

SCIENCE FOR SUSTAINABLE MARINE BIORESOURCES

A report for the Natural Environment Research Council (NERC), the Department of Environment, Fisheries and Rural Affairs (DEFRA) and the Scottish Executive for Environment and Rural Affairs (SEERAD)

Manuel Barange
GLOBEC International Project Office
Plymouth Marine Laboratory
Prospect Place, Plymouth PL1 3DH
m.barange@pml.ac.uk

May 2005

RE-FORMATTED VERSION, APPENDICES ONLY

For referencing, use version with original page-numbering at:

http://www.nerc.ac.uk/research/emergingops/bioresources/documents/scoping_study_final_report.pdf

APPENDIX 1: Terms of reference of the scoping study

Purpose:

To carry out a scoping study to identify the new areas of fundamental underpinning science, and possible modes of implementation/partnerships, required to achieve a step-change improvement in the sustainable ecosystem-based management of marine bioresources.

Deliverables:

A written ~10,000-word report (excluding annexes) to:

1. Provide a brief overview of the science that is being done by the UK into understanding the sustainable use and ecosystem based management of marine bioresources (focusing on fish and shellfish stocks), and an indication of how the various sectors work together to link science and policy.
2. Describe the current and likely future issues in marine bioresource sustainability in UK and European shelf/slope and estuarine waters, and identify key new areas of underpinning science required to address them, drawing on experiences and relevant science from the Southern Ocean and developing-country waters, as appropriate.
3. Explore the relevance of, and potential for, involvement of the social and economic science sectors and to present an informed view as to:
 - a. The key science areas and players in the social and economic sciences that would be relevant to this study area.
 - b. The risks/reward of involving, and the consequences of not involving, social sciences.
4. Present short-term and long-term options for how a joint initiative across the stakeholder spectrum could tackle the key areas under deliverable 2, indicating the estimated costs and effort required to address each one and what could be achieved by doing so (including an indication of pull-through to policy).
5. Suggest implementation mechanisms by which such an initiative could be run, providing illustrative examples of optimal structures for joint working.
6. Comment on the international context of the above deliverables.

APPENDIX 2: Scoping forms

Reference numbers match page numbers in original document. Some entries edited for length and overall consistency

British Antarctic Survey (BAS): Biological Sciences Division	58
Centre for Environment Fisheries & Aquaculture Science (CEFAS): Lowestoft	59-94, 98- 99
Centre for Environment Fisheries & Aquaculture Science (CEFAS): Burnham on Crouch	95-97
Centre for Ecology and Hydrology (CEH): Banchory	100-101
Centre for Ecology and Hydrology (CEH): Dorchester	102
Cornwall Sea Fisheries	103
Department of Agriculture & Rural Development (DARDNI)	104-109
Imperial College (University of London)	110-114
Invest in Fish South West	115
Joint Nature Conservation Committee (JNCC): Aberdeen	116
Marine Conservation Society (MSC)	117
Marine Biological Association of the UK (MBA)	118-122
National Lobster Hatchery UK	123
National Oceanographic Centre, Southampton	124-130
North Atlantic Fisheries College	131-133
Plymouth Marine Laboratory (PML)	134-136
Queen's University Belfast: Biology & Biochemistry	137
Sir Alister Hardy Foundation for Ocean Science (SAHFOS)	138-139
Scottish Agricultural College: Land Economy	140
Scottish Executive (Fisheries Research Services, Aberdeen)	141-179
University of Aberdeen: Biological Sciences	180-190
University of Hull: Scarborough Centre for Coastal Studies	191-192
University of Leicester: Biology	193-199
University of Liverpool: Port Erin Marine Laboratory	200-202
University of London: University Marine Biological Station Millport (UMBSM)	203-209
University of Newcastle upon Tyne: Marine Science & Technology	210-221
University of Portsmouth: Centre for Economics & Management of Aquatic Resources (CEMARE)	222-234
University of Portsmouth: Earth & Environmental Sciences	235-237
University of St Andrews: Sea Mammal Research Unit (SMRU)	238
University of St Andrews: Geography & Geosciences	239
University of Strathclyde: Statistics & Modelling Science	240-241
University of Wales, Bangor: School of Ocean Sciences	242-248

58. INSTITUTION: British Antarctic Survey
DEPARTMENT/ UNIT: Biological Sciences Division
Address: High Cross, Madingley Red, Cambridge, CB3 0ET
Contact person: Keith Reid k.reid@bas.ac.uk
Research Activity: **Southern Ocean ecosystem modelling**
Duration/cost: 2005-10; £ 610k
Funding: NERC
Principal Investigator: Dr Eugene Murphy e.murphy@bas.ac.uk

Objective/ Goal: The Ocean Ecosystems and Management project (a component of the Discovery 2010 programme) will use the Southern Ocean as a model to address two primary objectives that have direct relevance to the global implementation of ecosystem approaches to the management of fisheries: 1) To determine the analytical procedures and feedback mechanisms required to incorporate the results from long-term monitoring of the exploited ecosystem into management processes. 2) To develop a methodology for the implementation of ecosystem-based fisheries management at the space and time scales appropriate to the operation of the ecosystem and the fishery.

How are results communicated? Results of this project will form a major part of the UK input to fisheries management in the Southern Ocean through the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), as well as in the peer-reviewed literature.

Can results be used to support resource management? CCAMLR has adopted an ecosystem approach to fisheries management. The experience working with an RFMO that has an ecosystem based approach has been recognized as a key strength of BAS especially as NERC has been identified as one of the bodies that should be involved in providing the scientific basis for such approaches in the UK/EU.

59. INSTITUTION: Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Management Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: John K Pinnegar j.k.pinnegar@cefasc.co.uk
Research Activity: **Alternative future scenarios for marine ecosystems (AFMEC)** with Climatic Research Unit (CRU), UEA; Science & Technology Policy Research Unit (SPRU), Univ of Sussex, Centre for Social & Economic Research on the Global Environment (CSERGE), UEA.
Duration/cost: 2004-05; £111k
Funding: DEFRA (SO304; CEFAS project C2055).
Principal Investigator: John K Pinnegar

Objective/ Goal: To encourage debate about alternative futures for marine ecosystems, and to develop a series of future scenarios that can be used by Defra and other stakeholders for strategic planning. The project encourages a wider 'ecosystems' view, where marine protection objectives can be considered in the context of sustainable social and economic goals. The project takes into account views of the wider stakeholder community and will involve workshops where scenarios are constructed, reviewed and refined. The project will be undertaken by four complementary organisations. CEFAS will contribute broad cross-disciplinary knowledge of the marine environment and will draw on staff directly involved in management and monitoring of particular marine stressors. CRU will contribute knowledge of climate impacts but also experience in formulating future scenarios. SPRU and CSERGE will contribute knowledge of socio-economic drivers and will ensure that the marine-futures envisaged are in line with wider UK and European initiatives. The results of this project will inform a wide variety of potential users: fisheries organisations, offshore operators, coastal engineers and managers, regional development agencies, marine biologists, conservationists and tourist authorities.

How are results communicated? Two stakeholder workshops. Project web-site www.cefasc.co.uk/marine-futures/. Summary and technical report published early in 2005

Can results be used to support resource management? One of the most effective ways to communicate complex issues is in the form of a relatively small number of contrasting "scenarios". This study will encourage debate about alternative futures for marine ecosystems that can be used by Defra and other stakeholders for strategic planning.

60. INSTITUTION: Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Management Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk NR33 0HT
Contact person: Simon Jennings S.Jennings@cefasc.co.uk
Research Activity: **Development of ecological indicators and models to monitor and predict the ecosystem effects of fishing** with Plymouth Marine Laboratory; Univ of Wales, Bangor; FRS Aberdeen and Univ of Newcastle upon Tyne
Duration/cost: 2002-2007; £1277k
Funding: DEFRA (MF0731)
Principal Investigator: Simon Jennings

Objective/ Goal: To develop indicators of the ecological effects of fishing and to develop validated models that help to predict the impacts of fishing, and changes in fishery management practices, on the marine ecosystem. The indicators will be suitable for tracking fishery-induced changes in diversity, productivity, trophic structure and functional processes in marine ecosystems, and will be validated using historic and experimental data collected in the areas impacted by the main North Sea cod, haddock, whiting and saithe fisheries.

How are results communicated? Peer reviewed scientific literature. Presentations to conferences and stakeholders. Through ICES Working Groups, Study Groups and Advisory Committees.

Can results be used to support resource management? Yes. The validated models will allow us to advise on ecosystem consequences of implementing catch controls, effort controls and technical measures (including closed areas) and will provide the basis for establishing a system to monitor and report fishing impacts on the marine environment

61. INSTITUTION: Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Management Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk NR33 0HT
Contact person: Simon Jennings S.Jennings@cefas.co.uk
Research Activity: **Assessing the abundance, distribution and vulnerability of rare and declining species impacted by fisheries**
Duration/cost: 2002-07; £612k
Funding: DEFRA (MF0729)
Principal Investigator: Simon Jennings

Objective/ Goal: To provide validated quantitative assessments of the abundance, distribution and vulnerability of rare and declining species that are impacted by fisheries. These assessments are used to determine the validity of claims that particular species are threatened or not threatened by fishing. The research is also testing the effectiveness of existing fishery surveys to provide information on the abundance and distribution of species that are shown to be threatened by fishing.

How are results communicated? Peer reviewed scientific literature. Presentations to conferences and stakeholders. Through ICES Working Groups, Study Groups and Advisory Committees.

Can results be used to support resource management? Yes. Results are used to support advice on rare and declining species that are threatened by fisheries, in support of the integration of environmental protection requirements into the Common Fisheries Policy and the Biodiversity Action Plan for Fisheries. Results will also support the assessment, selection and validation of ecological quality objectives (Ecological Quality Objectives- EcoQOs) for threatened and declining species that will be proposed following the 5th North Sea Conference.

62. INSTITUTION: Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Management Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk NR33 0HT
Contact person: Dr Andy Revill a.s.revill@cefas.co.uk
Research Activity: **Development of fishing gears with reduced impacts on the seabed and the marine environment**
Duration/cost: 2002 – 05; £ 350k
Funding: DEFRA (M0706)
Principal Investigator: Andy Revill

Objective/ Goals: 1. To develop modifications to existing fishing gear designs (primarily beam trawls) which reduce the current existing adverse environmental impacts. 2. To investigate the potential efficacy of environmental impact-reducing fishing gear modifications or new gear designs under development globally. 3. To develop modifications to various trawl designs which reduce discarding of non-target fish.

How are results communicated? Implementation scheme with fishermen funded under the FIGG programme. Press releases, peer reviewed scientific literature, ICES working groups. Presentations and participation of stakeholders in advisory groups. Reports and presentation to Defra

Can results be used to support resource management? Yes. The technical mitigation measures developed / assessed under this programme are specifically intended for use in commercial fisheries. Testing / evaluation is undertaken on commercial vessels under fully commercial fishing conditions. The tools developed /evaluated under this programme could potentially be used to reduce the environmental impact of commercial fishing operations. This work can therefore be used to directly support resource management and ecosystem objectives.

63. INSTITUTION: Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Management Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: Dr Clive Fox c.j.fox@cefas.co.uk
Research Activity: **Impacts of environmental change on commercial fish stock recruitment**
Duration/cost: 2003-2007; £120k p.a.
Funding: DEFRA (M0431)
Principal Investigators: C Fox, S Pitois

Objective/ Goal: Collaborative project involving CEFAS and SAHFOS. To evaluate changes in zooplankton abundance and size spectra over European shelf over last 4 decades; To link these changes to possible impacts on larval fish growth and survival via individual based models; to improve the uptake of CPR data into fisheries science

How are results communicated? Peer reviewed journal articles. Attendance at ICES Zooplankton Ecology WG. To Defra via project reviews.

Can results be used to support resource management? Results should contribute towards improved understanding of role of long-term change in fisheries and thus to issues of stock sustainability. Results will be used to support medium to long-term scenario projections.

64. INSTITUTION: Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Management Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: Dr Carl M O'Brien c.m.obrien@cefass.co.uk
Research Activity: **Population dynamics models of European cod stocks**
Duration/cost: 2001-05 (5 years); £500k
Funding: DEFRA (MF0427)
Principal Investigator: Dr Carl M. O'Brien

Objective/ Goal: To build models of the important UK cod stocks, incorporating the accumulated knowledge of the biology and environmental influences on recruitment and survival, in order to improve the basis for defining sustainable harvesting strategies. The approach will be to develop a series of linked stage-structured models capable of representing the various spawning populations of cod in northern European waters extending from the English Channel to the northern North Sea and including the West of Scotland, Irish Sea and Celtic Sea. The models will explicitly represent the dynamics of pre-recruitment stages, as well as the survival of immature and adult fish.

How are results communicated? Peer-reviewed scientific literature. Presentations to conferences (national and international) and asset holders (fishers). Through ICES WGs, Study Groups and Advisory Committees ((ACFM & ACE) and NAFO.

Can results be used to support resource management? Yes! Current ICES practice is to advise on medium-term exploitation strategies that are predicted to maintain each stock within safe biological limits. These limits are defined for each stock in terms of an upper threshold of fishing mortality and a lower threshold of spawning stock biomass beyond which the precedent of historical data suggests that the risk of collapse becomes unacceptable. The models will be used to investigate the sensitivity of current stock forecasts to the inclusion of greater biological realism and to possible environmental influences.

65. INSTITUTION: Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Management Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: Dr Clive Fox c.j.fox@cefass.co.uk
Research Activity: **Development of spatially explicit models for Irish Sea plaice**
Duration/cost: 2000-05; £330k p.a.
Funding: DEFRA (M0423)
Principal Investigator: C Fox

Objective/ Goal: A consortium project involving CEFAS, Port Erin Marine Lab, Imperial College and NIOZ. To improve understanding of recruitment mechanisms for plaice (*Pleuronectes platessa*) via field and modelling studies based in the eastern Irish Sea; To develop Bayesian population dynamics models incorporating the full biological cycle including movements of fish between putative sub-stocks.

How are results communicated? Peer reviewed journal articles. Attendance by project members at relevant ICES assessment WGs. To Defra via project reviews.

