The Sea Fish Industry Authority

Seafish Technology

Environmental Management Systems
A Fisheries Perspective

Seafish Report No. SR436

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Summary

Environmental pressures are affecting all industries at an increasing rate. In the context of fisheries the E.C. Habitats Directive and, on an industrial scale, the Quality Status Report of the North Sea are potential responses to the need to take marine conservation values into account in the governance of the North Sea. The former imposes environmental responsibilities on Sea Fisheries Committees and the latter considers environmental factors that relate to the health of the North Sea in discussion of fisheries management matters.

With the growing awareness about the potential fragility of marine resources and the inevitable increase in such initiatives the fishing industry need a better understanding of the impact of its activities on the environment and to identify an approach that would enable them to achieve and eventually demonstrate good environmental performance.

In response the environmental pressures other industries have sought to improve environmental performance through the development and implementation of environmental management systems (E.M.S.).

This report discusses environmental management systems in the context of fisheries to evaluate their utility to achieve the same aims. The findings indicate that the fishing industry contain the requisite elements (suitable management structures and the ability to collect relevant information) that would enable them to operate such systems.

A suitably designed industry E.M.S. is an appropriate vehicle to implement environmentally responsible policy. It would demonstrate a responsible attitude towards the environment and a proactive approach to environmental management issues. It would allow consideration of strategies, technologies and operational procedures that could reduce the impact of fishing activities on the environment. Such an approach should provide a robust defence against environmental criticism and should improve the fishing industries claim to a stake in marine resources. It should also provide the fishing industry with greater influence in environmental negotiations and in the implementation of future environmental initiatives.

It is suggested most suitable/effective approach to implement an E.M.S. is on a collective basis;

for example via associations or sectoral métiers. Costs and workloads could be shared and perceived benefits are much greater than those that would accrue from individual implementation.

It is further proposed that any management system adopted should be systems based analogous to the BS7750 standard.

This would allow complete flexibility and would allow external certification, conferring credibility, respect and standardisation. It would provide marketing advantage allowing trade with others operating to the standard. It could, if required, be a route to accreditation to the E.M.A.S. scheme.

The overall funding of the research indicate that environmental management systems have a role to play in the development and future management of fisheries.

They can be used to demonstrate environmental performance and inform managers of their environmental opportunities and limitations. Environmental Management Systems applied to a fishery would result in better awareness of the environmental factors that affect the fishery and of the effect of the fishery on the environment. This could result in the industry being better able to define its requirements in terms of technologies and operations with reduced environmental impact. This approach would provide the industry with a greater understanding of its strengths, weaknesses and the threats facing it, and would enable industry to make best use of the opportunities presented.

1. Introduction

The advert of the E.C. Habitats Directive and subsequent U.K. legislation[1] has given an environmental management role to Sea Fisheries Committees. On an international scale the Quality Status Report of the North Sea Task Force, initiated by Ministerial conference, has considered environmental factors relating to the health of the North Sea Ecosystem in the discussion of fisheries management considerations. These are political responses to the requirement to take marine conservation values into account in the governance of the marine environment.

In order to ensure that the fishing industry can take a professional approach to these legislative and political pressures there is a requirement to:-

- Formulate policy on marine environmental matters.
- Ensure that policy is implemented.
- Build up a track record of successful implementation of that policy.

This report sets out to examine whether Environmental Management Systems might benefit the fish catching sector in their response to these initiatives and to the broader requirements to achieve and demonstrate good environmental performance in the increasingly searching spotlight of public opinion.

[1] - need something in here I think

2. Environmental Management Systems

Environmental Auditing maybe defined as the:

> "systematic analysis of an organisation in which procedures and routines are examined in order to map its impact on both the internal and the external environment".[††]

The audit includes both the technical and organisation aspects of an organisation's activities and the interaction between the two. Environmental auditing, of itself, does not provide a mechanism for an organisation to change its operating practices or reduce effects that impact adversely on the environment. It is important to emphasize that in environmental management the main intention is to integrate environmental strategy (measurable goal setting) into overall organisational strategy. Environmental auditing is a "tool" to ensure compliance with strategy, standards and goals and to discover opportunities for improvement.

The usefulness of the "audit" concept would be increased if it could be combined within a system that allowed both the evaluation of and modification to an organisation's policies, procedures and routines. This role is fulfilled by an Environmental Management System (E.M.S.) which allows an organisation to evaluate information provided by an Environmental Management Audit (E.M.A.) against a set of environmental criteria to indicate whether the activities of the organisation are meeting policy objectives. The system, via an Environmental Management Review procedure (E.M.R.), enables the continued modification of an organisation's activities and policies to ensure that these remain relevant in changing circumstances. Formal definitions of these terms are given in Appendix I.

A schematic diagram showing the stages in the implementation of an E.M.S. is described in Figure 1. The procedures to implement the E.M.S. are arranged in a cyclical format which allows for a continual process of analysis and frequent scope for update at whatever rate is deemed necessary.

Insert Figure 1 here

The process starts with a commitment to operate in an environmentally responsible manner. This requires an initial internal review of the direction and philosophy of the organisation so that desirable policies can be formed. Implementation of these policies requires an authoritative body to collate relevant information that would, after analysis, enable them to quantify the changes required in organisational activities for the organisation to conform to policy requirements.

