifications of the label warning and a further environmental impact report after one year. The Minister's announcement acknowledged the need to find an alternative treatment method "as soon as possible".
- 8.10 The Department of the Environment now has to establish Environmental Quality Standards for the chemical, taking account of the hydrographic conditions in different lochs.
- 8.11 Dichlorvos, the active ingredient, is on the UK government's Red List of the most dangerous substances that can enter waterways. It is also on the list of Priority Hazardous Substances agreed by the North Sea States for at least 50% reduction of inputs (relative to 1985 levels) by 1995. However, unless an alternative is found, inputs of Dichlorvos from salmon farming alone can

be expected to have increased by 700% in this period.

- 8.12 Alternative treatment methods including chemicals, vaccines and biological control using wrasse as cleaner fish, are being investigated in the UK and elsewhere.
- 8.13 * Pressure should be maintained on the industry to ensure that environmentally acceptable methods for the prevention or treatment of sea lice are developed quickly.

Feed Additives

- 8.14 Feed additives that are not medicinal are controlled under the Agriculture Act 1970 and the Feeding Stuffs Regulations 1988 (under EC Directive 70/524). These allow the use of the pigments canthaxanthin and astaxanthin, up to a content of 100mg per kg, in salmonids over the age of 6 months.
- 8.15 In 1989 the Food Advisory Committee recommended that Canthaxanthin should be prohibited from direct use in human food, and it was to consider further its use in chicken and fish feed. It also recommended that animal products coloured via feed additives should be labelled accordingly.

9 CONTROL OF POLLUTION

- 9.1 The Water Act 1989 introduces amendments to the Control of Pollution Act 1974 that rectify the definition of "trade effluent", making it explicit that discharges from fishfarms should be subject to discharge consents issued by the RPBs (or Islands Councils), for which a fee may be charged. This clarifies the earlier anomaly, whereby fishfarm cage effluents were not exposed to RPB control.
- 9.2 However, the correction is theoretical only. Methodologies for measuring the quantitative and qualitative effects of pollution from floating cages have not been developed. Not surprisingly, there are confusing discrepancies between the policies of the different Boards over the terms of discharge consents. For instance, Highland RPB requires 48 hours notice of Nuvan/Aquagard treatment whereas Clyde RPB only requires a written statement of the type and quantity of chemicals a farm intends to use. There also appear to be differences between the Boards in the stance taken over site monitoring.
- 9.3 The Clyde RPB has established conditions of consent which require the fishfarm to undertake its own monitoring, to be verified on a spot-check basis by the Board.
- 9.4 However, consents are at present little more than an informing and data-gathering exercise, rather than an effective tool for limiting pollution.
- 9.5 They merely require a fish farmer to state the following:
- the precise location of cages;
 - that no materials detrimental to the environment will be used;

- that no chemicals other than those stipulated will be used without the consent of the RPB;
 - that manufacturers' instructions will be conformed with;
 - that an agreed figure for biomass production will not be exceeded.
- 9.6 Although consents may specify production tonnage (HRPB) or peak biomass (CRPB), these figures generally reflect the figures quoted on the application and there is still no sign of precautionary limits being set for production levels within each sea loch.
- 9.7 Furthermore, fishfarmers are resisting the requirement to self-monitor. In the Clyde Board area, all 26 eligible farms are appealing against this imposition (July 1990). The remaining 12 produce less than the 250 t peak biomass figure, below which they are not required to fulfil the monitoring condition.
- 9.8 The Islands Councils (Western Isles, Orkney and Shetland) are restricted in their capacity to implement effective pollution control with limited resources, analytical equipment and expertise. Western Isles Council is dependent on Clyde RPB as consultant, but CRPB is under-resourced to manage its own direct responsibilities.
- 9.9 * In view of the poor state of knowledge about pollution loading and sea loch carrying capacity, precautionary limits should be imposed on production levels within each water body.
- 9.10 * Pollution control authorities should co-operate more effectively to set consistent and high standards for consent conditions and monitoring requirements throughout Scotland.
- 9.11 * The resources of River Purification Boards and Island Councils should be re-assessed to deal effectively with this major area of pollution regulation, and the research on which it should be based.
- 9.12 * Where fish farmers are required to do their own monitoring, the data must be on the public record, as for RPB-generated data. Public scrutiny of the records will be as important as RPB scrutiny.