Can results be used to support resource management? Data from egg surveys from M0423 have been used to support the re-evaluation of the status of the Irish Sea plaice stock leading to an increase in the TAC; the Bayesian models have been used to compare with traditional XSA approach; the spatial models will be used to evaluate the importance of including spatial evaluations in the assessment

66. INSTITUTION: Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Biology Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: Ewen Bell e.d.bell@cefass.co.uk
Research Activity: **Multispecies fisheries management: A comprehensive impact assessment of the sandeel fishery along the English east coast.**
Duration/cost: 2003-07; £1835k
Funding: DEFRA
Principal Investigator: Ewen Bell

Objective/Goal: To investigate ways of managing sandeel fisheries with minimal impact on other stocks. The project will produce a spatially explicit, multispecies model in which the dynamics of sandeels and their predators can be explored in relation to a range of local management options. A broader scale ecosystem model will also be used to examine the effect of management choices through the whole ecosystem. To achieve this, a 3 yr field programme will collect data, using novel and existing techniques, on the physical environment and local dynamics and behaviour of sandeels and their predators.

How are results communicated? Presentations to Defra. Peer reviewed scientific literature. Presentations to conferences and stakeholders. Through ICES Working Groups, Study Groups

Can results be used to support resource management? The main purpose of the project is to produce a software tool to support resource management.

67. INSTITUTION: Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Management Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: Laurence Kell l.t.kell@cefass.co.uk
Research Activity: **Fisheries Interactions**
Duration/cost: 4 years; £1,013k
Funding: DEFRA (M0322)
Principal Investigator: Laurence Kell

Objective/ Goal: To develop models of fisheries incorporating a broader range of uncertainties and processes than currently considered, to include interactions between fisheries management, exploitation, biology and our ability to monitor and assess them. More realistic treatment of interactions would improve the prediction of system response and the allocation of management resources, greatly facilitating precautionary management. A modelling framework is being developed that can be used to determine the relative benefits of tactical and strategic choices available to managers and to provide case-specific advice.

How are results communicated? Report to the EC, ICES Working Groups, Study Groups, Advisory Committees and the Annual Science conference. Peer-reviewed scientific literature. Presentations to conferences and stakeholders.

Can results be used to support resource management? Yes, the project intends to provide robust advice to managers, consistent with the precautionary approach. It will illustrate the new methods and models with a variety of case studies for stocks of importance to both DEFRA and DG-FISH.

68. INSTITUTION: Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Biology Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: Julian Metcalfe j.d.metcalfe@cefass.co.uk
Research Activity: **Spatial and temporal distribution of predators and predator/prey interactions.**
Duration/cost: 1999-2004; £3,200k
Funding: DEFRA (Fish III; MF0317)
Principal Investigator: David Righton d.righton@cefass.co.uk

Objective/ Goal: To identify and measure the interactions between fish predators (cod) and fish prey (sandeels). The project will: identify suitable field sites; determine local densities and distributions of cod and sandeels; describe the movements of cod in relation to the distribution of sandeels; establish feeding preferences of cod; and interact with the development of multispecies models at CEFAS and ICES.

How are results communicated? Reports. Peer reviewed scientific literature. Presentations to conferences and stakeholders. Through ICES Working Groups, Study Groups and Advisory Committees.

Can results be used to support resource management? Yes. Outputs from the project provide biological information that is fundamental to the understanding of predator-prey dynamics that underpins fisheries science and can be used to support the development of fishery management and conservation strategies.

69. INSTITUTION: Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Management Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: Laurence Kell l.t.kell@cefass.co.uk
Research Activity: **Evaluation of fishery management procedures and development of stock assessment methods**
Duration/cost: 4 years (completed); £970k
Funding: DEFRA (M0316)
Principal Investigator: Laurence Kell

Objective/ Goal: The project undertook case-specific evaluations of management/assessment procedures for the North Sea flatfish and other fisheries. It evaluated the efficacy of alternative management approaches under a variety of scenarios, and suggested ways in which management and assessment might be improved for wider use within ICES, given concerns about data quality and cost, the lack of conventional data for certain stocks and realistic measures of uncertainty in estimates. The approach is motivated by moves towards precautionary management. Stock assessment methods will include the estimation of appropriate reference points for management, as well as techniques for assessing current stock status.

How are results communicated? Reports to the DEFRA. ICES Working Groups, Study Groups, Advisory Committees and the Annual Science conference. Peer-reviewed scientific literature. Presentations to conferences and stakeholders.

Can results be used to support resource management? Yes. The benefits to policy will be through improved advice on the particular fisheries and stocks studied, and through better general advice based on experience with case studies.

70. INSTITUTION: Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Management Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: Mike Bell m.c.bell@cefass.co.uk
Research Activity: **Development of integrated systems for shellfish data collection, assessment and management**
Duration/cost: 2003-08; £885k

Funding: DEFRA
Principal Investigator: Mike Bell

Objective/ Goal: To underpin regular quantitative assessments of key shellfish stocks in order to provide advice on their status and management. This requires an improved understanding, not just of the dynamics of exploited shellfish stocks, but also of how these dynamics are reflected through the medium of monitoring and the application of stock assessment methods. There are inherent uncertainties and approximations in our perception of stock status, and in how this perception is translated into management advice. This project aims to identify and quantify these uncertainties, and thereby determine how best to deploy available resources towards monitoring and assessment. Crucial to this aim is the development of frameworks within which the processes of data collection, stock assessment and fishery management can be integrated.

How are results communicated? Peer-reviewed scientific literature. Presentations to conferences and stakeholders. Articles in Shellfish News.

Can results be used to support resource management? Yes. Results will: i) inform our programmes for monitoring and assessment of exploited shellfish stocks; ii) provide management models and tools; and iii) provide data and parameters in support of management. These will feed into practical resource management through advice to Defra, Sea Fisheries Committees and others.

71. **INSTITUTION:** Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Biology Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: Julian Metcalfe j.d.metcalfe@cefas.co.uk
Research Activity: **Investigating the behaviour and movements of cod in the English Channel and southern North Sea**
Duration/cost: 6 months; £24k
Funding: DEFRA
Principal Investigator: David Righton d.righton@cefas.co.uk

Objective/ Goal: To develop a greater understanding of the behaviour and movements of cod in and between ICES divisions VIIId and IVc. This work is needed to assist CEFAS in advising Defra on stock identity and separation issues with respect to the application of fisheries management and conservation policies.

How are results communicated? Official contract reports. Peer reviewed scientific literature. Presentations at conferences and to stakeholders. Through ICES Working Groups, Study Groups and Advisory Committees. Articles in fishing press

Can results be used to support resource management? Present fish stock assessments assume that the stock of cod in VIIId and IVc is a single unit and currently this is assessed and managed as one stock. Limited historical tagging data support this assumption, but recent concerns have been raised regarding its validity. The hypothesis that the stock in VIIId is a non-migratory stock (as has been observed for cod in other areas within its range e.g. Placentia Bay, Newfoundland) and should therefore be managed as a unit stock has been put forward by fishermen. The study will help to resolve this issue.

72. **INSTITUTION:** Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Biology Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: Julian Metcalfe j.d.metcalfe@cefas.co.uk
Research Activity: **Electronic telemetry tags: development of behaviour sensors for fish**
Duration/cost: 2004-09; £609k
Funding: DEFRA (Fish III; MF0155)
Principal Investigator: Julian Metcalfe

Objective/ Goal: To develop sensors that can monitor movements of free-ranging marine fish via acoustic transmitting and electronic data storage tags (DSTs). The main application is to provide information on feeding behaviour (eg prey consumption rates) in predatory fish such as cod, in relation to the environment at the appropriate spatial and temporal scales. This is needed to parameterise multi-species and ecosystem models used to advise on ecological impacts resulting from environmental changes and fishing intensity, and is fundamental to understanding fish ecology that underpins fisheries science.

How are results communicated? Reports. Peer reviewed scientific literature. Presentations to conferences and stakeholders. Through ICES Working Groups, Study Groups and Advisory Committees

Can results be used to support resource management? Yes. Outputs from the project provide the technologies required to provide the biological information that is fundamental to the understanding of fish ecology that underpins fisheries science and can be used to support the development of fishery management and conservation strategies.

73. **INSTITUTION:** Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Biology Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: Julian Metcalfe j.d.metcalfe@cefas.co.uk
Research Activity: **Linking the behaviour, spatial dynamics and the environment of cod and ray populations to evaluate fisheries scenarios**
Duration/cost: 5 years; £856k
Funding: DEFRA
Principal Investigator: David Righton d.righton@cefas.co.uk

Objective/ Goal: To develop a more comprehensive understanding and integration of behavioural, environmental and fisheries data to predict the response of cod and ray stocks to changes in the environment and fisheries. This work will assist CEFAS in advising Defra on a range of forward-looking fisheries management and conservation policies. A key element of the proposed research will be linking individual-based behavioural data-sets and environmental data-sets in order to determine the ecological drivers of cod and ray movements, and the impact of the environment on the growth and reproduction of individuals.

How are results communicated? Contract reports. Peer reviewed scientific literature. Presentations at conferences and to stakeholders. Through ICES Working Groups, Study Groups and Advisory Committees

Can results be used to support resource management? Yes. Outputs from the project provide biological information that is fundamental to the understanding of the spatial dynamics of commercially or ecologically important fish. Such information contributes to fisheries assessment and management and can therefore be used to provide evidence for the development of fishery management and conservation strategies.

74. INSTITUTION: Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Biology Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: Ewan Hunter : e.hunter@cefass.co.uk
Research Activity: **Validation and testing of biologically-based movement models for North Sea plaice and implementation in management and assessment.**
Duration/cost: 2003-07; £537k
Funding: DEFRA (Fish III; MF0152)
Principal Investigator: Ewan Hunter

Objective/Goal: The project is based around the validation, testing and implementation of a biologically-based simulation model of population movement for North Sea plaice. Aims: 1. To assess the potential impact of different management procedures on fish stocks using adult female behaviour data. 2., Male and juvenile plaice will be tagged to extend the scope of the model. 3. Geochemical analysis of otoliths from plaice tagged with data storage tags will be used to determine the lifetime movements of the fish. Model outputs will be used to support advice on the effects of closed areas and closed seasons.

How are results communicated? Reports. Peer reviewed scientific literature. Presentations to conferences and stakeholders. Through ICES Working Groups, Study Groups and Advisory Committees

Can results be used to support resource management? Yes. Outputs from the project provide information on North Sea plaice population dynamics that can be used to support the development of fishery management and conservation strategies (effects of closed areas and closed seasons)

75. INSTITUTION: Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Biology Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: Julian Metcalfe j.d.metcalfe@cefass.co.uk
Research Activity: **Movements of rays in sub-area IV in relation to special protected areas and possible management options**
Duration/cost: 1999-2004; £313k
Funding: DEFRA (Fish III; MF0148)
Principal Investigator: Ewan Hunter E.hunter@cefass.co.uk

Objective/ Goal: To describe the detailed movements of individual thornback rays over extended periods using electronic data storage tags and to calculate the proportion of time spent by each fish in each part of its geographical range. This will be used to describe the spatial dynamics of rays that use the Thames Estuary. Integration of this information with a spatial and temporal analysis of fishing effort will be used to advise Defra on the likely effects on ray stocks of closing particular areas. It will also provide information on the potential benefits to the commercial fishery in terms of improved stock biomass.

How are results communicated? Reports. Peer reviewed scientific literature. Presentations to conferences and stakeholders. Through ICES Working Groups, Study Groups and Advisory Committees

Can results be used to support resource management? Yes. Outputs from the project provide information on ray population dynamics in the southern North Sea that can be used to help develop fishery management and conservation strategies.

76. INSTITUTION: Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Biology Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: Julian Metcalfe j.d.metcalfe@cefass.co.uk
Research Activity: **Development of data storage tags (DST).** Phase 3: tag miniaturisation and development of fishery independent methods of data retrieval
Duration/cost: 1998-2004; £844k
Funding: DEFRA (Fish III; MF0145)
Principal Investigator: Julian Metcalfe

Objective/ Goal: To develop appropriate specialised telemetry technologies to support CEFAS research programmes on marine fish that provide the understanding of fish behaviour and ecology that underpins fisheries science. The project had two separate but linked aims: 1) To miniaturise the Mk 3 electronic data storage tag (developed under a previous Defra project) so that it would be small enough for deployment on male and juvenile plaice, juvenile cod and on Dover sole. 2) To develop fishery

independent methods of data retrieval to maximise data recovery and improve the cost benefit of electronic tagging experiments.

How are results communicated? Reports. Peer reviewed scientific literature. Presentations to conferences and stakeholders. Through ICES Working Groups, Study Groups and Advisory Committees

Can results be used to support resource management? Yes. Outputs from the project provide technologies required to provide the biological information that is fundamental to the understanding of fish ecology that underpins fisheries science and can be used to support the development of fishery management and conservation strategies.

77. INSTITUTION: Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Management Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: Dr Clive Fox c.j.fox@cefass.co.uk
Research Activity: **Identification of gadoid eggs from North Sea ichthyoplankton survey**
Duration/cost: 2004-06; £75k p.a.
Funding: DEFRA (CEFAS project C2016)
Principal Investigator: M Taylor (UEA), C Fox

Objective/ Goal: To use genetic probes developed by CEFAS under previous Defra contracts to identify early stage eggs of gadoids collected across the North Sea in 2004 by the International PLACES consortium (Plaice and Cod Egg Surveys, ICES sponsored). Collaborative project with University of East Anglia

How are results communicated? Peer reviewed journal articles. Planned article in Fishing News. ICES Living Resources Committee and North Sea Assessment WG. To Defra via project reviews

Can results be used to support resource management? Results will be first comprehensive survey of spawning areas of cod in the North Sea. Results will be highly relevant to definition of possible closed areas and evaluation of need for spatial management in relation to cod recovery plan

78. INSTITUTION: Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Biology Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: Julian Metcalfe j.d.metcalfe@cefass.co.uk
Research Activity: **Conservation genetics of Basking Sharks**
Duration/cost: 2004-06; £174k
Funding: DEFRA (GWD; CEFAS project C1946)
Principal Investigator: Julian Metcalfe

Objective/ Goal: To determine, using molecular genetics, the population structure and dynamics of basking sharks in the north east Atlantic. In particular, to determine whether there are discrete populations/stocks of basking sharks, the likely boundaries between any such populations and to what degree mixing between populations occur. To characterize the degree and frequency of gene flow within the whole population, or the extent to which populations are isolated or fragmented. The results will provide information in support of the management for recovery and sustainability, and the avoidance of unnecessary mortality.

How are results communicated? Reports. Peer reviewed scientific literature. Presentations to conferences and stakeholders. Through ICES Working Groups, Study Groups and Advisory Committees

Can results be used to support resource management? Yes. Project outputs will provide information on basking shark population structure and dynamics to Defra and other organisations to support the development of conservation strategies.