Specifically this would require:-

1. The registration of the legislative and regulatory requirements impacting upon an organisation's operations and their implications.

2. The registration and evaluation of the effects of an organisation's activities upon the environment.

[††]A more formal definition is given in Appendix I (2)

3. The registration and evaluation of environmental factors that may affect the activities of the organisation.

This body of information would allow the formulation of objectives and targets which, via a management program and manual, would result in a set of detailed records that could be assessed by audits and reviews to indicate the degree of compliance with original policies, and so highlight any requirement for change. Changes could then be accommodated and the cycle repeated. If the E.M.S. were to be audited to an external standard, such as BS7750 then the level of documentation required would be determined accordingly. The Environmental Audit process would examine this documentation in order to determine changes in the environmental performance of the organisation.

The decision making process for or against implementation of an E.M.S. in a fishery is outlined in figure 2.

The procedure is presented in the form of a flow chart that progresses through a series of questions and instruction which identify the necessary actions.

The flow chart should enable a fishery management unit to progress through the necessary steps to implement an E.M.S.; placing themselves in a position to examine fishery operations, identify impacts, undertake relevant research, and implement the changes required to improve environmental performance.

Essentially the two most important requirements are:

A management structure with the commitment and authority to enforce the policy and objectives set out in the E.M.S.

Qualitative and quantitative information on the environmental effects of the fishery and the effect of environmental change on the fishery.

A fishery model describing how relevant information required by an E.M.S. could be gained is described and discussed in Appendix I.

Insert Figure 2

3. Management Structure

An essential requirement of an environmental management system is the availability of a management structure which can demonstrate control an organisation's operations. This may comprise an individual, or committee or a corporate body.

There are several levels of management in both public and private management of fisheries; these are outlined in Table 1. Any level of management could become involved in environmental management. In a fisheries context the main requirement would be to determine at what level it would be most practical and profitable to consider implementing these systems. To discuss this further consider the following fisheries systems:-

i) An individual fishing vessel owned and operated by her skipper.
ii) The Cornish Handling Fishery for Mackerel (See Seafish Report SR434).
iii) Coastal common resource fisheries within Seafisheries Committee Limits
iv) An international common resource fishery; e.g. all fisheries within the geographical boundary of the North Sea.

In the first example the distinct management structure is the skipper. Within his capacity of owner and manager of the vessel he could implement an E.M.S. Provided that the information and record keeping systems were not too onerous, and that they provided valuable information to the skipper as well as proof of compliance with environmental policy, then implementation at individual boat would be possible. The onus of individual record keeping and paperwork would be common to all small business. The key to success in this situation would be to minimise workload. This could be achieved by making maximum use of existing data and a carefully designed record keeping system.

The management structure of the Cornish Handline Fishery for Mackerel (Seafish Report SR434) comprises "Winch Societies" located around individual coves along the Cornish coast. They operate along democratic cooperative lines. As such members of the cooperative would need to decide constitutionally whether they wanted an E.M.S. and then decide upon the allocation of duties and the management of the scheme.

If the various duties were shared amongst the members an individual's workload would be significantly reduced making the scheme more acceptable.

This would be feasible provided that the members were in favour of the scheme and that they perceived sustained benefit from continuing it.

In a coastal common resource fisheries situation there may well be pressure from the conservation lobby to introduce an E.M.S. in locations where areas of Wildlife importance are perceived, particularly in areas designated under the habitats directive. In the absence of an existing Management Structure the responsibility to implement such a scheme would fall to local fisheries committees or Harbour Authorities under the implementation of the habitats directive.

However, this delegated responsibility would not preclude implementation of E.M.S's on an individual or collective basis by fishermen. While local authorities would not have to accommodate existing E.M.S's it is obvious that the existence of a well designed industry E.M.S. established on a voluntary basis between fishermen and which accommodated the legislation and

needs of sensitive areas, would provide a suitable model for the local authorities to adopt and build on. Thus the existence and operation of a "fishery" E.M.S. prior to the local authority being in a position to design and implement their own, would place the fishing industry in a strong bargaining position should concessions be requested from the conservation lobby.

In the example of a larger scale multi-national common resource fishery such as the North Sea, the managing authority (National Government/EEC) could decide that it wished to initiate an E.M.S. concerning its management of the fishery. The utility of such a concept would be dependent on whether such a system would be perceived as necessary by the legislators in terms of their own environmental values system and to what extent it would augment existing fisheries management systems.

In terms of the environmental values system in this case one would expect a whole system approach including water quality, pollution inputs and ecosystems health. This has been carried out over the past five years by all the countries surrounding the North Sea.

The final Quality Status Reports (1993) have been produced. The driving force behind these studies has been the political view of the North Sea Ministerial Conference[†††] that there should be a coordinated approach to the study of the North Sea Ecosystem and man's impact upon it. The Ministerial Conference could be described as a management structure which has implemented an environmental review resulting in the Quality Status Report 1993.