10 THREATS TO WILD SALMON FROM ESCAPES

- 10.1 The deliberate release of farmed salmon smolts into the wild is now subject to a code of conduct, the effectiveness of which has yet to be assessed. Fears remain regarding the effects of other large scale releases of salmon of all ages, as a result of storm damage or accident, on the genetic integrity and fitness of the populations of wild salmon adapted to specific river systems.
- 10.2 Recent work has shown that wild and farmed fish do interbreed and that the eggs are fertile.
- 10.3 * Consideration should be given to declaring the east of Scotland as an aquaculture-free zone in accordance with the recommendation of an international conference in Norway (NASCO, April 1990).

11 OTHER IMPACTS ON WILD SALMON

- 11.1 All new freshwater fish farms now require planning permission.
- 11.2 Anxieties regarding the effects on wild salmon populations of increased levels of pollution, pathogens and parasites at salmon farms remain unresolved.
- 11.3 * **Further research is required, alongside precautionary arrangements to protect certain catchments from the effects of salmon farming until the impacts are better known.**

12 PREDATOR CONTROL

- 12.1 Both the fin fish and shellfish sectors have responded positively to our persistent encouragement to develop predator control guidelines. SSGA have produced a code of practice in conjunction with NCC and SWCL member bodies, and ASSG are in the process of doing so. In Shetland, SSFA has also produced its own guidance to members.
- 12.2 We acknowledge the awareness-raising value of this exercise, but the practical effectiveness of the codes, which has yet to be assessed, lies entirely in the hands of the industry. We look forward to seeing convincing evidence of the industry's commitment.
- 12.3 The CEC and DAFS also have an important role in enforcing the following principles:
 - a) avoidance of predator problems through adequate survey at the planning stage,
 - b) prevention of predation by adequate design and management.
- 12.4 As yet, anti-predator measures have been developed on a 'trial and error' basis at individual fish farms, and there is still no concerted effort to coordinate research and the fruits of experience within the industry. Advice on preventive and protective measures should be gathered and circulated. This will require detailed recording of predator problems and the success or failure of different measures. It is disappointing that the approach of the industry to date has been directed largely at limiting the damage of adverse publicity from seal shooting, rather than the development of effective alternatives. The Marine Conservation Society has therefore set up a series of workshops for the industry, aiming to promote progress through the sharing of information.
- 12.5 DAFS' present policy not to issue licences for predator control is unsatisfactory. It encourages reliance on defence clauses in the Conservation of Seals Act 1970 and the Wildlife and Countryside Act 1981 which are imprecise and open to misinterpretation. It means that there is no regulation or recording of the shooting that is undoubtedly occurring. It also relies on the fishfarmer's account which our experience shows to be very often faulty due to failures in identification and diagnosis. This situation is wholly

inadequate and, in the case of common seals, contravenes the UK's obligations under the the Bern Convention to 'regulate the taking of seals'.

- 12.6 * **Legislation on the destruction of predatory species must be reviewed, strengthened and enforced.**
- 12.7 * **DAFS should require all shooting of predators to be subject to licence, which should be issued only where avoidance and preventive measures have been tried and shown to fail, and where serious damage has been proven.**
- 12.8 * **Regular monitoring visits by properly trained and experienced DAFS staff, and a diagnostic and training service, should be introduced as part of this procedure.**