79. INSTITUTION: Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Biology Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: Ewan Hunter : e.hunter@cefass.co.uk
Research Activity: **Determination of Plaice lifetime movements in the North Sea by linking natural and electronic data records**
Duration/cost: 2003-07; £92k
Funding: EU Marie Curie EIF (CEFAS project C1894)
Principal Investigator: Ewan Hunter

Objective/Goal: To describe the lifetime movements of plaice *Pleuronectes platessa*, in the North Sea, by linking geographical movements recorded by fish tagged with electronic data storage tags to chemical signals simultaneously laid down in the ear-stones (otoliths) of the same fish. By linking these state of the art techniques, we aim to provide information on the population dynamics of North Sea plaice, which would be otherwise unattainable using conventional methods.

How are results communicated? Reports. Peer reviewed scientific literature. Presentations to conferences and stakeholders. Through ICES Working Groups, Study Groups and Advisory Committees

Can results be used to support resource management? Yes. The results of this study have the potential to improve the parameterisation of assessment methods currently applied in fisheries management, and will therefore feed directly into management advice designed to promote sustainability.

80. INSTITUTION: Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Biology Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: Ewen Bell e.d.bell@cefass.co.uk
Research Activity: **Critical Interactions between species and their implications for a precautionary fisheries management in a variable environment - a modelling approach (BECAUSE)**
Duration/cost: 2004-07; £163k
Funding: EU, DEFRA
Principal Investigator: Ewen Bell

Objective/ Goal: To identify and quantify critical biological interactions between and within commercial target fish species and non-commercial top predators leading to a description of food web structures and the derivation of precautionary reference points for ecosystem oriented fisheries management. These reference points and limit values accounting for interacting mechanisms with the environment are necessary for the development of adaptive strategies in fisheries management.

How are results communicated? web-site, workshops, reports, scientific journals and public printed media.

Can results be used to support resource management? The project seeks to improve multispecies modelling. Progress in this area will directly feed into scientific advice coming from within CEFAS as well as from ICES/STECF.

81. INSTITUTION: Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Management Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: Laurence Kell l.t.kell@cefass.co.uk
Research Activity: **Creation of multiannual management plans for commitment (COMMIT)**
Duration/cost: 2004-07; €458k (~ £314k)
Funding: EU
Principal Investigator: Laurence Kell

Objective/ Goal: This interdisciplinary study focuses on which elements are essential to make multi-annual management strategies acceptable for fishers and other stakeholders, and thus ensure their commitment and compliance with management regulations. Case studies will focus on mixed fisheries, based on fishery- (as opposed to stock-) based advice. Sources of uncertainty related to fishery systems and their management will be explicitly considered. Harvest rules will be developed on a case-specific basis by evaluating the biological and economic impacts of candidate rules, including the effect of non-compliance

How are results communicated? Peer-reviewed scientific literature. Presentations to conferences and stakeholders. Through ICES Working Groups, Study Groups and Advisory Committees

Can results be used to support resource management? Yes, they will highlight the key elements of multi-annual management strategies to help ensure greater stakeholder commitment, and hence improve compliance with management regulations.

82. INSTITUTION: Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Management Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: Laurence Kell l.t.kell@cefass.co.uk
Research Activity: **Fisheries independent survey based operational assessment tools (FISBOAT)**
Duration/cost: 3 yr €125k (~ £86k)
Funding: EU
Principal Investigator: Pierre Petitgas Pierre.Petitgas@ifremer.fr

Objective/ Goal: To develop fish stock assessment tools based solely on survey and other fisheries-independent data. A variety of methods are proposed to obtain direct estimates (and associated errors) of population abundance, mortality, spatial occupation and maturity at age. Assessment tools are evaluated within a simulation-testing framework, and their ability to capture changes in population biology and survey catchability is evaluated. The sensitivity of the assessment tools to uncertainties in survey estimates is also tested, so that alternative survey designs can be explored. The approach considers specific case studies, and the resultant advice is compared with current advice.

How are results communicated? Peer-reviewed scientific literature. Presentations to conferences and stakeholders. Through ICES Working Groups, Study Groups and Advisory Committees

Can results be used to support resource management? Yes, the project develops fisheries-independent tools to help manage fish stocks, useful for cases where fisheries-based data are poor or unreliable.

83. INSTITUTION: Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Management Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: Laurence Kell l.t.kell@cefass.co.uk
Research Activity: **Operational evaluation tools for fisheries management options (EFIMAS)**
Duration/cost: 4 yr; £280k + matched funding
Funding: EU
Principal Investigator: Laurence Kell

Objective/ Goal: To develop a framework that allows evaluation of the trade-off between management objectives when choosing between different management options. The evaluation framework will be developed to inform an exploratory, adaptive decision making process. These tools will be used to investigate the biological, social and economic effects of fisheries management measures in the EU, and will be applied to important fisheries. The tools will take account of the dynamics in the fisheries systems, as well as of uncertainties, and will include risk assessments.

How are results communicated? Peer-reviewed scientific literature. Presentations to conferences and stakeholders. Through ICES Working Groups, Study Groups and Advisory Committees

Can results be used to support resource management? Yes, the operational evaluation framework allows the biological, social and economic effects of alternative management options on fisheries to be investigated prior to their implementation

84. INSTITUTION: Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Management Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: Georgi M. Daskalov g.m.daskalov@cefass.co.uk
Research Activity: **European gelatinous zooplankton: Mechanisms behind jellyfish blooms and their ecological and socio-economic effects (EUROGEL)**
Duration/cost: 2001-2005; £14k
Funding: EU via IFA, Bulgaria (CEFAS project C1730).
Principal Investigator: Ulf Bamstedt, Univ of Bergen Ulf.Bamstedt@bio.uib.no

Objective/ Goal: To identify and quantify key factors regulating the abundance and succession of gelatinous plankton species in European waters. The aim is to define the basic factors that govern reproduction, growth, and survival of species commonly occurring in high abundance. Five different habitats are investigated and results are put into historical perspective. Mathematical models are constructed to explore competitive effects between gelatinous plankton and fish. EUROGEL is strongly orientated towards socio-economic aspects of gelatinous plankton outbursts, and emphasis is on quantitatively defining problems related to the fishery, coastal industry and recreational activities.

How are results communicated? Peer-reviewed scientific literature. Presentations to conferences, stakeholders & media

Can results be used to support resource management? Yes. Mechanisms behind impacts of gelatinous plankton on fisheries resources are largely unknown and/or neglected other than the huge evidence of such impacts on fish stocks e.g. *Mnemiopsis* in the Black and Caspian Seas. Better understanding of the mechanisms of interaction between fish and jellies would provide scientific basis for management of fish stocks in conditions of frequent blooms and approaches for regulation of gelatinous plankton populations.

85. INSTITUTION: Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Management Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: Beatriz A. Roel b.a.roel@cefass.co.uk
Research Activity: **Sardine dynamics and stock structure in the North-east Atlantic (SARDYN)**
Duration/cost: 3 years Cost: £73k
Funding: EU (CEFAS project C1532)
Principal Investigator: Beatriz A. Roel

Objective/ Goal: A comprehensive study of the life history and structural dynamics of the sardine *Sardina pilchardus* in Atlantic European waters with emphasis on factors required for improving the assessment and management of this species.

How are results communicated? Annual reports, report to WG MHSA and peer review papers.

Can results be used to support resource management? Yes, the study will lead to the modification/extension of existing assessment models or to the development of a new model based on biologically defensible definition of the stock boundaries and an adequate description of the sardine dynamics within the stock area.

86. INSTITUTION: Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Management Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: John Casey j.casey@cefass.co.uk
Research Activity: **Evaluation of the methodology to produce research based scientific advice under EU contract PKFM (part of WP4 and synthesis work-packages)**
Duration/cost: 3.5 years: £26k
Funding: EU with matched DEFRA funding
Principal Investigator: Trevor Hutton t.p.hutton@cefass.co.uk

Objective/ Goal: To identify and understand specific shortcomings in the European fisheries policy and its implementation, which have contributed to problems evident in several European fisheries, and to devise means for their rectification. The project focuses on knowledge production and decision-making within the fisheries management system, the interrelationships between these processes, and the role played by stakeholders. Fisheries for North Sea cod will be adopted as a case study.

How are results communicated? Peer reviewed scientific literature (no publications at this stage only in draft form). Presentations to conferences and stakeholders (presentations at the ICES, ASC) through ICES Working Groups (specifically the Working Group for Fisheries Systems; which PKFM contributes to directly), Study Groups and Advisory Committees

Can results be used to support resource management? Yes, directly. Project results include a review of cod assessment and social studies on the institutional arrangements for fisheries management (undertaken by anthropologists in the team), used to inform ICES, the ACFM and the EC of management short-comings for North Sea cod (on a technical and institutional basis).

87. INSTITUTION: Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Management Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: John Casey j.casey@cefas.co.uk
Research Activity: **External determinants of fleet dynamics** (work package coordination) and **Technological developments and tactical adaptations in EU Fisheries (TECTAC)**
Duration/cost: 3 years: £94k
Funding: EU with matched DEFRA funding
Principal Investigator: Trevor Hutton t.p.hutton@cefas.co.uk

Objective/ Goal: To supply fisheries managers with a modelling tool that will allow them evaluating the impact of regulations (TACs, MAGPs, area and season closures, subsidies) on the dynamics of fleets and fishing mortality. The carrying idea is the investigation of the dynamics of the elements that cause changes in fleet dynamics: the technological advances in both gears and vessel equipment, and also the overall tactical adaptation of fishing vessels.

How are results communicated? Peer reviewed scientific literature. Presentations to conferences and stakeholders, including ICES, ASC, European Fisheries Economist and International IFFET. Through ICES Working Groups, Study Groups and Advisory Committees, and STECF working groups and EU Commission

Can results be used to support resource management? This project will contribute significantly to measuring the actual affects of technical change within North Sea fleets on fishing mortality and catchability, in addition to understanding the effects of any effort control regulations (such as days at sea regulations), as the research focuses on the relationship between effort and fishing mortality. Furthermore, studies in this project have modelled spatial effort allocation of fishing vessels, which is relevant to area closures (MPAs).

88. INSTITUTION: Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Management Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: Beatriz A. Roel b.a.roel@cefas.co.uk
Research Activity: **Cephalopod stocks in European waters: review, analysis, assessment and sustainable management**
Duration/cost: 3 years Cost: £25k
Funding: EU (CEFAS project C1508)
Principal Investigator: Beatriz A. Roel

Objective/ Goal: Review current knowledge and issues in cephalopod fisheries science, to assemble, organise, analyse and synthesise data from ongoing national projects, previous and new EC-funded R&D projects, and to recommend future actions for scientists and cephalopod fishery managers in European waters.

How are results communicated? An annual report, Review papers, new research papers and a common database and GIS for cephalopod fisheries.

Can results be used to support resource management? Yes, see objectives above

89. INSTITUTION: Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Management Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: Laurence Kell l.t.kell@cefas.co.uk
Research Activity: **Evaluation of management strategies for roundfish stocks (MATES)**
Duration/cost: 1 yr (completed); £300k
Funding: EU
Principal Investigator: Laurence Kell

Objective/ Goal: MATES evaluated, through simulation, management strategies for roundfish stocks that stabilise catch levels by setting bounds on the inter-annual variability in TACs. An integrated modelling approach was used, which modelled both the 'real' and observed systems, and the interactions between all system components. This framework allowed evaluation of the robustness of candidate management strategies to both the intrinsic properties of the systems, and the ability to observe, monitor, assess and control them. Strategies were evaluated in terms of level of risk (probability of SSB falling below a threshold) and cumulative yield.

How are results communicated? Peer-reviewed scientific literature. Presentations to conferences and stakeholders. Through ICES Working Groups, Study Groups and Advisory Committees

Can results be used to support resource management? Yes, stable future catch levels are an important consideration for fishers, and MATES investigated the ability of management strategies to provide these given the prevailing uncertainties.

90. INSTITUTION: Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Management Science Area

Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: Laurence Kell l.t.kell@cefass.co.uk
Research Activity: Evaluation of research surveys in relation to management advice (EVARES)
Duration/cost: (completed); £224k
Funding: EU
Principal Investigator: Laurence Kell

Objective/ Goal: EVARES estimated sampling error in indices of abundance obtained from research vessel surveys and evaluated it's importance for stock assessment and subsequent scientific advice. Both data analysis and simulations techniques were conducted for a variety of European fish stocks and surveys using a common framework.

How are results communicated? Report to the European Commission. ICES Working Groups, Study Groups, Advisory Committees and Annual Science conference. Peer-reviewed scientific literature. Presentations to conferences and stakeholders

Can results be used to support resource management? Yes, EVARES was commissioned by the EU specifically to perform a cost/benefit analysis for RV surveys and to identify their strengths and weaknesses. Results could be applied for preliminary evaluation of many other surveys.

91. **INSTITUTION:** Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Management Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: Laurence Kell l.t.kell@cefass.co.uk
Research Activity: Framework for the evaluation of management strategies (FEMS)
Duration/cost: 3 yr; £96k
Funding: EU
Principal Investigator: Laurence Kell

Objective/ Goal: To develop a computer simulation framework for the evaluation of management strategies by undertaking a variety of case studies for stocks of importance to community states. The framework considers sources of uncertainty not currently routinely considered by International fisheries fora with the intention of developing methods that provide robust advice to managers consistent with the precautionary approach. FEMS will provide software and methodology that will be used by other EU proposals to evaluate the consequences of improving our understanding of fishery systems.

How are results communicated? Peer-reviewed scientific literature. Presentations to conferences and stakeholders. Through ICES and ICCAT Working Groups, Study Groups and Advisory Committees

Can results be used to support resource management? Yes, FEMS aims to develop methods that provide robust advice to managers, and help improve our understanding of fishery systems. The methodology has been adopted/used by other current and submitted EU projects (e.g. PKFM, EASE, RASER, COMMIT, EFIMAS, FISBOAT)

92. **INSTITUTION:** Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Management Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: Peter Witthames p.r.witthames@cefass.co.uk
Research Activity: Studies on fish reproduction in cod and hake in relation to population structure considering fisheries and climate to develop stock recovery plans
Duration/cost: 3 years, €1060k
Funding: Matched DEFRA and EU (in collab with IMR Norway, AZTI Spain & IEO Spain)
Principal Investigator: Peter Witthames

Objective/ Goal: To develop more cost effective and accurate methods to provide data on the age dependence of cod and hake reproductive potential caught over a large part of their latitudinal range. These methods will be applied to improve fisheries independent assessment of spawning stock biomass using egg production and for modeling stock recovery in different fisheries and environmental scenarios.