In doing so it has taken a more inter-disciplinary view of fisheries compared to traditional fisheries management studies. In addition to discussion of impacts on fish populations it has considered both long-term and short-term impacts of the fishing industry on marine mammals, seabirds, physical disturbance of the seabed and the production of litter.

Thus although at present in its early stages it seems plausible that with political support an E.M.S. scheme might be introduced to cover the whole of the North Sea and be managed by the nations surrounding it. Such a system would be expected to include environmental parameters relevant to fisheries outwith normal fisheries management considerations.

[†††] - footnote needs entering in here

4. Environmental Policy

Central to the introduction of an E.M.S. scheme is the requirement to the organisation to formulate environmental policy. This maybe defined as follows:-

The company's overall aims and principles of action with respect to the environment including compliance with all relevant regulatory requirements (Eco Management and Audit Scheme).

Thus the minimum policy requirement is to accommodate the legislative obligations. In fishery terms these would include mesh sizes, quotas and other fisheries management measures along with environmental legislation concerning vessel operation such as measures to prevent pollution and correct disposal of litter.

However, the intention is to provide a tool which the organisation may use to demonstrate environmental performance above that of basic legislative requirements. Thus the environmental policy statement should include a "statement of intent" designed to exceed these requirements and seek ways of improving environmental performances.

In recognising that minimal impact on the environment and an awareness of environmental issues is of fundamental importance a proactive approach is required. An example of a simple form of environmental policy for the operation of a fishing vessel could be as follows:-

The 'statement of intent';

> "Individual fishing vessel owners will undertake to operate in an environmentally responsible manner, through"; would be implemental through the following policy

- minimising the environmental impact of their vessels operations

- evaluate the impact of environmental factors on the vessels operations.

In order to fulfill this policy statement a number of objectives would be set. Possible examples include.

i) Ensure that vessels operations complies with existing legislation to protect the environment in the waters in which it is operating.

ii) Use environmental considerations when making choices about fishing strategy, gear types, vessel construction and maintenance materials.

iii) Make sufficient records to enable a regular audit of the vessels activities with respect to their environmental effects and, where possible, the effects of environmental factors on the fishery.

iv) Make the vessel's Skipper and crew aware of this policy and the need to operate taking account of environmental issues. Provide training where necessary.

v) Review the policy regularly taking into account current environmental issues.

This example, should be regarded as a starting point. Vessel operators would need to adapt their policies to their particular circumstances. The common feature of all policy statements is a commitment to work in an environmentally responsible manner. and enable employees to draw upon this policy when making decisions.

In these environmental policies there should be some indication of the boundaries which should be set.

Consideration should be given as to whether policy should accommodate environmental considerations of the fishery only or whether the environmental credentials of organisations upstream and downstream (suppliers and vendors of product) should be taken into account.

5. Assessment and Verification

An E.M.S. could be implemented and audited on an entirely "in house" basis. However, if the scheme could be audited to an external standard it would gain credibility and improve standardisation.

This requirement could be met by designing the system so that it could be audited to BS7750 or the European Eco Management and Audit Scheme (E.M.A.S.). These two systems set out to be generic E.M.S's against which individual E.M.S's can be assessed. If shown to be adequate the organisation's system can be accredited to either the generic schemes.

The generic schemes are different in several respects. The E.M.A.S. which is principally arrived at manufacturing operations, does not list the fish catching sector as a suitable industry for assessment. Participants of E.M.A.S. are required to demonstrate an improvement in their environmental performance after each audit cycle. The variable nature of fisheries could make this difficult to demonstrate.

By contrast the BS7750 system is open to any organisation or industrial sector whose E.M.S. can meet the required criteria. It is systems based and does not require demonstration of improved environmental performance. Also BS7750 is a 'subset' of the E.M.A.S. scheme so accreditation to BS7750 would not hamper accreditation under the E.M.A.S. scheme, and could be used as a "step towards E.M.A.S.". There are moves to build a world wide system of environmental management systems accreditation schemes which are likely to be systems based, analogous to BS7750. However, as might be imagined, considerable work is required before the schemes could be adopted.

Who is going to act in judgement over these schemes? It is important to distinguish between the following levels of responsibility;

i) Environmental consultant. This is an individual or organisation who would draft the initial preparatory review and help to draft the environmental policy and management and record keeping system. No special qualifications are compulsory for this role and it could be done 'in house'.

ii) Environmental Auditor. Currently anyone can call themselves an Environmental Auditor. However, the Environmental Auditor's Registration Scheme runs a scheme which has three grades, Associate Environmental Auditor, Environmental Auditor and Principle Environmental Auditor. There are qualification and experience requirements for obtaining these qualifications (see Appendix ?) and their names are on a register held at ? together with details of the scope of their work.

iii) Accredited Environmental Verifier. This designates a person who is qualified to certify the Eco Management and Audit Scheme. However, the criteria for registration have not been worked out yet so therefore no one actually holds this qualification.

iv) Accredited Environmental Certifier. This designates a person who is qualified to certify the Environmental Management System to BS7750 (As in iii) the criteria for registration have not been fully worked out yet so currently no one holds this qualification. Companies operating BS7750 and E.M.A.S. are working to environmental management systems of that

standard but none have certification or verification yet.