13 IMPACTS ON WILD FISH STOCKS

- 13.1 Salmon farming is an intensive form of livestock rearing. Like other intensive systems, it relies on high protein feeds, of which dried fishmeal is a principal component. The 1989 yield of UK farmed salmon (28,000 t) required about 35,000 t of feed, derived from a catch weight of about 130,000 t of fish. The process of catching, drying, pelleting and transporting sea-caught fish for feeding to salmon in very remote locations is costly and inefficient in terms of energy use. Furthermore, North Sea stocks of industrial fish (sandeels, capelin, Norway Pout and sprat) are under great pressure of over-exploitation. Increasingly, feed producers are resorting to South Atlantic and Pacific sources of industrial fishmeal, where the pressure on similar stocks is rising rapidly in the context of poorly regulated catching.
- 13.2 Demands on this resource are compounded by wasteful handling, storage and use of fish feeds on site.
- 13.3 These attributes of salmon farming - and indeed of all intensive livestock rearing systems using fishmeal - disqualify any claim of sustainability. It is quite wrong to present salmon farming as a realistic long term substitute for over-fished wild stocks of salmon or any other fish. On the contrary, **salmon farming contributes to the overfishing of a new suite of fish species, adding to the overall problem of resource depletion.**
- 13.4 A return to wise management of the natural resource would be a very much more sustainable option, with economic, ecological and energy conservation advantages.
- 13.5 The salmon farming industry should expect to be affected by a general move away from intensive rearing systems as resource use policies in the UK are adapted to meet the government's stated (but yet to be demonstrated) commitment to sustainable development.
- 13.6 By contrast, shellfish farming requires low inputs of energy and no resource-expensive feeds and medications. As regards the options for pro-

ductive use of Scottish sea lochs for the benefit of local communities, the development strategy should take account of comparisons between the true sustainability of these rearing systems. No such comparison forms any part of the strategy at present.

- 13.7 * **Government should increase its efforts to achieve international agreements and national management policies on the use and conservation of wild salmon stocks in a sustainable manner.**
- 13.8 * **Government and fishmeal merchants should commit themselves to the importation and use of fishmeal only from sustainably managed sources within at most five years (by 1995).**

14 LANDSCAPE, TOURISM AND RECREATION

- 14.1 We are not aware of any assessments of the effects of fishfarming on tourism, recreation and wilderness quality. However, our own analysis (SWCL 88) has been widely endorsed and confirmed by experience. The acceptability of fishfarming in the landscape is influenced by its connotations in the public mind. In certain areas, needless seal destruction, careless use of chemicals, problems of untidy shore bases, litter and the offensive smell of dead and rotting fish have between them done little to endear fishfarmers to their fellow residents, let alone visitors.
- 14.2 There is an urgent need for Structure and Local Plan Policies to be developed and adopted for the better protection of landscapes. As far as the impact of fish farming is concerned this should be based on the CCS Locational Strategies project using landscape assessment techniques.
- 14.3 * **CCS should give higher priority to its work on Locational Strategies.**
- 14.4 * **The industry should adopt higher standards of site maintenance.**

15 WASTE DISPOSAL AND LITTER

Dead Fish

- 15.1 Recommended methods of burying dead fish in caustic pits have resulted in unauthorised discharges leaching into the sea, causing pollution and disease risks. Dead pits may not be a practical option in many areas. Storage of dead fish and collection by waste removal firms is now well established, in addition to collection systems for fresh casualties which may be acceptable for pet food manufacture. Equipment for macerating and ensiling dead fish and processing the product for fertiliser, compost or animal feed is operating in Norway, but the technology has not been perfected in Britain, where there is also concern about further use of pathogen rich material. Smell is still a problem at some farms.

Polystyrene and other litter

- 15.2 Polystyrene is now being phased out or used in enclosed systems so it is not exposed to the elements, but large amounts are still present in the environment. Discarded feed bags and fragments of equipment have caused concern. Collection and recycling of bags has not proved viable due to the

decay of feed residues. Bulk delivery and handling, using fewer bags which can be baled and buried, is now being tried. Meanwhile, companies are showing awareness of the problem and improvements are being made.