How are results communicated? Peer reviewed scientific literature. Presentations to conferences and stakeholders through releases to the National Fisheries Press. Through ICES Working Groups, ICES Annual Science Theme Session 2005, Study Groups and Advisory Committees. Website <http://raser.imr.no>

Can results be used to support resource management? Yes - developing more cost effective and accurate methods for application in fishery Independent assessment of SSB based on egg production; evaluating the impact on assessment and management of more realistic variations in population reproductive potential for cod and hake.

93. **INSTITUTION:** Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Biology Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: Julian Metcalfe j.d.metcalfe@cefass.co.uk
Research Activity: Cod spatial dynamics and vertical movements in European waters and implications for fishery management (CODYSSEY)
Duration/cost: 4 years; £417k
Funding: EU collaborative, total EU support ~€2.25m
Principal Investigator: David Righton d.righton@cefass.co.uk

Objective/ Goal: The aim of the research is to improve understanding of the horizontal migrations and vertical movements of cod and the influence of environmental and biological factors on them in order to provide management relevant information as to the horizontal availability, vertical accessibility and individual vulnerability of cod to fishing activities. The fulfilment of this objective will provide tools for the evaluation of stock assessment methodology, management and conservation of cod stocks in European waters and will be highly relevant to future stock assessment and the management of cod stocks under the soon-to-be renegotiated Common Fisheries Policy, and other fisheries management instruments.

How are results communicated? Contract reports. Peer reviewed scientific literature. Presentations at conferences and to stakeholders. Through ICES Working Groups, Study Groups and Advisory Committees. Website: www.codysey.co.uk

Can results be used to support resource management? Yes. Outputs from the project provide biological information that is fundamental to the understanding of the spatial dynamics of this commercially important fish. Such information contributes to fisheries assessment and management and can therefore be used to provide evidence for the development of fishery management and conservation strategies.

94. **INSTITUTION:** Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Management Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: John K Pinnegar j.k.pinnegar@cefas.co.uk
Research Activity: **Enhancing the outreach of aquatic biodiversity and ecosystem research in support of the transition towards global sustainability (ECOFISH)**
(Duration) cost: €295k
Funding: EU-INCO (IICA4-CT2002-50001, CEFAS project C1387).
Principal Investigator: John K Pinnegar. Project leader: Dr R Froese, Kiel, Germany rfroese@ifm.uni-kiel.de

Objective/ Goal: Strengthening of networking among Fishbase and EwE (Ecopath with Ecosim) users in Europe and developing countries (Africa, South America and Asia) by creating a functioning information network; co-ordination of research among Ecofish partners (25 scientist from 19 countries) with a view to enhance relevance for global and regional sustainability; increasing the impact of research co-operations through dissemination of results to other scientists, decision makers and the public at large; involvement of the interested public (such as anglers and divers) in monitoring fish biodiversity.

How are the results communicated? Six workshops (in Germany, Senegal, Greece, Spain and Mexico). Project website www.ecofish.org. Regular e-mail newsletter 'FishBytes' www.fisheries.ubc.ca/publications/fishbytes/. Through FishBase website www.fishbase.org

Can results be used to support resource management? The main purpose of this project is to provide training and a forum for transferral of knowledge/expertise from European scientists to individuals from Africa, South America and Asia. The project is aimed mainly at supporting participation at workshops.

95. **INSTITUTION:** Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Environmental Quality Science Area
Address: Remembrance Avenue, Burnham on Crouch, Essex CM0 8HA
Contact person: Andrew Kenny Andrew.Kenny@cefas.co.uk
Research Activity: **Towards operational oceanography – improving Smart Buoy technology**
Duration/cost 2 years, £90k
Funding: DEFRA
Principal Investigator: Dave Mills

Objective/ Goal: To develop autonomous buoy systems that will deliver improved data and information on the nutrient status and ecosystem response of UK coastal waters and shelf seas. These tools and data are to support Defra responsibilities under the Nitrate Directive, Urban Waste Water Treatment Directive and the OSPAR Convention.

How are results communicated? By peer reviewed publication, conferences, and ICES (mainly via the Plankton Ecology WG)

Can results be used to support resource management? The results of this programme provide vital observational data to parameterise ecosystem models such as ERSEM.

96. **INSTITUTION:** Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Environmental Quality Science Area
Address: Remembrance Avenue, Burnham on Crouch, Essex CM0 8HA
Contact person: Andrew Kenny Andrew.Kenny@cefas.co.uk
Research Activity: **Role of seabed mapping techniques in environmental monitoring**
Duration/cost 4 years, £1000k
Funding: DEFRA
Principal Investigator: Sian Boyd

Objective/ Goal: To critically evaluate an array of state of the art seabed mapping techniques in order to establish their suitability for application to areas of environmental management of direct relevance to Defra and to develop methodologies including survey design using such techniques for a range of assessment applications.

How are results communicated? By peer reviewed publication, conferences (national and international) and ICES mainly via the marine habitats working group (WGMH).

Can results be used to support resource management? The mapping of habitats is vital in understanding the spatial distribution of benthic bioresources and potential pelagic links.

97. INSTITUTION: Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Environmental Quality Science Area
Address: Remembrance Avenue, Burnham on Crouch, Essex CM0 8HA
Contact person: Andrew Kenny Andrew.Kenny@cefas.co.uk
Research Activity: **Development and validation of biological techniques for marine monitoring**
Duration/cost: 10 years, £800k
Funding: DEFRA
Principal Investigator: John Thain JETHain@cefas.co.uk

Objective/ Goal: To develop a suite of validated biological effects techniques that can be readily applied on behalf of Defra to meet the need for assessment of the quality of water and sediment in the marine environment. This will ensure that Defra has the ability to deploy suitable and up to date biological effects techniques for surveying marine quality, both in long term strategic quality assessment programmes such as the UK National Marine Monitoring programme and in emergency responses.

How are results communicated? By peer reviewed publication, conferences (national and international) and ICES mainly via the WG on Biological Effects WGBEC which is chaired by John Thain.

Can results be used to support resource management? The results of this programme provide a vital link between ecosystem level effects and specific causality of biological change particularly in relation to contaminants.

98. INSTITUTION: Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Biology Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: Julian Metcalfe j.d.metcalfe@cefas.co.uk
Research Activity: **Linking hydrographic frontal activity to ecosystem dynamics in the North Sea and Skagerrak: importance to fish stock recruitment.**
Duration/cost: 3 years; £210k
Funding: EU
Principal Investigator: David Righton d.righton@cefas.co.uk

Objective/ Goal: Perform field studies to quantify cross frontal and along frontal migration of selected piscivorous species and to analyse stomach samples to quantify species and life stage/ size-specific diet composition of 0-group gadoid fish in and around frontal systems.

How are results communicated? Official contract reports. Peer reviewed scientific literature. Presentations at conferences and to stakeholders. Through ICES Working Groups, Study Groups and Advisory Committees

Can results be used to support resource management? Yes. Outputs from the project provide important biological information. Such information contributes to fisheries assessment and management and can therefore be used to provide evidence for the development of fishery management and conservation strategies.

99. INSTITUTION: Centre for Environment, Fisheries & Aquaculture Science
DEPARTMENT/ UNIT: Fisheries Biology Science Area
Address: CEFAS, Pakefield Road, Lowestoft, Suffolk, NR33 0HT
Contact person: Julian Metcalfe j.d.metcalfe@cefas.co.uk, www.cefas.co.uk
Research Activity: **Basking Shark population assessment**
Duration/cost: 2000-05; £291k
Funding: DEFRA (GWD, CEFAS project C1310)
Principal Investigator: Julian Metcalfe

Objective/ Goal: To elucidate elements of the life history of basking sharks in the north-east Atlantic, especially within EU and UK territorial waters. Modern satellite telemetry (pop-up archival transmitting tags) has been used in conjunction with remotesensing imagery, sightings and strandings data to determine the movement patterns and migrations, over-wintering areas, and site fidelity of basking sharks in EU waters. The results contributed to the successful UK CITES listing proposal (2002) and will provide information in support of the management for recovery and sustainability, and the avoidance of unnecessary mortality.

How are results communicated? Reports. Peer reviewed scientific literature. Presentations to conferences and stakeholders. Through ICES Working Groups, Study Groups and Advisory Committees

Can results be used to support resource management? Yes. Outputs from the project directly supported the successful UK CITES listing proposal (2002) and will provide information on basking shark population dynamics to Defra and other organisations to support the development of conservation strategies

100. INSTITUTION: NERC Centre for Ecology and Hydrology
DEPARTMENT/ UNIT: Banchory
Address: Hill of Brathens, Banchory, AB31 4BW
Contact person: Morten Frederiksen mfr@ceh.ac.uk, Sarah Wanless swanl@ceh.ac.uk
Research Activity: **Long-term seabird studies on the Isle of May**
Duration/cost: 30 years; £30k pa basic staff costs, plus external income (up to £80k pa)

Funding: NERC, JNCC
Principal Investigator: Morten Frederiksen, Sarah Wanless

Objective/ Goal: To understand and predict the dynamics of North Sea seabird populations, using long-term data collected on the Isle of May (Firth of Forth). North Sea seabirds feed on sandeels during the breeding season, and the dynamics of sandeel stocks, their prey as well as the physical environment are integral to an understanding of seabird dynamics. Conversely, seabirds provide valuable information about marine ecosystems, and in collaboration with researchers working on different trophic levels we aim to exploit this to attribute observed changes to specific drivers (such as climate change), and to help understand and resolve environmental conflicts.

How are results communicated? Annual contract reports, primary scientific papers, popular articles etc.

Can results be used to support resource management? Data from seabirds provide cost-efficient information about the marine environment, particularly sandeels. Both direct (number and quality of fish fed to chicks) and indirect (time budgets, breeding success, survival) measures help to understand fish stocks at a scale and resolution difficult to achieve through fisheries surveys. Through statistical modelling observed changes in seabird demographic parameters can be attributed to different environmental drivers, allowing robust assessment of e.g. fishery impacts.

101. **INSTITUTION:** NERC Centre for Ecology and Hydrology
DEPARTMENT/ UNIT: Banchory
Address: Hill of Brathens, Banchory, AB31 4BW
Contact person: Francis Daunt frada@ceh.ac.uk, Sarah Wanless swanl@ceh.ac.uk
Research Activity: Seabird foraging dynamics and diet
Duration/cost: 20 years; £40-100k pa
Funding: NERC, EU, JNCC
Principal Investigator: Sarah Wanless

Objective/ Goal: To determine feeding distributions, foraging activity and prey capture rates of six species of North Sea seabirds using state-of-the-art bird borne logging devices. These detailed locational and energetic results are being integrated with diet data collected using conventional methods and emerging techniques such as stable isotope and fatty acid signature analyses. Data on foraging dynamics and diet are being integrated to determine the functional relationships between seabirds and the marine environment. To date effort has focussed on the breeding season but is currently broadening to include the overwintering and pre-breeding phase.

How are results communicated? Peer-reviewed publications, popular articles and contract reports

Can results be used to support resource management? Detailed data on where avian predators of known origin and status feed throughout the year are urgently needed to identify key marine areas. In combination with dietary information they enable spatially and temporally explicit assessments of consumption by seabirds of commercially exploited prey. In conjunction with prey abundance and distribution they also potentially enable us to develop multispecies functional responses of seabirds, an essential step in establishing the impact of fisheries on top predators in the North Sea.

102. **INSTITUTION:** NERC Centre for Ecology and Hydrology
DEPARTMENT/ UNIT: Dorchester
Address: Winfrith Technology Centre, Winfrith Newburgh, Dorchester, Dorset DT2 8ZD
Contact person: Prof Bland J Finlay bjf@ceh.ac.uk, Dr Genoveva F Esteban gent@ceh.ac.uk
Research Activity: Macroecology; microbial eukaryotes
Duration/cost: 3 years; £269k
Funding: NERC (M&FMB programme; in collaboration with 21 European research groups)
Principal Investigator: Prof BJ Finlay FRS

Objective/ Goal: Biodiversity at the microbial level may be fundamentally different in character from that of macroscopic organisms. Are smaller microbial eukaryotes so numerous that each species has a fair chance of being distributed to all parts of the world? In what size range of organisms does 'ubiquity' begin to break down? For species that are ubiquitous, does this also apply to genetic and physiological variants within species? If microbial ubiquity is the norm, what are the consequences for ecosystem functions? We investigated a freshwater pond in England and a marine brackish water bay in Denmark.

How are results communicated? Mainly in peer-reviewed international journals; popular magazines like NERC's Planet Earth; lectures/talks at national and international meetings; web site; lectures to stakeholders.

Can results be used to support resource management? Our claim is that size-frequency distributions of species are self-similar at all spatial scales (i.e. fractal or nearly so); this, combined with interpolation, provides simple tools for predicting the diversity of species at any spatial scale. We have proved this with insects and protists, but the same procedure could be used with large taxonomic groups, e.g. birds, mammals, fish. For fish, there may be practical economic benefits of the approach. For example, a continuously monitored size-frequency distribution of the fish in the North Sea would provide a snapshot of the relative abundance of large, small and medium-sized fish. Using FishBase, all we need is the names or sizes of the fish and the total number of species.

103. **INSTITUTION:** Cornwall Sea Fisheries
Address: Old Bonded Warehouse, Quay Street. Penzance, Cornwall, TR18 4BD
Contact person: Edwin Derriman ederriman.seafisheries@cornwall.gov.uk
Research Activity: Baseline study shellfish stock survey
Duration/cost: 3 years, £23k

Funding: EU Objective One
Principal Investigator: Sam Davis sdavis.seafisheries@cornwall.gov.uk

Objective/ Goal: Baseline data on Cornish shellfish stocks (population structure, seasonality and health etc). Baseline data on effort in the industry and whether it is exploited to maximum potential. Improved future management of the fishery through the use of this data. A preliminary assessment of the future potential growth of the fishery. An assessment of the potential to improve productivity without increase of effort. Involve the stakeholder in collection and use of fishery data.