6. Disclosure of Information

Since one of the objectives of an E.M.S. is to show that the operation of an organisation is environmentally responsible it would be necessary at some point to make available information. The two systems E.M.A.S. and BS7750 take an entirely different attitude to disclosure. The E.M.A.S. scheme requires disclosure of environmental policy and an 'open book' approach to the organisation's environmental performance whereas BS7750 gives the organisation complete flexibility in its attitude and approach to disclosure.

7. Preparatory Reviews

The initial step of an organisation that has no formal E.M.S. is to prepare a preparatory review to establish its current position with respect to the environment. The aim is to consider all aspects of the organisation to identify strengths, weaknesses, risks and opportunities as a basis for establishing an E.M.S.

The review should cover four key areas:-

- Legislative and regulatory requirements
- An examination of all existing environmental management practices and procedures.
- Evaluations and registration of significant environmental effects and external influences.
- An assessment of feedback from the investigation of previous incidents and non-compliance.

The most suitable approach to compile a preparatory view is to use questionnaires, checklists, interviews and other forms of consultation, augmented with direct inspection and measurements.

The preparatory review would identify the components of the organisation required to operate an E.M.S. Once such a system is implemented operating activities could be audited against objectives and targets.

A correctly conducted preparatory review is a very valuable tool. It should provide guidance in:

i) Deciding on the appropriateness of an E.M.S. to a particular organisation.

ii) Deciding what form an E.M.S. should take.

The preparatory review should, as the whole process of setting up an E.M.S. and Environmental Audit, provide a reflection of the organisation as it might be perceived from an environmental perspective.

The review would then be discussed within the organisation and should be central to the design of the E.M.S.

Environmental Effects

The definition of an environmental effect given in BS7750 is as follows:-

“Any direct or indirect impingement of the activities, products and services of the organisation upon the environment whether adverse or beneficial”.

The methodology used to assess the significance of environmental effects is not prescribed in either the Eco Management and Audit Scheme or BS7750. It is the subject of much debate and discussion and there is no clear cut and simple system which could be followed. Current thinking is provided a scheme determined the relative importance of environmental effects using

logical and dependable means then it should fulfill the requirements of the two standards.

It should be pointed out that the decision to implement an E.M.S. commits the organisation to a responsible approach towards the environment. In choosing and ranking its perceived environmental effects the organisation must be prepared to accommodate other perceptions of its activities. If it does not the organisation could be accused of covering up effects which were perceived as serious by public option. A consequence of ignoring these effects is that the organisation may not have the requisite data to provide an effective counter argument to criticism on effects which had been ignored. It must be realised that with a powerful "green" lobby public perceptions are often as important as scientific or other information. Thus when assessing the level of significance of environmental effects it is vital to explore all possible effects, and to understand that public perceptions, as well as the view of the scientific community, should be taken into account.

Since the intention is that the organisation should pay for and benefit from an E.M.S. then the organisation should take the lead in determining the levels of significance attached to each effect. A benefit of employing an environmental consultant or auditor would be to provide the organisation with an external view of their activities and advice on the relative significance of its effects taking into account issues raised by environmental pressure groups as well as scientific and technical criteria.

It is understood that environmental verifiers and certifiers, employed to verify and certify a system to the Eco Management and Audit Scheme or BS7750 standard will have to be different personnel. Their role will be simply to evaluate whether the management system in place is adequate and operating to the required specification. They will not be involved in the ranking of effects provided that the operators of the system have ranked the environmental effects in a logical and dependable manner.

The profile of environmental effects would be specific to each fishery and would depend upon the consumption of raw materials, the catch and waste products the operating routines and procedures, and the area fished.

Environmental effects fall in to four types:-

i) known and quantified
ii) known and unquantified
iii) potential and unquantified
iv) unknown

An example of type (i) would be the selectivity of net configurations on fish populations on which quantitive data is available. Type (ii) effects would include the effects of fishing on populations of cetaceans, whilst an example of a type (iii) effect could include effects on food chains or potential effects of beam trawling or scallop dredging. It may be possible to rank environmental effects on a priority basis of risk to the environment. There are several schemes available most of which rely on relative assessment of risk over given time periods and severity. These could be evaluated to assess suitability for the fishing industry. An example is provided below.

This scheme which is used in health and safety is a formal method which quantifies the

importance (priority) of environmental risk. It is a ranking process that categorises an effect (risk) by severity to the environment (very severe - low consequence) and by Probability of Occurrence (high - low). The cross reference of these two assessment criteria results in a priority score on a scale of 1-10 (figure 3).

Figure 3 - Ranking Matrix

Probability		Severity				
			Very Severe		Low Consequence	
	High	1	2	3	4	5
	↓	1	1	3	5	7
		2	2	6	7	8
		3	3	7	8	9
	↑	4	4	8	9	10
	Low	5	5	9	10	10

Figure 3 is an example of a priority chart that has been compiled using the general reference criteria (Severity and Probability) in Table 5,, Appendix ? which relates specifically to health and safety aspects of chemical process control industries.

Appendix

Environmental Fishery Model (E.F.M.)