- 15.3 * **Research and development of alternative treatment and of re-cycling methods of dealing with dead fish should be accelerated, with the aim of replacing the unsatisfactory use of dead pits.**
- 15.4 * **Local authorities should prepare to enforce new litter control powers being brought forward under the Environmental Protection Bill.**

16 NAVIGATION

- 16.1 Navigation aspects are considered for each sea-bed lease application in a complex consultation between CEC, DAFS and Department of Transport involving also the Royal Yachting Association, Clyde Cruising Club, the West Highland Anchorages and Moorings Association, 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.
- 16.2 Considerable progress has been made by the West Highland Anchorages and Moorings Association (WHAM) in gaining the co-operation of the Crown Estate as regards the siting of new leases to avoid navigational problems. We welcome this improvement and see it as evidence of the potential for reconciliation between different interests. It is not clear however why the task of negotiation should fall to a small unpaid voluntary body, when protection of navigational interests is a duty imposed by law on the Department of Transport. Government departments should meet their obligations.

Concerns

- 16.3 A major concern now is an agreement between the Scottish NFU and the Department of Transport to require the marking of the boundaries of a lease rather than the obstructions (ie cages) themselves which will be much smaller. In a heavily leased loch it becomes difficult to establish which side of an apparently isolated marker to pass. (It is not required to colour the buoys in accordance with the cardinal system of buoyage.) It would be cheaper, much more effective and, therefore, safer to mark the actual danger.
- 16.4 * **Navigational markers should be placed on the cages themselves, rather than the boundaries of the lease area.**

17 SOCIAL CONSIDERATIONS

- 17.1 Social aspects discussed in SWCL 88 were the subject of debate at a seminar held by Rural Forum/SWCL in April 1990 (report available from Rural Forum). The growth of the fishfarming industry has been welcomed and very substantially supported by public funds (HIDB £25m), on the basis of its contribution to the economic and social welfare of remote parts of Scot-

land. Reference is frequently made to the benefits which have indisputably arisen, but the real value of this industry will lie in the extent to which the benefits can be sustained. However, virtually no assessment has been made of the long term viability of these enterprises - a question of more social and environmental than economic concern - nor of the social effects of increased efficiency and technological change. The Crown Estate claim informally to place social benefits high on their list of priorities, but such an objective does not appear in their Development Strategy.

Local benefits

- 17.2 Fish farming has developed in those parts of Scotland already stressed by depopulation and unemployment. The carefully planned exploitation of an abundant natural resource could, if integrated into the local economy, assist the survival of fragile communities, but by contrast, any failure to marry social and environmental priorities with economic goals at all planning levels may cause further instability. Serious problems with disease, the use of toxic chemicals, and market prices, have cast doubt on the wisdom of rapid over-development in the early years.

Industry structure

- 17.3 As the industry faces the results of over-development, the larger companies tend to survive better. Salmon farming represents a small proportion of the multinational companies' activities and their commitment may be influenced by economic factors entirely divorced from the local scene. Local staff therefore tend to feel powerless and disinclined to become involved in local management or planning, despite training opportunities. At present, one large company has approximately half its managers recruited and trained locally and half from college-trained non-locals.

Career opportunities

- 17.4 Mobility, as well as ability, is a prime consideration in recruitment of trainee managers, so is restricted to young single men. However, colleges providing courses leading to aquaculture qualifications will make more qualified people available and the career structure may become more standardised.

Housing

- 17.5 The influx of outsiders, whether managers or scientific staff, sandwich students or newcomers attracted by the industry, puts an added strain on the housing market, already distorted by second homes and holiday accommodation. Housing for staff is a constant worry for fish farming companies with some staff being forced into inadequate housing or to travel long distances. Transport to work is not provided for full-time staff as a matter of policy, resulting in one large company having 60% of its workforce travelling more than 30 miles to work by private cars. The cost and loss of mobility for wives and families is a regular grievance. Many of the incomers are young, single men, not expecting to settle. This can put strains on communities which have lost many of their own young people.