How are results communicated? Production of two annual reports and a final report in 2006. Regular interim reports to the Cornwall Sea Fisheries Committee

Can results be used to support resource management? Yes. The Committee regulates the fishery by the use of byelaws. Baseline data from the study will assist in ensuring that future byelaws are focused on problem areas, or in areas where the best gains and benefits will be realised. Stakeholders want to become more involved in the management of the fishery. This project involves 7 vessels (spread geographically) and their crews over the 3 yr data collection programme. Crews are fully committed to the programme and are much better equipped to understand some of the issues surrounding fisheries management. Their positive attitude has started to permeate through the local industry and other vessel owners have asked to be involved in future projects. Such stakeholder support helps enormously if/when restrictive measures are needed. *Also undertaken work for Abalone (Ormer) but completed over two years ago. Involved in the National Lobster Hatchery (NLH).*

104. INSTITUTION: Department of Agriculture and Rural Development (NI)
DEPARTMENT/ UNIT: Aquatic Systems, AFESD
Address: Newforge Lane, Belfast BT9 5PX
Contact person: Dr Richard Briggs Richard.briggs@dardni.gov.uk
Research Activity: **Fishery independent investigations of Irish Sea fish stocks**
Durationcost: Ongoing; £300k
Funding: DARDNI
Principal Investigators: R.Briggs; P-J. Schon pieter-jan.schon@dardni.gov.uk

Objective/ Goal: To obtain fishery independent information through the use of acoustic, trawling and other forms of research vessel survey on the distribution, abundance and population structure of fish and shellfish stocks in the Irish Sea. These data are used in stock assessment, conservation and fishery management. Planned work includes completion of groundfish surveys in October 2005 and March 2006; *Nephrops* trawl/camera surveys in April and August 2005 respectively; an Irish Sea herring and sprat survey in September 2005; a herring larva survey in November 2005 and a Scallop dredge survey in February 2006.

How are results communicated? Through ICES and scientific publication.

Can results be used to support resource management? Yes, the objective of the project is to provide resource managers with a data upon which management decisions to be made and policy formulation. i.e. Total Allowable Catches and technical conservation measure.

105. INSTITUTION: Department of Agriculture and Rural Development (NI)
DEPARTMENT/ UNIT: Aquatic Systems, AFESD
Address: Newforge Lane, Belfast BT9 5PX
Contact person: M Service matt.service@dardni.gov.uk
Research Activity: ***In situ* coastal monitoring programme**
Durationcost: 2 yr; £180k
Funding: DARDNI, Environment and Heritage Service, Loughs Agency.
Principal Investigators: M Service

Objective/ Goal: Coastal water quality parameters are being remotely measured across a network of sites around Northern Ireland by a collaborative project between the Environment and Heritage Service (EHS) and The Department of Agriculture and Rural Development (DARDNI). This site aims to provide near real time data on coastal water quality acquired from a network of remotely moored monitoring stations that telemeter data through GSM modem links. Studies of sea loughs and estuaries around the coast of Northern Ireland suggest that three sites are eutrophic - these have been identified as Sensitive Areas (SA's) under the terms of the EC Urban Waste Water Treatment Directive (UWWTD). This directive is designed to reduce the pollution of freshwater, estuarine and coastal waters by effective monitoring and improved management of pollution sources.

How are results communicated? Through the web site www.afsni.ac.uk/services/coastalmonitoring/default.htm and scientific publications.

Can results be used to support resource management? Yes, the objective of the project is to provide resource managers with near real time data to allow management decisions to be made. i.e. operation of tidal barriers.

106. INSTITUTION: Department of Agriculture and Rural Development (NI)
DEPARTMENT/ UNIT: Aquatic Systems, AFESD
Address: Newforge Lane, Belfast BT9 5PX
Contact person: M Service matt.service@dardni.gov.uk
Research Activity: **The sensitivity of benthic habitats in NW Irish and Malin Shelf**
Durationcost: 3 yr; £180k
Funding: DARDNI, EU Interreg.
Principal Investigators: M Service

Objective/ Goal: To complete synoptic maps of key areas of sea bed habitats in the NW Irish Sea, N Channel and Malin Shelf. Subsequent analysis will i) indicate sensitivity to fishing, aquaculture, land run off, gravel extraction and other offshore development such as windfarms; ii) identify gaps in knowledge(unsurveyed areas) and rank in order of relevance for targetted surveying using acoustic technology; iii) develop video database of N Ireland benthic habitats; iv) review techniques for quantifying video data; v) develop sensitivity indices and predictive models for benthic habitats; and vi) produce maps on GIS format.

How are results communicated? Through the web site www.searchmesh.net/ and scientific publications.

Can results be used to support resource management? Yes, the objective of the project is to provide resource managers with near real time data to allow management decisions to be made. i.e. operation of tidal barriers.

107. INSTITUTION: Department of Agriculture and Rural Development (NI)
DEPARTMENT/ UNIT: Aquatic Systems, AFESD
Address: Newforge Lane, Belfast BT9 5PX
Contact person: Dr Richard Briggs Richard.briggs@dardni.gov.uk
Research Activity: **Population dynamics and assessment of Irish Sea fish and shellfish stocks**
Durationcost: Ongoing, £600k
Funding: DARDNI
Principal Investigators: R.Briggs; P-J. Schon pieter-jan.schon@dardni.gov.uk

Objective/ Goal: To provide information on the biology, population dynamics and status of Irish Sea fish and shellfish stocks of importance to Northern Ireland, as required for conservation of the stocks and management of the fisheries. To further develop the sampling and analytical procedures in order to improve the scientific basis for fishery management. Specific objectives include the collection of fisheries data on cod, whiting, herring, haddock, scallops and *Nephrops* and to attend relevant ICES meetings and perform stock assessments.

How are results communicated? Through ICES and scientific publication.

Can results be used to support resource management? Yes, the project will provide resource managers with information to assist management decisions and policy formulation, ie. Total Allowable Catches and technical conservation measures.

108. INSTITUTION: Department of Agriculture and Rural Development (NI)
DEPARTMENT/ UNIT: Aquatic Systems, AFESD
Address: Newforge Lane, Belfast BT9 5PX
Contact person: Dr Richard Gowen Richard.gowen@dardni.gov.uk
Research Activity: **Marine ecology**
Durationcost: Ongoing,
Funding: DARDNI
Principal Investigators: R.Gowen

Objective/ Goal: To acquire scientific data to allow DARD to meet its current and future statutory and policy responsibilities and contribute to UK policy on marine environmental management. The study of Irish Sea ecosystem structure and functioning (at the plankton level) will provide the base line against which future change can be quantified and the evidence base to determine the scale of anthropogenic influence in the Irish Sea. An important element of this work is the establishment of time-series of key variables (temperature, salinity, dissolved nutrients and plankton) in the western Irish Sea.

How are results communicated? Peer review publications, external meetings and workshops

Can results be used to support resource management? The longterm aim is to use the environmental data to underpin fisheries management and support the development and implementation of marine environmental policy.

109. INSTITUTION: Department of Agriculture and Rural Development (NI)
DEPARTMENT/ UNIT: Aquatic Systems, AFESD
Address: Newforge Lane, Belfast BT9 5PX
Contact person: M Service matt.service@dardni.gov.uk
Research Activity: **Shellfish/ecosystem carrying capacity of Northern Irish sea loughs (SMILE)**
Durationcost: 2 yr; £200k
Funding: DARDNI
Principal Investigators: M Service

Objective/ Goal: 1. To establish functional models at the lough scale, describing key environmental variables and processes, aquaculture activities and their interactions; 2. To evaluate exploitation carrying capacities (i.e. the standing stock at which the annual production of the marketable cohort is maximized) for aquaculture in the different loughs, considering interactions between cultivated species, for normal and alternative cultivation practises (i.e. marketable size of cultured organisms, cultivation period etc.); 3. To examine the effects of overexploitation on key ecological variables; 4. To examine bay-scale environmental effects of different culture strategies.

How are results communicated? Through the web site www.ecowin.org/SMILE and by stakeholder meetings.

Can results be used to support resource management? Yes, the aim of the project is to provide resource managers with usable models for management.

110. INSTITUTION: Imperial College (University of London)
DEPARTMENT/ UNIT: Biology

Address: RSM Building, Prince Consort Road, London, SW7 2BP
Contact person: Dr Murdoch McAllister m.mcallister@imperial.ac.uk
Research Activity: **Applying modelling methods to identify and use information-rich ecosystem indicators.** Part of: Development of indicators of environmental performance of the Common Fisheries Policy (INDECO)
Duration/cost: 2004-06; €35k
Funding: EU (Concerted Action)
Principal Investigator: Dr Murdoch McAllister

Objective/ Goal: Modelling methods that can incorporate informative indicators of the status of marine ecosystems are to be identified. The focus is on models that determine how measurable aspects of ecosystems may change as a result of fishing and environmental changes, multi-species fisheries models and models of the impacts of fishing on benthic communities, seabirds and mammals. In the case studies, models that can utilize measurable indicators will be identified and evaluated for their usefulness in helping analyse effects of fishing on fish assemblages, seabirds, mammals and benthic communities and distinguishing these effects from other factors such as eutrophication and anoxia.

How are results communicated? 1. A document reviewing potentially useful modelling methods that can be used to identify the ecosystem indicators having the highest information value. 2. A document that explores the use of some of these potentially useful operational modelling methods that evaluate or estimate ecosystem indicators with regard to representative European marine fisheries ecosystems. 3. A document that synthesizes the findings of the review and case study application to provide conclusions about potentially useful operational modelling methods and generic indicators of marine ecosystem status.

Can results be used to support resource management? Yes. The results of this work will (1) identify the most useful indicators of marine ecosystem status, (2) identify the most useful modelling methods available that utilize measurable indicators of the impacts of fishing on marine ecosystems, and (3) make recommendations about how such models should be applied to help manage fisheries impacts on marine ecosystems.

111. **INSTITUTION:** Imperial College (University of London)
DEPARTMENT/ UNIT: Biology
Address: RSM Building, Prince Consort Road, London, SW7 2BP
Contact person: Dr Murdoch McAllister m.mcallister@imperial.ac.uk
Research Activity: **Developing a computer simulation-testing framework to evaluate fishery management methods.** Part of: Fisheries independent survey based operational assessment tools (FISBOAT).
Duration/cost: 2004-07; £104k
Funding: EU (Specific Targeted Research Project)
Principal Investigator: Dr Murdoch McAllister

Objective/ Goal: A computer simulation-testing evaluation framework is to be built to test the potential performance of survey-based stock assessment procedures and management procedures based on them. The simulation-testing framework will enable evaluations when the underlying population dynamics is uncertain and survey catchability changes. It will allow testing of short-term management options based on such data. The simulation-testing framework includes three components: a population dynamics model to simulate the underlying population dynamics; observation model to simulate the survey data to be collected; and harvest control rule module to simulate the fisheries management decision rule based on assessment of the data.

How are results communicated? Documents are to be provided summarizing the evaluation of the performance of all tested methods with respect to robustness, precision, capability to capture stock trends and data requirements, stock risks, average yield and interannual variability in yield. Recommendations on which methods perform best for each of the case study species. The application of the computer simulation tools is to be demonstrated during workshops.

Can results be used to support resource management? Yes. The results of this work will (1) develop simulation evaluation tools to allow fisheries managers to evaluate how well management methods based on fisheries independent data only will perform, (2) identify those management methods that utilize fishery independent data only that may perform sufficiently well for management purposes.

112. **INSTITUTION:** Imperial College (University of London)
DEPARTMENT/ UNIT: Biology
Address: RSM Building, Prince Consort Road, London, SW7 2BP
Contact person: Dr Murdoch McAllister m.mcallister@imperial.ac.uk
Research Activity: **Developing a computer simulation-testing framework to evaluate multi-annual fisheries management methods.** Part of: Creation of multi-annual management plans for commitment (COMMIT).
Duration/cost: 2004-07; £90k
Funding: EU (Specific Targeted Research Project)
Principal Investigator: Dr Murdoch McAllister

Objective/ Goal: (1) Design a computer evaluation framework to evaluate the long-term performance of multi-annual management methods for mixed stock fisheries taking into account multi-fleet dynamics, and responses of fishers to management. This will allow scenario-based computer simulation experiments to be conducted for a range of hypotheses about the system to be managed. (2) Implement within the framework a model for the key biological and economic interactions including uncertainty for the three case studies (i.e., operating model). (3) Develop alternative management procedures to those currently used that can be evaluated against different hypotheses about the true dynamics, as represented by the operating model.

How are results communicated? Documents are to be provided summarizing the evaluation of the performance of all tested methods with respect to robustness, precision, capability to capture stock trends and data requirements, stock risks, average yield and interannual variability in yield. Recommendations on which methods perform best for each of the case study species. The application of the computer simulation tools is to be demonstrated during workshops.

Can results be used to support resource management? Yes. The results of this work will (1) develop simulation evaluation tools to allow fisheries managers to evaluate how well multi-annual fisheries management methods that account for uncertainty in stock and fishing fleet dynamics will perform, (2) identify those management methods that may perform sufficiently well for management purposes.

113. **INSTITUTION:** Imperial College (University of London)
DEPARTMENT/ UNIT: Biology
Address: RSM Building, Prince Consort Road, London, SW7 2BP
Contact person: Dr Murdoch McAllister m.mcallister@imperial.ac.uk
Research Activity: **Developing operating model in fisheries management evaluation framework.** Part of: Operational evaluation tools for fisheries management options (EFIMAS)
Duration/cost: 2004-08; £58k
Funding: EU (Specific Targeted Research Project)
Principal Investigator: Dr Murdoch McAllister

Objective/ Goal: A generic "operating model" will be developed that can appraise the biological, social and economic effects of the existing fisheries management measures in EU taking into account plausible hypotheses about the dynamics of the stocks and fleets. An operating model is a simulation model of the system to be managed that includes parameters and outputs from methods for monitoring and assessing the status of the system. The operating model will be applied to evaluate different management options using output parameters and results from empirical analyses of available data to address the main fisheries advisory and management problems.

How are results communicated? Documents are to be provided summarizing the evaluation of the performance of all tested methods with respect to robustness, precision, capability to capture stock trends and data requirements, stock risks, average yield and interannual variability in yield. Recommendations on which methods perform best for each of the case study species. The application of the computer simulation tools is to be demonstrated during workshops.

Can results be used to support resource management? Yes. The results of this work will (1) develop simulation evaluation tools to allow fisheries managers to evaluate how well existing fisheries management methods that account for uncertainty in stock and fishing fleet dynamics will perform, (2) identify those management methods that may perform sufficiently well for management purposes.

114. **INSTITUTION:** Imperial College (University of London)
DEPARTMENT/ UNIT: Biology
Address: RSM Building, Prince Consort Road, London, SW7 2BP
Contact person: Dr Murdoch McAllister m.mcallister@imperial.ac.uk
Research Activity: **Developing operating model in fisheries management evaluation framework.** Part of: Framework for evaluation of fishery management strategies (FEMS)
Duration/cost: 2003-06; £104k
Funding: EU (Specific Targeted Research Project)
Principal Investigator: Dr Murdoch McAllister

Objective/ Goal: (1) Develop spatial models of Atlantic swordfish population dynamics for use in fisheries stock assessment and evaluate the use of closed areas to enhance stock recovery and yield per recruit. Analyze swordfish tagging and fishing effort data to identify plausible scenarios for harvest rates and movement patterns at age. (2) Analyze tagging and fishing effort data to parameterize operating models for Atlantic bluefin population dynamics for the evaluation of multi-area based fisheries management control options for tuna. (3) Develop and test new data-based harvest control rules for tuna compatible with new understanding about stock structure, migration and multi-area management regimes.