To demonstrate the utility of an E.M.S. within the context of fisheries it is necessary to describe its implementation in a fishery situation.

Many different types of models can be applied to fisheries, most often:-

i) to model fish populations in fisheries management
ii) to evaluate economic implications of different fisheries management strategies.
iii) to evaluate social implications on fluctuating fisheries

The Environmental Fisheries Model is a framework within which an E.M.S. can be applied to a fishery.

The E.F.M. has been designed to evaluate the position of the fishery in relation to the environment and the cost of fishing activities to the environment in terms of impacts and use of resources. The model has been designed to provide data on fishery parameters which can be evaluated by an E.M.S. It must be emphasised that the environmental policy is the core element of any Environmental Management System and should be designed by an organisation's managers and their environmental advisors.

Figure ? shows the Environmental Fisheries Model which describes information on a fishery in terms of inputs and outputs and illustrates where and how an E.M.S. would be incorporated. Important factors affecting the vulnerable fish biomass input are discussed in the Fish Vulnerability Model (F.V.M.) Section 3.1.1.1.

The Environmental Fisheries Model (E.F.M.) enables the implementation of an Environmental Management System (E.M.S.) to a fisheries situation. The E.M.S. would require a management unit which wished to implement such a system to formulate a policy on the inputs and outputs, to collect information on these inputs and outputs, to carry out audits and to act on such information in line with the stated environmental policy of the organisation.

The identification and quantification of the input and the output components of the model would provide an informed understanding of the environmental dynamics of the fishery, an indication of the limits of knowledge of the environmental effects on the fishery (Figure 2) and the affections of environmental factors on the catchability of principal raw material (fish) via the fish vulnerability model (Figure 3).

Insert Figure 2 here

For illustration purposes information which would be readily available and quantifiable is presented in **bold**, whereas that which is not known or perceived as difficult to quantify is shaded.

In its simplest form the model contains two elements - inputs and outputs. Inputs describes the components that a fishery requires to operate and outputs describe the product of its activities. The components of information can be evaluated via the E.M.S. to produce a modified set of 'operational constraints' (Section 3.1.2). These then act upon the 'raw materials' (Section 5.1.1) of the fishery to produce a changed set of outputs. Information on the new outputs can be

evaluated by E.M.S. and the cycle repeated.

1.1. Inputs

Inputs are defined as the raw material inputs into a fishery operation and the legislative and institutional framework surrounding that operation. Inputs maybe categorised as:-

i) Raw Materials
ii) Operational Constraints

Raw Materials
These comprise the materials that a fishery consumes in order to operate. They may be regarded as the 'physical' inputs into a fishery and may be categorised under the following activities.

Table 1 - Raw materials consumed within fishery activities

Activity	Raw Materials`		Chemical Composition
Vessel Operation	Fuel - Diesel		Hydro carbon
	Fish		Oily/White fish
	Gear Mobile	Trawl Doors	Steel, wood
		Trawl Netting	Synthetic Fibre
		Floats	Plastic, Aluminium
		Bobbins	Plastic, Rubber
	Gear Static		
		Pots/Cages	
		Netting,floats	
Vessel Construction		wood	Soft/hardwood
		steel	Ferric compounds
		glass fibre	Organic resins and glass fibre
Vessel Servicing	Paint		Hydro carbon
	Lubricating Oil		Hydro carbon
	Cleanser		Multiple
	Anti-fouling		Organometallic

Identification of 'raw materials' would quantify the physical and chemical nature of raw materials consumed so that substitutes could be considered. For example wood from renewable sources could be used for boat building, or fishing gear materials could be chose for their level of environmental impact during manufacture of their persistence in the environment if lost.

The consumption of raw materials would be specific to each fishery and would have to be identified accordingly. The information that the model would require would be the amount of

raw material consumed and its chemical composition.

1.1.1 Fish Vulnerability Model (F.V.M.)
The most important raw material consumed by the fishery is fish. An environmental management system for a fishery operation would not be complete without reference to the environmental factors governing the vulnerability of the fish to the gear deployed in the fishery. The Fish Vulnerability Model provides a conceptual framework within which these environmental factors can be described.

The model describes the way in which the fish stock biomass is made vulnerable to the fishery. It comprises three fractions:-

- Fish Stock Biomass; this describes the total fish in the stock in the area.
- Accessible Biomass; this describes the fraction of the fish stock accessible to the fishery.
- Vulnerable Biomass; this describes the fraction of the accessible biomass which encounters the gear and is retained or otherwise killed.

The fish stock biomass, and the fractions derived from it can be influenced by both natural and man made factors. These are described in Figure 3. Although an environmental audit is not designed to quantify all these factors it should make reference to them when analysing the fishery. This analysis would provide a description of catch and effort data from the current and previous years. The analysis would then set these results in the context of the environmental and legislative framework in which the fishery is operating. Important references could include:-

- Interpretation of catch and effort data in the light of legislative changes.
- Effect of changing environmental parameters; for example, the effect of climatic change on the spatial and temporal distributions of fish stocks.
- Threats of fishing mortality from other sources.

This analysis would be particularly beneficial to skippers and managers in interpreting biological and environmental data on the fishery.