Local Economic Benefits

- 17.6 The jobs generated by salmon farming have undoubtedly benefitted the

Highlands and Islands, supporting local schools and services, and bringing a modest level of prosperity. However, the profits of many fish farms are not spent in the local area and the level of investment is determined from outside. In the event of a downturn the local workforce and economy is the first to suffer. Disease has brought forward the 1990 harvest and the prospect of lower stocking rates for 1991 has already brought planned reductions in the workforce. In the words of a Highland Regional Councillor, "there are disastrous problems about to break, which have been foreseen for several years."

Shellfish development

- 17.7 This has taken off more slowly than expected, with a very small increase in companies in 1989 and about 20% of all farms accounting for the bulk of production of mussels and oysters. Many shellfish farms are family run and provide part-time work which fits into traditional working patterns; whereas the amount of overtime and long travelling time required of some salmon farm workers precludes their doing any other work.

Integration

- 17.8 It is vital for the stability of rural communities that fish farming is integrated into the local economy at a sustainable level, with a balance between large and small operators and between fin fish and shellfish culture, taking into account both the national and international economic factors and the local environmental factors which will influence long term development of the industry.
- 17.9 The tendency for salmon farming, in its growth phase, to attract local people out of part-time occupations, such as prawn creeling, which may themselves be adversely affected by salmon farming, makes the community more dependent on salmon farming and therefore more vulnerable to external financial strains and 'boom and bust' economics.
- 17.10 Fishfarming presents both risks and opportunities in social terms. If the industry is to fulfil the promise of sustained economic and social renewal of the north and west of Scotland, guidelines for development must reflect this priority. The long-standing free-for-all provides no such guarantee.
- 17.11 * A thorough study should be undertaken of the opportunities and threats which the fishfarming industry in its different forms presents to rural communities, as a basis for strategic planning.

PART III

STRATEGIC PLANNING

18 INTRODUCTION

18.1 Every industry needs its own strategy for development to meet its own needs. However, resources such as sea lochs are used and valued by others also, and the industry's needs must be reconciled, through the offices of a higher authority, with a strategy for the protection of all interests in the longer term. The case has been made above for a strategic view of social issues, in order to guide development in the public interest. A similar strategy is also required to protect the quality, richness and productivity of the marine environment, for the following reasons.

- a) The environmental effects of fishfarming are not well understood.
- b) A wide range of ongoing research is exploring these effects, but mainly from the industry's - and not from other interests' - point of view.
- c) Fishfarming is only one of a number of activities which impact on the marine environment; these are controlled and regulated by many different authorities, although each uses the same resource.
- d) Controls and regulations presently in force are so rudimentary that the industry remains essentially free to continue to expand, restricted only by its own technical or economic limitations.
- e) As a result, the coast has been exposed to a steadily increasing scale of development which may be damaging other interests.
- f) Ecological change may be local or widespread, slight or acute, temporary or irreversible. It may involve short term algal blooms with disastrous economic effects, or long term changes to populations of rare or commercially important species.
- g) Until these matters are better understood, precautionary safeguards are needed, for example to set limits on local and generalised pollution loads and to protect certain core areas for the purposes of comparison, research and species protection.
- h) All existing controls are piecemeal and reactive; there is no plan for unifying the many powers and duties of different authorities in the interests of the environment.

18.2 The purpose of a marine conservation strategy would be:

- to inform decision-makers and other interested parties of the nature and scale of marine conservation needs,

- to provide a basis for policies which ensure the protection of the environment in the long term, and to meet standards of sustainable use.

18.3 The strategy should

- describe and explain in general terms the biological value of marine coastal ecosystems in Scotland,
- describe the importance of these coastal systems in the wider context,
- identify the factors which affect this value, beneficially or adversely,
- describe the ecological effects (and their significance) of the various forms of use of marine resources,
- assess the extent and importance of the threats,
- establish guidelines for the control of these uses, such as to protect the value and productivity of the resource,
- identify areas where these values are best represented and deserve strongest measures of protection,
- plan a process of liaison and co-operation between agencies to achieve effective resource conservation.