How are results communicated? Documents are to be provided summarizing the evaluation of the performance of all tested methods with respect to robustness, precision, capability to capture stock trends and data requirements, stock risks, average yield and interannual variability in yield. Recommendations on which methods perform best for each of the case study species. The application of the computer simulation tools is to be demonstrated during workshops.

Can results be used to support resource management? Yes. This work will (1) develop new mark-recapture based methods for fisheries management that provide a stronger empirical basis for population and harvest rate estimation than more conventional stock assessment methods that use catch-age and indices of abundance, (2) identify management methods based on mark-recapture stock assessments that may perform sufficiently well for management purposes of the case study species.

115. **INSTITUTION:** Invest in Fish South West
Address: Barn C, Boswednan Farm, Tremethick Cross, Penzance, Cornwall TR20 8UA
Contact persons: Heather Squires, Jen Storemski or Spike Searle
info@investinfishsw.org.uk, www.investinfishsw.org.uk
Research Activity: **Constructing comprehensive bio-economic model of SW Approaches to test management options**
Duration/cost: 2004-06, £1600k
Funding: DEFRA, EU, M&S, CFPO, SWFPO, WWF, EN etc

Objective/ Goal: To characterise the socio-economics, biology and ecology of the Cornish and SW England fisheries in the western English Channel, Western Approaches. Develop a transparent, integrated assessment tool to evaluate costs and benefits of fish stock recovery options for SW England. Develop Cornish and SW England recovery plan options. Evaluate costs and benefits, and agree the recommended option(s). Communicate results to all stakeholders, interest groups and public.

How are results communicated? Through steering group members, website and comprehensive comms strategy.

Can results be used to support resource management? By providing the concerned groups with a method of analysing and costing options generated by the stakeholder groups themselves. By providing a transparent structure within which they can reach consensus about the best options to put forward. By enabling the stakeholders to communicate these options to their own (and other) constituencies and interest groups

116. **INSTITUTION:** Joint Nature Conservation Committee
DEPARTMENT/ UNIT: Seabirds and Cetaceans
Address: Dunnet House, 7 Thistle Place, Aberdeen AB10 1UZ
Contact person: Dr Jim Reid jim.reid@jncc.gov.uk
Research Activity: **Seabird population (and cetacean) survey and monitoring**
Duration/cost: Ongoing
Funding: DEFRA. Also private sector, govt departments, and nature conservation agencies
Principal Investigator: Dr Jim Reid

Objective/ Goal: Various. We monitor breeding performance and numbers at several colonies, annually and at longer time-scales. Special studies of seabirds at sea, distributional and ecological. are undertaken opportunistically. We currently are engaged in identifying protected areas at sea. Observations of cetaceans are made opportunistically and the results analysed to highlight dispersion and other aspects of ecology.

How are results communicated? Through various means – annual reports, special reports, scientific papers.

Can results be used to support resource management? Breeding performance of North Sea seabirds (black-legged kittiwakes on Isle of May) is used as an indicator of sandeel availability. Sandeel fishery regulation dependent on breeding success.

117. **INSTITUTION:** Marine Conservation Society
DEPARTMENT/ UNIT: Biodiversity
Address: Wolf Business Park, Alton Road, Ross on Wye HR9 5NB
Contact person: Dr Jean-Luc Solandt js@mcsuk.org
Research Activity: **Monitoring Basking Shark sightings from the general public**
Duration/cost: 1987 – present; ~ £30k pa
Funding: from SNCOs, Trust Funds and core funds
Principal Investigator: Dr Jean-Luc Solandt

Objective/ Goal: Maintain the national database of information on numbers, geographical and size distribution, behaviour and movements of basking sharks in UK waters. Collect and analyse sightings data to improve our knowledge of basking shark ecology, population dynamics and behaviour. Provide information to support the objectives and targets in the UK Basking Shark Species Action Plan, and extended protection measures in Northeast Atlantic waters

How are results communicated? Results are communicated in the public press; scientific articles; Wildlife magazines; Maritime interest magazines. Also in posters; leaflets; summary reports; technical reports (2003 and 2005); management recommendations to individual devolved nations (2005) and also through the general communications and website of the Marine Conservation Society.

Can results be used to support resource management? Can help to provide recommendations for protected areas for the species because of our large spatial and temporal database providing maps of hotspots of sharks around the UK. Can aid with local management (through the publication of a Code of Conduct) of the species, and how local authorities can provide information on how the general public can interact with the species without causing harm. Can aid with the dialogue with fishermen in relation to bycatch of the species (and others), and facilitate communication between the conservation and fishing sector (MCS will be running a biodiversity roadshow in Scotland this year) in order to help identify hotspots and reasons for by-catch. *Also research on pink seafans, pink seafan anemone, survey Atrina fragilis populations and sea turtle populations and movements in the UK. Partners for all of these biodiversity action plans*

118. **INSTITUTION:** Marine Biological Association of the UK
Address: The Laboratory, Citadel Hill, Plymouth, PL1 2PB
Contact person: Dr David Sims dws@mba.ac.uk
Research Activity: **Movements and behaviour of free-ranging fish in relation to environmental variability**
Duration/cost: 2000- present; total ~£375k
Funding: NERC, DEFRA, Fisheries Society, Royal Society, National Geographic Society
Principal Investigator: Dr David Sims

Objective/ Goal: To understand habitat selection processes in free-ranging fish through tracking their movements and behaviour to better identify why fish select certain habitats at particular times, and to understand the interplay between environmental variability and the spatial structure and dynamics of natural populations. We integrate movement trajectories from electronically tagged fish with environmental heterogeneity assessed remotely by satellite or by direct sampling. Our ultimate goal is to understand the behavioural 'rules' underpinning movements as a basis for developing process-based predictive models of fish dispersion patterns.

How are results communicated? Results are communicated through peer-reviewed journals, presentations at international conferences, and to the wider public by media releases and National Science week events. Principal papers have been published in *Nature*, *Proc. R. Soc. B* (2 papers), *J.Anim. Ecol.* and *MEPS*.

Can results be used to support resource management? Understanding the spatio-temporal dynamics of fish movements resulting in realised patterns of distribution and abundance is a key component of resource management. The ability to understand and therefore predict changes in fish population distributions in relation to natural and anthropogenic factors will be a crucial element of how fish stocks are managed within an ecosystem approach, or under adaptive management regimes.

119. INSTITUTION: Marine Biological Association of the UK
Address: The Laboratory, Citadel Hill, Plymouth, PL1 2PB
Contact person: Dr David Sims dws@mba.ac.uk
Research Activity: **Long-term changes of fish populations in relation to climate variability and fishing**
Duration/cost: 2000- present; £44k
Funding: DEFRA
Principal Investigator: Dr David Sims, Dr Martin Genner (Hull), Prof. A.J. Southward, Prof. Steve Hawkins

Objective/ Goal: To determine the influences of climate and fishing on marine fish using long-term datasets collected by the MBA. Since 1913 the MBA has recorded the species number, relative abundance, length and mass of fish from standardised trawls in the western English Channel. These datasets were used to investigate (1) how temperature changes during the 20th Century altered the migration phenology of commercially important species of flatfish and squid, (2) how climate variability influenced abundance trends of the fish community comprising about 90 species, and most recently, how fishing and climate effects on key species can be teased apart using multivariate methods. This work has demonstrated important regional differences and similarities in responses.

How are results communicated? Results are communicated through peer-reviewed journals, presentations at international conferences, and to the wider public by media releases and National Science week events. Principal papers arising from this work have been published in *Proc Roy Soc B* (2 papers) and *J Anim Ecol*.

Can results be used to support resource management? Understanding the relative influences of climate and fishing on fish is a key step in unravelling the mechanisms underpinning observed fluctuations in marine fish populations. By determining how fish responded to these effects in the past may contribute to our ability to predict population trajectories in future. Our work indicates the importance of understanding fish responses at the regional level, the details of which may directly affect management choices in particular areas.

120. INSTITUTION: Marine Biological Association of the UK
Address: The Laboratory, Citadel Hill, Plymouth, PL1 2PB
Contact person: Nova Mieszkowska, nova@mba.ac.uk
Research Activity: **Marine biodiversity and climate change (MarClim)**
Duration/cost: 2001- 05; £584k
Funding: DEFRA, EN, SNH, SE, EA, CCW, Crown Estates, JNCC, States of Jersey, WWF
Principal Investigator: Professor S. J. Hawkins sjha@mba.ac.uk

Objective/ Goal: MarClim has established a single focus to improve the understanding of the effects of global climate change on coastal marine biodiversity. The project focuses on a suite of temperature-sensitive invertebrate species that reach their northern or southern limits of distribution in Britain and Ireland. Using datasets extending back to the 1950s, combined with current re-surveys, MarClim is identifying changes in range and population structures within near-limit habitats that have occurred in response to the current period of rapid warming. The results are being used to help model and track future effects of climate change on marine biodiversity and inform policy and decision-makers.

How are results communicated? Peer-reviewed journals, scientific and government agency conferences, scientific reports, policy and conservation working groups. Website: www.mba.ac.uk/marclim where all published material is available.

Can results be used to support resource management? The scale and nature of marine climate change impacts now need to be built into how we manage human activities, establish site-based conservation mechanisms, monitor, assess and report on the status of habitats, species and ecosystems, as well as the structuring of underlying legislation and policies. MarClim species are recommended by government agencies for inclusion as part of the key indicator set for marine and coastal biodiversity: they are easy and cost effective to measure, they are very responsive indicators of climate change signals, directly inform on climate change as a top policy priority of Government and inform and assess climate change risks and vulnerabilities on policies for sustainable development.

121. INSTITUTION: Marine Biological Association of the UK
Address: The Laboratory, Citadel Hill, The Hoe, Plymouth, PL1 2PB
Contact person: Dr Stuart Jenkins sjen@mba.ac.uk
Research Activity: **Using long-term records to determine changes in fish- benthos interactions**
Duration/cost: 2000- present; £73k
Funding: NERC, DEFRA
Principal Investigator: Dr S.R. Jenkins

Objective/ Goal: To use existing long-term data from the Plymouth coastal area on demersal fish and benthic invertebrates plus historic and contemporary surveys of fish diet to understand how anthropogenic-induced change in the marine environment will impact fish-benthos interactions. Specifically, how will changes in availability of fish prey (benthic invertebrates) brought

about both directly (climate change, physical disturbance from demersal fishing) and indirectly (changes in ecosystem functioning of benthic sediments) affect demersal fish populations? How will this interaction be modified by climate and fishing induced changes in fish community structure?

How are results communicated? Results are communicated through peer-reviewed journals, presentations at inter-national conferences, and to the wider public by media releases and National Science week events.

Can results be used to support resource management? Understanding the linkages between benthic invertebrates and demersal fish is paramount in any ecosystem-based approach to fisheries management. Preliminary results from our work have indicated substantial changes in both infaunal community structure and diet composition in some demersal fish species over 70 years in the English Channel. Further work is required to better understand how changes in benthos brought about by anthropogenic pressures such as fishing, climate change and aggregate extraction impact on fish resources.

122. INSTITUTION: Marine Biological Association of the UK
DEPARTMENT/ UNIT: Marine Environmental Change Network (MECN)
Address: The Laboratory, Citadel Hill, Plymouth, PL1 2PB
Contact person: Dr Matthew Frost matfr@mba.ac.uk
Research Activity: **E1 / L5 long-term time series: measurement of physical parameters and plankton collection**
Duration/cost: 2002-05; £112k
Funding: DEFRA
Principal Investigator: Professor Stephen J. Hawkins sjha@mba.ac.uk

Objective/ Goal: The E1/L5 time series was restarted as part of the pilot phase of MECN, to ensure delivery and interpretation of long-term and broad-scale contextual information for water-quality monitoring. Physical and biological (plankton) data from E1/L5 are being collated in a database and the methods of data collection included in intercalibration and quality assurance exercises. The goal is to analyse and cross-correlate the data with data from other time-series to determine mechanisms underlying environmental and anthropogenic change in marine systems. It is planned to add benthos to the suite of parameters measured in the Western English Channel to improve understanding of the WEC ecosystem.

How are results communicated? Data from E1/L5 have been included in a review to Defra and are available through Defra and the MECN website, www.mecn.org.uk. Peer reviewed papers are given in relevant publications.

Can results be used to support resource management? 'Ecosystem based' management requires an understanding of how ecosystem components interact with each other and how they respond to natural and anthropogenic drivers. Data from E1 / L5 are crucial in assessing the relative importance of natural fluctuations and global (climate change), regional (eg eutrophic-ation, fishing) and local (e.g. point source pollution, aggregate extraction) anthropogenic impacts. These data have already been utilised for the purpose of disentangling climate and fishing impacts by comparisons with other time series in the North Sea. Measurements at E1 / L5 are in the western English Channel, where studies over the past 100 years have contributed much of our understanding of how marine ecosystems function. They provide boundary conditions for the rest of the English Channel.

123. INSTITUTION: National Lobster Hatchery, UK.
Address: South Quay, Padstow, Cornwall PL28 8BL
Contact person: Dylan Taylor www.nationallobsterhatchery.com
Research Activity: **Refining lobster *Homarus gammarus* hatchery practices to improve efficiency and effectiveness**
Duration/cost: Ongoing; ~£25k pa (part of core work)
Funding: own funds
Principal Investigator: Dylan Taylor hatchery@hatchery.plus.com

Objective/ Goal: To refine the aquaculture process used in the hatchery, such as disease diagnosis and treatment. This is published through Fish Farming International and hopefully Crustaceana this year. We also do collaborative work with the University of Plymouth, in 2004 we conducted a study looking at the use of functional nutritional supplements (mannan oligo-saccharide) with lobster larvae, and aim to publish the results with reference to survival and growth rates.

How are results communicated? In the press, both mass media and industry news, and hopefully in 2005 in peer reviewed papers. We also publicise our work on our website.

Can results be used to support resource management? Yes, other stock enhancement projects can pick up on refinements and improvements that we are making to improve their efficiency. (Three other projects in UK exist similar to ours). This can then be used in improved fishery enhancement practice.