Insert Figure 3 here

This model describes the environmental influences which result in the vulnerable biomass of fish; that is fish which are vulnerable to capture and retention by the gear.

This understanding is essential in identifying the environmental factors that affect the amount and variation of the principal raw material utilised by the industry.

3.1.2 Operational Constraints
These are the legislative and regulatory requirements that are imposed upon the fishery. They may be regarded as a set of constraints that a fishery has to operate within and which act to dictate the overall scope and dimension of the fishery. They comprise:-

i) Policies
ii) Regulations
iii) Management Procedures
iv) Environmental Procedures

These 'operational constraints' are imposed upon the fishery by the 'regulating bodies' (See Table 2), and any other body (Skipper or Manager) whose decisions influence the operation of the fishery. The information contained in Table 2 is not exhaustive but meant to provide examples of the type of data required.

The 'regulatory bodies' may be regarded as operating on three levels. The first level comprises the statutory and international, (M.A.F.F., S.F.C.'s) whose 'operational constraints' define the overall scope and dimensions of the fishery. These bodies control the fishery through statutory instruments designed to result in effective fisheries management. They are also empowered under the Seafish Conversation Act (1992) to take conservation interests into account when designing legislation and byelaws. The second level comprises the management of producer organisations, fishing vessel owners, fishermen's associations and cooperatives whose 'operational constraints' regulate the routine operations of the fishery. The third and perhaps most important level, since environmental management is likely to affect fishery operations directly, are the skippers of the individual vessels.

Each body exerts an influence on the fishery through the application of their individual policies, the regulations by which they are implemented, and the environmental procedures and management practices through which the regulations are enforced.

The application of the 'operational constraints' which influence activities both on land and at sea, upon the 'raw materials' result in a set of fishery 'outputs' (See Section 1.2.).

Table 2 - The Regulating Bodies and the 'Operational Constraints' that are applied to a fishery.

Insert table here

1.2 Outputs
The outputs of a fishery comprise:-

i) Catch
ii) Waste Products
iii) Environmental Effects

The profile of each category would be specific to each individual fishery and would have to be identified accordingly.

1.2.1 Catch
An important aspect of an environmental audit could be quantification of the catch in terms of:-

i) Landings
ii) Discards
iii) Release Mortality (component of fish that escape through cod-end and die).
Catch composition represents all that is landed aboard the vessel. This is a result of the

selectivity of the gear applied to the fish population.

In addition qualitative factors which may influence landings or discards should be studied as they may represent the key to alterations in practices that are necessary.

1.2.2 Waste Products

These may be regarded as the 'degraded' products of fishery activities that serve no useful purpose and which might represent a threat to the environment. Table 4 provides a few examples that maybe considered.

Table 4 - Describes examples of waste products generated by a fishery

Waste Products		Chemical Composition
Combusted Diesel		Nitrous Oxide (NO)
		Nitrogen dioxide (NO2)
		Hydro carbons
		Soot Particles
Gear: (disused or lost)		
	Trawl Doors	Wood and Steel
	Trawl Nets	Synthetic
	Static Nets	Plastic/Synthetic
	Floats	Aluminium
	Pots	Steel, Plastic
Contaminated Substances		
	Waste Water	Complexes
	Oil	Treated Hydro carbons
	Paint	Petroleum based
	Solvents	Organo hydro carbons
Fish Guts and Trimmings		Organics and Bone
Fish Discards		Whole Fish

The information that the model requires on waste products relates to the amount produced and the chemical composition of each product.

The identification and quantification of the physical and chemical nature of the waste products would provide an understanding of their potential to impact on the environment and would allow selection of the most suitable handling and disposal methods.

Analysis of the raw materials quantities against output quantities could be carried out to provide environmental indices; for example quantity of fuel burnt or gear lost against quantity of fish

landed, or the ratio of landings to discards. One of the most important indices for many fisheries is 'catch per unit effort'. Observed changes in this index could be evaluated, using the Fish Vulnerability Model (F.V.M.), to indicate the underlying environmental factors affecting the fishery. The F.V.M. is not intended to be able to relate 'catch per unit effort' to abundance, but rather to use the index to describe the environmental 'health of the fishery. An example would be whether changes in gear type or selectivity had altered or improved prospects for the fishery, or whether they had been obscured by other environmental effects.

Such analyses could form the basis for comparison between fishing methods and gear types in the forms of raw material inputs and environmental effects against landings, discards or other outputs. In addition to providing specific benefits for individual fisheries the E.F.M. could be extremely useful in the context of fisheries management in the broadest interpretation. Information about environmental parameters would provide an environmental 'status' or signature' of the fishery: that is a profile of the environmental impacts and associated risks and benefits of fishery operations. If it were possible to give weightings to these impacts, risks and benefits then 'signatures' of different fisheries prosecuting the same target species could be compared to create an overall index of their impact on the environment. The signature would also allow a fishery to assess its strengths and weaknesses, the threats facing it from other fisheries and variations in its resource base. Such evaluations would enable the fishery to make best use of the opportunities presented and provide it with a fuller understanding of its prospects.