18.4 The total absence of a conservation strategy for coastal ecosystems, and the lack of a neutral overall authority, remain as major flaws in any claim by the government to be pursuing an environmentally responsible policy in fish farming.

18.5 * **Preparation of a marine conservation strategy should be an urgent task for the conservation agencies in Scotland. The strategy should include the identification of protected areas.**

18.6 * **Precautionary safeguards on development should be designed to protect ecosystems of known or suspected vulnerability, and should be introduced without delay, to remain in place until superseded by protective measures based on adequate research.**

19 CONTROLS

19.1 The fishfarming industry has long claimed that it is closely controlled. This is not so. Most of the existing controls are effective in theory only. In general the industry remains constrained in practice only by its own technical and economic limitations. A few applications for new sites have been refused on the grounds of other interests, but the effect has been to marginally adjust the pattern of development, without affecting the overall scale or type. Despite our efforts, and those of other official and unofficial groups, government has not seen fit to reform the framework of controls.

Crown Estate Commission's Advisory Committee

19.2 The only 'concession' has been in the Secretary of State's announcement (Dec 88) of an Advisory Committee to the Crown Estate, for the purposes of resolving contentious applications for new sea bed leases. However, far from providing a broadly-based overview of the development of the industry and its relations with other interests, this committee has a narrow remit; in its first year it failed to meet even to carry out this narrow remit, despite a clear responsibility to do so. This cynical failure has only added justifica-

tion to the scepticism and distrust repeatedly expressed towards the Crown Estate and the Scottish Office in these matters.

Development Strategy and Area Guidelines

- 19.3 In October 1989 CEC published 'Marine Fish Farming in Scotland - Development Strategy and Area Guidelines', an "indicative locational strategy" to provide a basis for a range of possible trends in the development of the industry. Strangely, it was launched at a time when Crown Estate staff were openly expressing the view that the development phase of the industry was already at an end, with almost all suitable inshore sites having been taken up by some 800 existing leases (salmon and shellfish).
- 19.4 We do not accept that the need for a development strategy is past. Technological changes, such as improved disease control, and market factors are likely to introduce new development pressures in due course. However, the CEC's document does not provide a basis for managing these pressures. It has been criticised for its lack of impartiality, its superficial judgement of site sensitivity, and its failure to address ecological constraints or other conflicting interests. The designation - Very Sensitive Areas (VSAs) - has been introduced as a constraint ostensibly reflecting conservation interests. However several such areas are already well settled with salmon farms, and several of the NCC's 'Marine Cultivation Areas' are not adopted as VSAs. Other limitations are that the document only deals with the mainland and provides no adequate plan for the overall distribution or structure of the industry.

Environmental Assessment (EA)

- 19.5 The EC Directive on Environmental Assessment has been implemented in the UK without any meaningful effect as regards fishfarming. Since its introduction in 1988, only one marine fishfarming development has been subjected to EA. The standard of the procedure was such that it is at present the subject of a formal complaint to the European Commission by the Marine Conservation Society.
- 19.6 The present shortcomings in the EA system arise from factors including:
- appointment of CEC as 'Competent Authority'; this is inappropriate, considering their financial interest in the granting of a lease;
 - the CEC's setting of thresholds, for triggering EA, at such levels of production that the measure is very rarely implemented;
 - CEC's failure to provide adequate guidance to developers to ensure that the statutory requirements of EA are met;
 - limitations in the legislation, at both UK and EC levels, limiting EA to the consideration of salmon farming only, and of individual projects only.
- There is a need for broadening of the definition to 'Aquaculture', and for EA to be applied to policies and programmes as well as individual projects.

Codes of Practice

- 19.7 Progress is welcome in the preparation of codes of practice to encourage environmentally acceptable standards in a number of areas. These have a useful role to play in raising awareness, improving public relations and

developing a sense of collective responsibility within the industry. At their best, they may raise standards above that which is legally required. However, their value should not be over-estimated. They have no force in law, and representative bodies have no locus whatsoever to control the activities of non-members who are often the worst offenders. Codes of practice should be under-written with enforceable regulation and monitoring to protect wider interests, and we deplore the failure of government to provide this base in the case of, for example, predator control.