124. INSTITUTION: National Oceanography Centre, Southampton
DEPARTMENT/ UNIT: DeepSeas Benthic Biology Group, George Deacon Division
Address: Waterfront Campus, European Way, Southampton, SO14 3ZH
Contact person: Dr Brian J Bett bjb@soc.soton.ac.uk
Research Activity: **Atlantic margin environmental survey**
Duration/cost: On-going since 1996
Funding: AFEN (Atlantic Frontier Environmental Network) and DTI
Principal Investigator: Dr Brian J Bett

Objective/ Goal: Large-scale regional environmental assessment of UK deep-water territory, identifying features and processes in the geological and biological attributes of the seabed. Using acoustic remote sensing, seabed photography and direct sampling provide a state of the art description of the UK deep-sea environment. To map features and habitats and establish baseline environmental data for such features and habitats.

How are results communicated? Via peer-reviewed scientific publications (e.g. Bett, B.J., 2001. UK Atlantic Margin Environmental Survey: Introduction and overview of bathyal benthic ecology, Continental Shelf Research, 21, 917-956. Masson, D.G., 2001. Sedimentary processes shaping the eastern slope of the Faeroe-Shetland Channel, Continental Shelf Research, 21, 825-857.) Publically accessible reports (e.g. AFEN www.geotek.co.uk/; DTI Ecology www.offshore-sea.org.uk/; DTI Geology www.offshore-sea.org.uk/) and a range of supporting conference and other materials.

Can the results be used to support resource management? Yes. Although perhaps one of the world's best studied deep-water areas, the UK's deepwater territory is still only poorly know. Appropriate management of deep-water bioresources is fundamentally dependant on a knowledge of what resources exist and where. Our knowledge of the basic functioning of such deep-water ecosystems is also limited as are the effects of extant, and future potential, human impacts on these systems.

125. **INSTITUTION:** National Oceanography Centre, Southampton
DEPARTMENT/ UNIT: George Deacon Division
Address: Waterfront Campus, European Way, Southampton, SO14 3ZH
Contact person: Dr Tom Anderson tra@soc.soton.ac.uk
Research Activity: **Modelling biophysical interactions in the ocean**
Duration/cost: Ongoing
Funding: NERC
Principal Investigator: Tom Anderson

Objective/ Goal: To use ecosystem models embedded in 3D models to study biophysical interactions and the controls on community structure in the ocean, focussing in particular on the North Atlantic. Models include the high-resolution Harvard Ocean Prediction System models (HOPS), and the Ocean Circulation and Climate Advanced Modelling Project (OCCAM) which is global, with resolutions of 1, 1/4 and 1/12 degrees.

How are results communicated? International journal papers, conference/workshop presentations, project reports

Can results be used to support resource management? Yes. Modelling of food web structure forms the basis of predicting transfer to higher trophic levels including fish.

126. **INSTITUTION:** National Oceanography Centre, Southampton
DEPARTMENT/ UNIT: George Deacon Division
Address: Waterfront Campus, European Way, Southampton, SO14 3ZH
Contact person: Dr Boris Kelly-Gerreyn bag@soc.soton.ac.uk
Research Activity: **Marine productivity**
Duration/cost: 18 months; £173k
Funding: NERC
Principal Investigator: Tom Anderson tra@noc.soton.ac.uk

Objective/ Goal: To establish a numerical model system providing a robust 3-D physical environment within which ecosystem and zooplankton models of different structure and complexity can be compared and assessed. To determine the optimal complexity of marine hydrodynamic and ecosystem models necessary to describe zooplankton dynamics in the Irish Sea.

How are results communicated? International journal papers, conference/workshop presentations, project reports

Can results be used to support resource management? Yes. This work assesses the contribution of top-down and bottom-up controls on phytoplankton species succession in biogeographical region 5 (Irish Sea) and can be adapted for use in the entire north west European shelf area. Understanding controls on phytoplankton community structure helps to identify/ predict zooplankton (fish food) types.

127. **INSTITUTION:** National Oceanography Centre, Southampton
DEPARTMENT/ UNIT: George Deacon Division
Address: Waterfront Campus, European Way, Southampton, SO14 3ZH
Contact person: Dr Boris Kelly-Gerreyn bag@soc.soton.ac.uk
Research Activity: **FerryBox project**
Duration/cost: 3 years; ~£200k
Funding: EU and NERC
Principal Investigator: David Hydes djh@noc.soton.ac.uk

Objective/ Goal: The European FerryBox Project is a multi-disciplinary research and development project to qualify and foster routine underway measurements from ferry boats to better monitor the environmental conditions of European Seas. They will demonstrate the validity of the hypothesis that FerryBox systems can: a) cost effectively deliver continuous information of immediate scientific value, b) prove that FerryBoxes are reliable systems for monitoring and management, and c) provide real-time data which can be effectively assimilated into prognostic numerical models to improve their accuracy.

How are results communicated? International journal papers, Web pages, international and national conference/ workshop presentations, passenger leaflets and posters

Can results be used to support resource management? Yes. This work will assess the variability in geographical locations 3 and 4 (western and eastern English Channel) and help to refine the set of sub-ecosystems required within MERP. Monitoring and analysis of cross-margin exchanges will be critical in validating hydrodynamic ecosystem models.

128. INSTITUTION: National Oceanography Centre, Southampton
DEPARTMENT/ UNIT: George Deacon Division
Address: Waterfront Campus, European Way, Southampton, SO14 3ZH
Contact person: John Allen jta@noc.soton.ac.uk, Jane Read jfr@noc.soton.ac.uk, Penny Holliday nph@soc.soton.ac.uk
Research Activity: **The extended Ellett line hydrographic and biogeochemical time series**
Duration/cost: Ongoing; ~£200k pa
Funding: NERC
Principal Investigator: David Hydes djh@noc.soton.ac.uk

Objective/ Goal: Since 1996 the Southampton Oceanography Centre has been occupying an extended version of the historic Ellett Line (Oban to Rockall) that runs all the way to Iceland. The Extended Ellett line is important oceanographically because it completes the measurements of the warm salty water flowing into the Nordic Seas from the eastern North Atlantic. It also measures around half of the returning deep and cold current, the overflow water. More recently an extensive suite of biogeochemical measurements has been added, these are aimed at determining the relative importance of opal and calcite production and how this changes with time.

How are results communicated? International journal papers, conference/workshop presentations, project reports, web pages

Can results be used to support resource management? Yes. The line passes through the centre of biogeographical region 8 (Atlantic NW Approaches, Rockall Trough and Faeroe-Shetland Channel). Further work could be accommodated.

129. INSTITUTION: National Oceanography Centre, Southampton
DEPARTMENT/ UNIT: George Deacon Division
Address: Waterfront Campus, European Way, Southampton, SO14 3ZH
Contact person: John Allen jta@noc.soton.ac.uk,
Research Activity: **Faeroes, Iceland, Scotland, hydrographic and environmental survey (FISHES)**
Duration/cost: Part of BICEP 2001-06; ~£500k
Funding: NERC
Principal Investigator: John Allen

Objective/ Goal: Operational oceanography in which large scale hydrographic and biogeochemical measurements across the Iceland Basin were compared with ocean colour images to select a region and objectively plan a high resolution occupation for process studies and forecast modeling. Primary productivity parameters from a FRRF instrument were obtained in real time and concurrent with a data set including temperature, salinity, pressure, fluorescence, and particle size and abundance from an optical particle counter (OPC). Combined with in-situ sampling, we showed that the ageostrophic motions associated with an unstable front doubled the export potential of diatoms in the frontal zone.

How are results communicated? International journal papers, international and national conference/workshop presentations, project reports, Web pages etc.

Can results be used to support resource management? Yes. The survey area is relevant to Region 8, and results show that mesoscale fronts and eddies may double the growth and export potential of seasonal overturning alone.

130. INSTITUTION: National Oceanography Centre, Southampton
DEPARTMENT/ UNIT: George Deacon Division
Address: Waterfront Campus, European Way, Southampton, SO14 3ZH
Contact person: Richard Sanders rics@noc.soton.ac.uk,
Research Activity: **Estimating export production in the oceans**
Duration/cost: Ongoing
Funding: NERC
Principal Investigator: Various within GDD

Objective/ Goal To estimate export production using a variety of tools including but not limited to 234Th, 15N, Remote sensing, Drifting sediment traps, nutrient budgets, deep sediment traps. We have applied these tools in a variety of environments including the Southern Ocean, the Irminger basin and the PAP site. We plan to deploy them on an oceanographic transect through region 8 on a regular basis.

How are results communicated? International journal papers, conference/workshop presentations, project reports.

Can the results be used to support resource management? Yes. The magnitude, timing and taxonomic composition of export production define the maximum quantity of new food available to secondary producers.

131. INSTITUTION: North Atlantic Fisheries College
DEPARTMENT/ UNIT: Fisheries Section, Marine Sciences Dept.
Address: Port Arthur, Scalloway, Shetland, ZE1 0UN
Contact person: Dr Suz Henderson suz.henderson@nafc.uhi.ac.uk
Research Activity: **Monitoring effect of landslide on marine environment in Shetland**

Duration/cost: 12 months; £14k
Funding: Community Economic Development Programme, Shetland Enterprise, North Atlantic Fisheries College, Fishing industry
Principal Investigator: Dr Suz Henderson, Dr Sue Marrs

Objective/ Goal: To monitor the effects of a landslide (19 Sept 2003) on the shellfish catches and waterquality within two voes in the South of Shetland.

How are results communicated? Poster display at public open day at NAFC. Published Fisheries Development Note (NAFC publication). Articles in local newspapers and in NAFC newsletter. Direct communication to shellfish fishermen.

Can results be used to support resource management? Provides background information on the effects and length of recovery, that otherwise would have gone unnoticed, related to water quality, the marine environment and shellfish stocks.

132. INSTITUTION: North Atlantic Fisheries College
DEPARTMENT/ UNIT: Fisheries Section, Marine Sciences Dept.
Address: Port Arthur, Scalloway, Shetland, ZE1 0UN
Contact person: Dr Suz Henderson suz.henderson@nafc.uhi.ac.uk
Research Activity: **Investigation into the spatial and temporal differences in velvet crab fisheries biology around Shetland waters**
Duration/cost: 18 months; £25k
Funding: Community Economic Development Programme, Shetland Enterprise, North Atlantic Fisheries College
Principal Investigator: Dr Suz Henderson, Dr Sue Marrs

Objective/ Goal: To investigate the differences in fisheries biology (moulting period, catch damage, sex ratio, berried females period, crab sizes) of velvet crab stocks around Shetland, using a research vessel survey and laboratory work.

How are results communicated? Poster display at public open day at NAFC. Published Fisheries Development Note (NAFC publication). Articles in local newspapers and in NAFC newsletter. Direct communication to shellfish fishermen at Shellfish Organisation meetings. Scientific journal articles

Can results be used to support resource management? Provided data required to allow the local Shellfish Management Organisation to implement regulations on closed fishery periods. Also provided additional information on the fisheries biology of resource stocks, and pinpointed areas where future research could benefit management decisions.

133. INSTITUTION: North Atlantic Fisheries College
DEPARTMENT/ UNIT: Fisheries Section, Marine Sciences Dept.
Address: Port Arthur, Scalloway, Shetland, ZE1 0UN
Contact person: Dr Suz Henderson suz.henderson@nafc.uhi.ac.uk
Research Activity: **Shellfish monitoring programme**
Duration/cost: Ongoing; ~£25k in 2003/04
Funding: Shetland Enterprise, North Atlantic Fisheries College
Principal Investigator: Dr Suz Henderson, Dr Sue Marrs

Objective/ Goal: To coordinate, collect and collate a continual series of fisheries data on all commercially fished shellfish (brown edible crabs, velvet swimming crabs, lobsters, King scallops, Queen scallops, Common whelk) around Shetland to allow the status of the stocks to be monitored. In addition various fisheries research projects (eg lobster tagging studies) are undertaken to provide additional information on shellfish biology.

How are results communicated? Direct communication to shellfish fishermen at Shetland Shellfish Management Organisation meetings. Stock Status reports (NAFC publication). Poster display at public open day at NAFC. Articles in local newspapers and in NAFC newsletter. Scientific journal articles

Can results be used to support resource management? These data are essential to the management of local shellfish stocks, providing information to the Shetland Shellfish Management Organisation on current stock status and future predictions.

134. INSTITUTION: Plymouth Marine Laboratory (with Proudman Oceanographic Laboratory & MetOffice)
Address: PML, Prospect Place, Plymouth PL1 3DH
Contact person: Icarus Allen jia@pml.ac.uk
Research Activity: **Shelf seas ecosystem modelling**
Duration/cost: Ongoing; £300k per year
Funding: NERC, EU
Principal Investigator: Icarus Allen

Objective/ Goal: We are developing high resolution coupled hydrodynamic shelf seas ecosystem models for the NW European Shelf. The models are a combination of ERSEM and POLCOMS, and are nested with the FOAM North Atlantic model. The objectives are: 1. To hindcast and understand the processes controlling the seasonal cycle of the lower trophic levels (up to mesozooplankton); 2. To make nowcast simulations of the NW European shelf ecosystem; 3. To make long term hindcast simulations of the CRP to understand the processes driving observed changes in ecosystem function; 4. To assess via simulation ecosystem response to anthropogenic changes e.g. changing nutrient loads, changing patterns of demersal trawling. In the longer term we would like to address put the higher trophic levels (to fish) back into ERSEM to try and understand the mechanistic links between environmental change and fish populations.

How are results communicated? Via peer reviewed publication, international conference, websites.

Can results be used to support resource management? Yes. The model give us insight into environmental processes which can inform policy, allowing complex 'what if' scenario-testing to inform management decisions.

135. INSTITUTION: Plymouth Marine Laboratory
Address: PML, Prospect Place, Plymouth PL1 3DH
Contact person: Mel Austen mcva@pml.ac.uk
Research Activity: **Costing the impact of demersal fishing on marine ecosystem processes and biodiversity (COST-IMPACT):** a holistic framework linking environment, fisheries and socio-economics
Duration/cost: 3 yr
Funding: DEFRA, EU
Principal Investigator: Mel Austen

Objective/ Goal: To help decision makers integrate fishing and environmental policy by determining: 1. How demersal fishing impacts the biodiversity of marine benthos and the ecosystem goods and services they provide (meta-analysis of existing data, effects on pelagic-benthic coupling through nutrient cycling); 2. How these impacts influence other marine ecosystem processes (ecosystem modeling); 3. What the likely economic values of marine ecosystem goods and services are and how these values are affected by fishing (economic valuation). COST-IMPACT has provided a tool (decision support system) to help determine whether a balance can be achieved between the impacts of fishing on marine ecosystems, the economic value of the goods and services they provide, and the economic value of a fishery

How are results communicated? Scientific papers (1 published, 6-10 in preparation); web site www.cost-impact.org; reports to EU; through projects reference user group consisting of policy makers, managers, representatives of fishermen organisations; through valuation workshops with EU users; at policy workshops with representatives from DGs Fish, Environment and Research; through presentations to DEFRA, English Nature, at EU stakeholders workshop on EU Marine Strategy; plan to publish articles in fishermen's news magazines; press release.