An example would be that of an inshore fishery assessing the implications of its resource base moving into inaccessible offshore waters in response to a drop in mean sea temperature. Another example could be the comparison of time series records of the 'catch per unit effort' against M.A.F.F. data on the variation of stock levels to indicate the current and future viability of fleets in response to changing circumstances.

It is realised that much of this data is unavailable at present and that which is available is often unreliable; fishery statistics being a good example. It is also understood that the dynamics of fisheries are notoriously difficult to understand or predict. By their nature they are often characterised by individuals working in a competitive environment exploiting a common resource. Innovations can rapidly change the likely environmental effects of the fishery.

It must be emphasised that the environmental policy is central to the concept of the E.M.S. The organisation has to put its policy into writing after taking account of the known and potential environmental effects. It is the conception and documentation of the environmental policy and its review in light of changing circumstances and legislation, which represent the key to a successful Environmental Management System. Once the policy is written down and known, the management and an organisation can draw upon this policy and the Environmental Management System for routine management, assessment of environmental risk to the fishery, assurance of adherence to good environmental practice, and provision of material for public relations.

It is during the environmental audit and review stages that opportunities may arise which could provide an increased understanding of the relationship between fisheries and the environment, and opportunities to reduce effects and seek financial savings. The review stage of E.M.S. is particularly important when considering innovative technology as it allows the examination of associated impacts in a structured manner, rather than in a piece meal manner when effects become manifest.

9. Discussion

Environmental pressures are affecting all industries at the present time. Environmental Management Systems are a response to these pressures and considerable efforts have been and are continuing to be exerted to standardise these systems on a National European and Worldwide Scale.

This report describes the first attempt to evaluate the utility of various management systems to determine whether they could be used by the fish catching sector to improve environmental performance in a systematic and dependable manner.

This report identifies that the essential elements required do operate an Environmental Management System are present in the fish catching sector and comprise the management structure, the ability of units of the industry to make policy, and the ability of industry, probably with the help of outside consultants, to make a dependable list of effects.

The questions which remain are:

i) Which set of standards would be used to assess the E.M.S.?

ii) What unit of management could sensibly and economically operate an E.M.S. ?

iii) What benefits and limitations would accrue from the operation of an E.M.S. and would they enable the fishing industry to respond to pressure from the Environmental movement ?

Taking each question in turn:

The set of standards used to assess the E.M.S. could be decided upon by the industry. Although there is no compulsion to use BS7750 or the Eco Management and Audit Scheme, adhering to a set of outside standards would improve credibility. However, the outside standards set out to monitor the Management System and not the way in which the effects are listed or categorised; therefore any system that is assessed against external standards could still be open to criticism.

Of the two external systems discussed in the report BS7750 is more suitable for the catching sector because it provides operators with a flexible system which they can adopt to their own circumstances and needs.

It does not demand anything other than that the Management system chose, is adhered tom, nor is there any requirement to demonstrate annual improvements. There in nothing to stop the fishing industry from designing its own ‘in house’ environmental management system aralogons to the Seafish Quality Award Scheme. A major benefit or using BS7750 is that it would enable trading relationships with others with the scheme in place as a standard framework.

The unit of management could, as discussed in Section 3, vary from an individual vessel to the whole of the North Sea. Although environmental management could be carried out successfully on an individual vessel basis it is debateable whether the exercise would be of any value.

There could be some benefit to the individual vessel’s in terms of record keeping an analysis of it’s environmental performance but these are likely to be offset by a high workload and a

perceived lack of any major benefit due to isolated operation and the uncoordinated implementation of many different systems.

A more promising approach would be to operate on a co-ordinated and collective basis via fishermen's associations co-operatives or vessels working in a given métier or fishing sector. In these circumstances groups of vessels would adopt the same environmental policies. EMS and record keeping system shared between members and environmental information pooled (a system would have to be devised to protect confidentiality). A collective approach to these systems could also (take a step towards) improving the fishing industry's stake in marine resources. Operators of single fishing vessels are unlikely to exert much influence in environmental negotiations whereas a co-ordinated response, based on pooled data and identical E.M.S.'s would be far more effective and robust in countering and responding to criticisms from environmental groups.

Set against this fishermen operating in competition for common resources may not find it easy to come together to agree on a single environmental management system. However, there have been examples of fishermen reaching agreements on voluntary management systems designed to avoid conflict between gears on the same grounds where different resources are being targeted.

The agreement between South Devon Trawlers Owners , South Devon Shell fishermen, Devon Sea Fisheries Committee and the South West Fish Producer Association divides up an area South of Salcombe and in Start Bay into potting and trawling grounds. This suggests that there is scope for a collective approach under the right circumstances.

The most important benefit of embarking upon an Environmental Management System is that it would demonstrate that fishermen were taking a responsible approach to the environment and proactive approach to Environmental Management issues. In this sense the process of environmental review and formulation of policy may be seen to be the most important part of the management system. Record keeping and auditing could occur later following on naturally from the policy statement. The alternative option is to leave Environmental Management of fisheries to the Government. This approach could risk the fishing industry being faced with Government policies for which it would be ill prepared and possibly have no answer. A proactive approach would improve the industry's opportunity to influence such policy and demonstrate fishing industries commitment and responsible approach towards the environment. This approach should provide industry with a stronger and more defendable claim to a stake in marine resources.