Integration

- 19.8 Fishfarming involves the **economic use** of a **natural resource** for benefit of **local people**. Economic, environmental and social components are inextricably linked. However, the leading agencies' policies to date have been badly skewed towards short term economic objectives. Environmental safeguard is seen as the responsibility of others, and it appears that social benefits are simply expected to flow from economic activity. Investment of public finance in research and development has reflected this bias.

National Planning Guidelines (NPGs)

- 19.9 We have consistently advocated the introduction of NPGs (see SWCL 88) as a forward planning tool with which economic, social and environmental objectives could be reconciled from the point of view of the national long term interest. They should be used to counteract the predictable tendency for one set of objectives to over-ride the others, due to disparities between different agencies' powers.
- 19.10 NPGs should reflect government policy, promoting development which is consistent with long term social and environmental needs, as defined in the relevant strategies, and with the principles of sustainable development. The guidelines should indicate the processes of liaison which are required to maintain the balance of objectives in the day to day process of decision-making.

Environmental audit

- 19.11 Environmental protection measures range from strategic and locational policies to standards and procedures for control and regulation. The practical effectiveness of these measures must be subject to periodic assessment, where special emphasis should be placed on progress towards sustainability. Parameters on which such progress should be measured include:
- total resource and energy costs of inputs
 - environmental impacts of inputs and outputs at a local, regional and global level.
- 19.12 The results of such audits should be used to inform the process of policy development, for example in relation to the balance between salmon and shellfish farming.

Controls: Summary

- 19.13 Our criticisms of the control system remain, depressingly, as valid today as in March 1988. We observe:
- **no change** in the attitude of the Crown Estate Commissioners;

- **no evidence** of a responsible strategy for the development of marine fishfarming (despite the misleadingly titled 'Development Strategy', see above);
- **no change** in the Crown Estate's policy on the monitoring of leases, renewal of leases, publication of details relating to the location, duration and conditions attached to leases, answering of letters, etc.

Most depressing of all, we see:

- **no indication** by Scottish Office Ministers that they intend to take proper control over an issue which they have left in the wrong hands for too long;
- **no end** to the invidious situation in which CEC is a major financial beneficiary of decisions where it is officially acting as arbiter of the public interest.

- 19.14 There is still no public policy which openly accounts for other legitimate interests (local employment, fishing, recreation, wildlife conservation) in relation to principles other than location (eg scale, ownership, type of enterprise, length of lease, lease conditions). Each application for a new site is still considered on its own, without the benefit of proper strategic guidelines. The VSA designation remains flawed, misleading and largely meaningless.
- 19.15 The manner in which the Crown Estate wields - and more importantly is **allowed to wield** - its controlling interest in the sea bed is indefensible on many grounds. Most significantly, it fails to square with the government's stated commitment to sustainable development.
- 19.16 The following changes are urgently required; to accommodate fishfarming more effectively in the **present** structure of responsibilities.
- 19.17 * **A lead Minister should be identified to take responsibility for restoring and overseeing the balance between economic, social and environmental objectives in marine fishfarming.**
- 19.18 * **A committee of experts should be appointed to advise the Minister on the integration of these objectives within the principles of sustainable development. This committee should have resources to direct research and survey as appropriate, should advise on government policy, and should take over the role of the ill-fated CEC Advisory Committee in relation to contentious applications.**
- 19.19 * **National Guidelines should be produced by SDD to reconcile economic, social and environmental objectives, as a context for planning control.**
- 19.20 * **Development control duties should be removed from the Crown Estate, and planning control powers for the local authority extended in their place.**
- 19.21 * **A licensing system should be introduced (by DAFS) as a means of regulating standards of training, chemical use, predator control, waste disposal, husbandry practices, disease control, safety etc.**

- 19.22 * Duties as 'Competent Authority' under the Environmental Assessment Regulations should be transferred from CEC to Local Planning Authorities or DAFS.
- 19.23 * The Crown Estate should prepare and publish a detailed Corporate Environmental Policy, outlining the standards of environmental care which it intends to meet in all aspects of its operations (especially, in this case, marine). This policy should be subjected to regular environmental audit, as recommended by government in the management of all other branches of industry.
- 19.24 * Environmental audit procedures should be applied by government to the full range of control measures, from strategic policies to procedures for regulation of husbandry practices.

A Broader View

- 19.25 It is increasingly acknowledged that the separation of locational planning from regulation duties is incompatible with sound resource management. The continuing chaos of powers and duties relating to the use and protection of marine resources must therefore be resolved. Very much improved integration is required if there is to be a realistic prospect of progress towards sustainable development.
- 19.26 * More fundamental reforms should be considered, including the formation of a single cross-sectoral authority, with responsibilities in both planning and management of marine resources, as recommended in the Conservation and Development Programme for the UK (Johnson 1983), and the Marine Conservation Society (1990).

ABBREVIATIONS

ASSG	Association of Scottish Shellfish Growers
CCS	Countryside Commission for Scotland
CEC	Crown Estate Commission
CRPB	Clyde River Purification Board
DAFS	Department of Agriculture and Fisheries for Scotland
EA	Environmental Assessment
EC	European Commission
HIDB	Highlands and Islands Development Board
HRPB	Highland River Purification Board
MCA	Marine Consultation Area
NASCO	North Atlantic Salmon Conservation Organisation
NCC	Nature Conservancy Council
NFU	National Farmers' Union
NLB	Northern Lighthouse Board
NPG	National Planning Guideline
PSP	Paralytic Shellfish Poisoning
RPB	River Purification Board
SDA	Scottish Development Agency
SDD	Scottish Development Department
SSB	Scottish Salmon Board
SSFA	Shetland Salmon Farmers' Association
SSGA	Scottish Salmon Growers' Association
SWCL	Scottish Wildlife and Countryside Link
VSA	Very Sensitive Area
WHAM	West Highland Anchorages and Moorings Association

REFERENCES

CROWN ESTATE COMMISSION (1989) Marine Fish Farming in Scotland - Development Strategy and Area Guidelines

DEPARTMENT OF AGRICULTURE AND FISHERIES FOR SCOTLAND, Salmon and Trout Farming in Scotland. Reports of Annual Surveys

HOUSE OF COMMONS SELECT COMMITTEE ON AGRICULTURE, Fourth Report, Volume I (1990) Fish Farming in the UK. HMSO, London

GOWEN, R J, BROWN, J R, BRADBURY, N B AND MCLUSKY, D S (1988), Investigations into benthic enrichment, hypereutrophication and eutrophication associated with mariculture in Scottish coastal waters (1984-1988) Report to Highlands & Islands Development Board, Crown Estate Commissioners, Nature Conservancy Council, Countryside Commission for Scotland and Scottish Salmon Growers Association

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

MARINE CONSERVATION SOCIETY (1990) 'A Future for the Coast?' Proposals for a UK Coastal Zone Management Plan.

RURAL FORUM (1990) Report on Rural Forum/Scottish Wildlife & Countryside Link Seminar - Marine Fish Farming in Scotland - Socio-Economic Impacts

SCOTTISH SALMON GROWERS' ASSOCIATION Guidance Notes for the Use of Medications

SCOTTISH SALMON GROWERS' ASSOCIATION (1990) Salmon Farming and Predatory Wildlife - A Code of Practice (in conjunction with Nature Conservancy Council, Sea Mammal Research Unit, World Wide Fund for Nature, The Royal Society for the Protection of Birds, Marine Conservation Society, The Vincent Wildlife Trust)

SCOTTISH WILDLIFE AND COUNTRYSIDE LINK (1988) Marine Fishfarming in Scotland - A Discussion Paper, 70pp