These benefits have to assessed against the limitations and costs of operating such a system. An important limitation to the use of these systems in capture fisheries is that the natural variation of the environment, in which fishing activity principals occurs, limits the scope for overall management.

As such financial savings may be limited compared to those achievable in a factory environment where greater control is possible. Process industries can exert control over many variables, thus cause and effect can be evaluated and appropriate action taken. By contrast environmental variables in the fish capture industry are difficult to control and cause and effect more difficult to establish. Under these conditions remedies may be outside the immediate powers/control of the operator. Difficulties may also arise in fisheries that change rapidly between resources and employ different technologies. Under these circumstances the most suitable approach would be

to review the environmental effects of each new set of gear as each new resource is targeted. Such factors could add to the costs of carrying out this work as the review cycle would have to be carried out more frequently.

Conclusions

Environmental Management Systems are a suitable means by which industry can formulate and implement policy on the environment and integrate policy into its Management Systems.

From the prospective of the fish catching sector the concept of an EMS is best seen in the context of a means by which the fishing industry can respond in a rational and defendable way to the conservation and environmental movements through the implementation of environmentally responsible policies.

1. The fishing industry contains the necessary elements to implement and operate and environmental management system. These comprise of Management structures and the ability to collate information.

2. The implementation of an EMS would demonstrate a responsible attitude towards the environment and a proactive approach to environmental management issues. This approach should increase credibility and respectability and should provide industry with a stronger and more affordable claim to a stake in marine resources.

3. A suitably designed EMS should enable industry to respond to marine conservation and environmental issues in a rational and affordable manner.

4. The most suitable approach to implement an EMS is on a collective basis through co-operatives, associations or métiers of vessels working within a defined area. Cost could be shared and data could be pooled. A co-operative and collective approach would provide a robust defence against criticisms from environmental groups. This would improve the fish catching sectors ability to provide a united professional front to environmental managers.

Although fishermen tend to be individualistic and find co-operation difficult, such co-operation is possible. Fishermen operating in Salcombe and Start Bay have formed and maintained voluntary agreements to minimise conflict between putting and trawling activities on the same grounds.

5. Implementation of an EMS would improve the scope of industry to influence negotiations on environmental policy in the implementation of the habitats directive, and similar future initiatives.

6. Leaving decisions on environmental management to government risks industry being faced with policies for which it would be ill prepared, had no input, and possibly unable to accommodate.

7. Use of an EMS would provide a better understanding of the impact of the fishery on the environment. It could allow the development of strategies, technologies and operational procedures could reduce the impact of fishing activities.

8. An EMS could be certified to BS7750 would improve credibility and standardisation. It would confer marketing advantages allowing trade with others requiring adherence to the standard.

BS7750 is a suitable external standard for the fish capture sector as it provides operators with the flexibility to implement systems that can be designed to suit individual needs and circumstances.

Further Work

There is a requirement to refine the approaches described in the report and to apply the theoretical models to a practical situation with known environmental impacts within the framework of an external standard such as BS7750.

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Glossary

Raw materials	-	The material inputs that a fishery consumes in order the operate; examples include diesel and fish.
Operational constraints	-	The policies, regulations, environmental procedures and management practices that shape the dimension of the fishery, e.g. its quota, location, fleet practice, gear usage, access, etc.
Regulating bodies	-	Any body that influences the operation of the fishery through the application of its own set of operational constraints. Examples, M.A.F.F., SFC's, Conservation Bodies, Producer Organisations, Associations, Skippers.
Catch	-	The composition of all that is landed aboard the vessel.
Waste Product	-	A product of fishery operations that serves no useful purpose and which may impart on the environment.
Environmental Effect	-	Any impact on the environment resulting from fishery activities.

Appendix I

1. Environmental Management Audit (EMA)

   A systematic evaluation to determine whether or not the environment management system and environmental performance comply with planned arrangements and whether or not the system is implemented effectively and is suitable to fulfill the organisations environmental policy.

2. Environmental Management Review (EMR)

   The formal evaluation by management of the status and adequacy of systems and procedures in relation to environmental issues, policy and regulations as well as new objectives resulting from changing circumstances.

3. Environmental Management Systems (EMS)

   The organisational structure responsibilities, practices, procedures, processes and resource for implementing environmental management.

7. Further Work

There is a requirement to refine the approaches described in the report and to apply the theoretical models to a practical situation with known environmental impacts within the framework of an external standard such as BS7750 or a European Standard, ISO900.

6. Conclusions

Environmental Management System shave a role in the development of fisheries. They can be used to demonstrate environmental performance and inform managers of their environmental opportunities and liabilities. Increased awareness of the environmental factors affecting fisheries and the effect of the fishery on the environment could lead to the fishing industry being able to claim a better stake in the fisheries resources and being better able to define its requirements in terms of technology with reduced environmental impact.

Initially the E.M.S. concept is best applied to fisheries systems where there is a clearly defined management structure. The concept maybe applied to “common resource” systems; however, this would require a managing authority to implement and operate the system.