Can results be used to support resource management? Yes! C-I has been held up by English Nature and the DG Environment as an example of implementing an 'ecosystem approach' framework to integrate fisheries and environmental management within a socio-economic context. The holistic C-I 'ecosystem approach' could equally be used for other anthropogenic impacts on the marine systems. From the outputs of the natural scientists the effects of different fishing regimes on fishery productivity and other ecosystem services have been modelled. Where possible, changes in their economic value (monetary and non-monetary) have been calculated. From these results a decision support tool has been developed for incorporating trade-offs within management between fishing effort and ecosystem services. Stakeholder and RUG input into valuation estimates and development of the decision support tool has been enabled through targeted workshops. This tool is largely driven by socio-economic considerations (cost to society) supported by strong, underlying fisheries and ecology science and developed with the input of the users – fishermen, management and policy makers.

136. INSTITUTION: Plymouth Marine Laboratory
Address: PML, Prospect Place, Plymouth PL1 3DH
Contact person: Roger Harris r.harris@pml.ac.uk
Research Activity: **L4 plankton monitoring programme**
Duration/cost: 1988- present; costs vary
Funding: NERC, DEFRA
Principal Investigator: Roger Harris

Objective/ Goal: Ongoing zooplankton research at Plymouth Marine Laboratory has established a weekly time series of zooplankton species since 1988, and a time series for a range of physical, chemical and biological measurements, including phytoplankton species composition since 1992 at L4, a coastal station off Plymouth. The objective is to monitor seasonal and inter annual variability as well as long-term trends in the planktonic ecosystem of the western English Channel. In addition to long-term ecological research the L4 programme is an integral part of the PML Core Research Programme and a variety of experimental and process studies are carried out.

How are results communicated? L4 data are made freely available via www.pml.ac.uk/L4/ . Results are also communicated through scientific publications (see website for list) as well as within appropriate research groups, for example the Marine Environmental Change Network (MECN), ICES Working Group on Zooplankton Ecology and GLOBEC.

Can results be used to support resource management? Results give important information on interannual variability and long-term trends in biodiversity. Current work is relating plankton dynamics to fish eggs and larval of the western English Channel. This is a unique high-frequency time-series in so far as it covers both zooplankton and phytoplankton (450+ taxa).

137. INSTITUTION: Queen's University Belfast
DEPARTMENT/ UNIT: School of Biology & Biochemistry
Address: MBC, 97 Lisburn Road, Belfast BT9 7BL
Contact person: Christine Maggs c.maggs@qub.ac.uk
Research Activity: **Coralline algal studies**
Duration/cost: ongoing, for 2 more years; £200k
Funding: EU, local government (Environment & Heritage Service)
Principal Investigator: Christine Maggs

Objective/ Goal: Calcified coralline algae are slow-growing but are a valuable natural resource, previously as a low-cost soil ameliorator but now as a high-value scaffold for bone and dental implants. We have interlinked projects exploring both conservation and exploitation of the resource e.g. by aquaculture. The goal of the different subprojects is (1) to determine growth rates (hence sustainable harvesting figures) (2) assess associated biodiversity and (3) provide material to partners to explore the best material for bioengineering.

How are results communicated? In scientific papers and at conferences

Can results be used to support resource management? Yes, by determining sustainable harvesting rates

138. INSTITUTION: Sir Alister Hardy Foundation for Ocean Science (SAHFOS)
Address: The Laboratory, Citadel Hill, The Hoe, Plymouth, PL1 2PB
Contact person: Martin Edwards maed@sahfos.ac.uk
Research Activity: **The Continuous Plankton Recorder IV: environmental change and biodiversity**
Duration/cost: 2002- 07; £88k pa
Funding: DEFRA and other funding partners
Principal Investigator: All of SAHFOS contributes

Objective/Goal: i) To use SAHFOS data to interpret marine ecology and to try to distinguish anthropogenic, climatically forced and natural plankton variability. ii) To apply CPR data to investigations to the effects of pollution and enhanced inorganic nutrient loading on pelagic ecosystems. iii) To use the CPR data to monitor changes in marine biodiversity and to help in the development of an index that can assess the ecological health of UK regional seas.

How are results communicated? Predominantly through peer-reviewed journals, although SAHFOS participates in some ICES Working Groups. There have also been many TV and radio appearances recently, as well as newspaper articles.

Can results be used to support resource management? Primarily used as an overall assessment of the response of marine ecosystems to environmental change

139. INSTITUTION: Sir Alister Hardy Foundation for Ocean Science (SAHFOS)
Address: The Laboratory, Citadel Hill, The Hoe, Plymouth, PL1 2PB
Contact person: Anthony J. Richardson anr@sahfos.ac.uk
Research Activity: **The Continuous Plankton Recorder: fishery investigations**
Duration/cost: 2002- 07; £685k
Funding: DEFRA
Principal Investigator: All of SAHFOS contributes

Objective/ Goal: To provide core funding for the CPR survey (encompasses 7 scientific objectives); and to conduct fisheries investigations with CPR data. The latter encompasses 3 objectives: i) a literature review (completed); ii) applying statistical models to understand links between CPR data and long-term changes in fish stocks; and iii) promoting the use of CPR data in new approaches to fisheries assessment within ICES.

How are results communicated? Predominantly through peer-reviewed journals, although SAHFOS participates in some ICES Working Groups. There have also been many TV and radio appearances recently, as well as newspaper articles.

Can results be used to support resource management? Not in an annual sense (SAHFOS data are usually released one year after collection), but with new approaches for multi-annual assessment, the CPR can provide frequent (monthly), large-scale (North Atlantic) assessment of the food environment for young fish.

140. INSTITUTION: Scottish Agricultural College
DEPARTMENT/ UNIT: Land Economy
Address: Kings Buildings, West Mains Rd, Edinburgh EH9 3JG
Contact person: Dr Dominic Moran dominic.moran@sac.ac.uk
Research Activity: **Economic analysis of notifiable fish diseases**
Funding: SEERAD, EU, DARDNI (no information given on duration/cost)
Principal Investigator: Dr Dominic Moran, Dr Abdulai Fofana

Objective/ Goal: Cost benefit analysis of surveillance levels for fish diseases in the UK. The objective of this study is to evaluate current spending on disease surveillance for three notifiable fish diseases: infectious salmon anaemia (ISA), viral haemorrhagic septicaemia (VHS) and infectious haemorrhagic necrosis (IHN). In simple terms this objective requires the assessment of whether the UK is currently investing enough in surveillance relative to the costs that might accrue in the event of a disease outbreak. As part of this objective, the study provides a rationale for government involvement in fish disease surveillance and provides recommendations relating to future spending on surveillance.

How are results communicated? Final report just submitted to SEERAD/DEFRA

Can results be used to support resource management? Yes: results show the optimal spending level on disease control

141. INSTITUTION: Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Robin Cook cookrm@marlab.ac.uk
Research Activity: **Modelling the behaviour of nutrients in the coastal waters of Scotland**

Duration/cost: 2000-05; completed
Funding: SEERAD
Principal Investigator: Mike Heath heathmr@marlab.ac.uk

Objective/ Goal: 1) To establish whether Scottish waters suffer from eutrophication as defined by the UWWT and Nitrate Directive. 2) To determine the fate of nutrients emanating from Scottish sources, and in particular to determine whether they make a significant contribution to eutrophication in the waters of Scottish or other Member States. The study was carried out using the ERSEM ecosystem model configured to represent the whole European shelf, in collaboration with Hamburg University and the Macaulay Land Use Research Institute.

How are results communicated? Oral presentations, reports and peer reviewed publications

Can results be used to support resource management? Yes, the project provided SEERAD with information on the scale of impact of various nutrient sources.

142. INSTITUTION: Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Robin Cook cookrm@marlab.ac.uk
Research Activity: **Population dynamics models of European cod stocks**
Duration/cost: 2000-05; £58k in 2004/05
Funding: SEERAD
Principal Investigator: Mike Heath heathmr@marlab.ac.uk

Objective/ Goal: To build population models of important UK cod stocks incorporating the accumulated knowledge of the biology of the species and the environmental influences on it, in order to investigate sustainable harvesting strategies. Such models will be used to: i) define appropriate safe biological limits in terms of exploitation rate and reproductive potential, and ii) investigate the possible response of the stock to environmental change. Partners on the project are CEFAS (lead), Strathclyde University and FRS. FRS has worked most closely with Strathclyde on the transfer of modelling technology developed in C263/C702 for spatially resolved modelling of *Calanus finmarchicus* population dynamics in ocean basins, into a form where it can be used to model cod dynamics in shelf seas. However most of the work is being done at Strathclyde.

How are results communicated? Oral presentations, reports and peer reviewed publications

Can results be used to support resource management? Yes, the project is developing models of cod populations incorporating spatial structure at various scales. It is intended that these could replace existing management models and be used to predict the consequences of different spatial management schemes.

143. INSTITUTION: Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Robin Cook cookrm@marlab.ac.uk
Research Activity: **Recruitment and mortality of *Calanus* eggs and nauplii**
Duration/cost: 2001-04; £68k in 2004/05
Funding: NERC, SEERAD
Principal Investigator: Steve Hay haysi@marlab.ac.uk

Objective/ Goal: Mortality as well as fecundity and growth control the spatial-temporal patterns in copepod abundance and biomass. Quantifying mortality rates, determining the underlying causes, and explaining their variability is a crucial step towards understanding population dynamics of *Calanus finmarchicus* and *C. helgolandicus*. This project's focus is on eggs and early nauplii as these are the stages in which the vast majority of the life-cycle mortality occurs, and it is also in these stages that mortality is most variable. The aim is to map and explore factors determining control in growth, development, fecundity, hatch success and mortality of these two species. The work in the northern North Atlantic Irminger Sea will be aboard RV Discovery on cruises in the spring, summer and winter. In addition at Plymouth and Aberdeen, two long-term monitoring sites (L4 in the English Channel, and Stonehaven in the northern North Sea) we further explore seasonal dynamics of these two species.

How are results communicated? Oral presentations, reports and peer reviewed publications

Can results be used to support resource management? Indirectly, results will help to develop better models of how climate has changed the structure and function of the food web

144. INSTITUTION: Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Robin Cook cookrm@marlab.ac.uk
Research Activity: **Development and testing ecological indicators and models to monitor and predict the ecosystem effects of fishing (IMPACT)**
Duration/cost: 2002-07; £8k in 2004/05
Funding: SEERAD, EU
Principal Investigator: Simon Greenstreet greenstreet@marlab.ac.uk

Objective/ Goal: To develop indicators of the ecological effects of fishing and to develop validated models that help to predict the impacts of fishing, and changes in fishery management practices, on the marine ecosystem. The indicators will be suitable

for tracking fishery-induced changes in diversity, productivity, trophic structure and functional processes in marine ecosystems, and will be validated using historic and experimental data collected in the areas impacted by the main North Sea cod, haddock, whiting and saithe fisheries. The project will focus on the development of a minimum number of indicators that reflect the main properties of the marine ecosystem and could be monitored on a range of scales in space and time. Models to predict the impacts of fishing on the ecosystem will describe how catch controls, effort controls and technical measures (with emphasis on closed areas) affect spatial and temporal patterns of fishing effort, and the potential effects of these patterns of effort redistribution on diversity, productivity, trophic structure and functional processes. Models will be validated with field data.

How are results communicated? Oral presentations, reports and peer reviewed publications

Can the results be used to support resource management? Yes, the project will provide ecosystem indicators of change in the fisheries food web which can be used to gauge the effectiveness of management measures

145. INSTITUTION: Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Robin Cook cookrm@marlab.ac.uk
Research Activity: **Zooplankton demography and trophic interactions in the subarctic North Atlantic, and their coupling to physical oceanography: 40-years on from the NAO minimum**
Duration/cost: 2001-05; £74k in 2004/05
Funding: NERC, SEERAD
Principal Investigator: Mike Heath heathmr@marlab.ac.uk

Objective/ Goal: This UK consortium project is coordinated by FRS and funded from phase 2 of the NERC MarProd programme. The purpose of the consortium was to conduct a campaign of seagoing measurements in the Irminger Sea and adjacent areas to discover the relationships between oceanic circulation, the life cycle dynamics and demography of three key crustacean zooplankton (*Calanus finmarchicus*, *Thysanoessa longicaudata* and *Meganctiphanes norvegica*) and the structure and productivity of the pelagic food web. The impact of climate variability on these relationships is being examined by means of a comparative analysis of the data collected during the campaign with comparable measurements made in 1963 during the NORWESTLANT surveys, and with data from the Continuous Plankton Recorder surveys.

How are results communicated? Oral presentations, reports and peer reviewed publications

Can results be used to support resource management? Yes, results show how climate has changed the structure and function of the food web

146. INSTITUTION: Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Robin Cook cookrm@marlab.ac.uk
Research Activity: **Integrated approach to the biological basis of age estimation in commercially important fish species (IBACS)**
Duration/cost: 2001-05; £49k in 2004/05
Funding: SEERAD, EU
Principal Investigator: Peter Wright wrightp@marlab.ac.uk

Objective/ Goal: To improve the biological basis of age estimation for commercial fish species. The project will integrate modelling, laboratory and field observations to provide an objective basis for interpreting the macrostructures of otoliths used for estimation of fish age. The project will establish a new age estimation protocol and enable training through a data base hosted in a web site accessible by fisheries laboratories and fishermen's organisations. FRS interest in this project primarily relates to using otoliths to infer the growth history, behaviour and environmental experience of wild fish, thereby providing a tool for investigating the factors affecting the distribution and growth of cod.

How are results communicated? Oral presentations, reports and peer reviewed publications

Can results be used to support resource management? Yes, better estimates of fish age relate directly to fisheries advice.

147. INSTITUTION: Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Robin Cook cookrm@marlab.ac.uk
Research Activity: **Interactions between the marine environment, predators, and prey: implications for sustainable Sandeel fisheries (IMPRESS)**
Duration/cost: 2000-04; £34k in 2004/05
Funding: SEERAD, EU
Principal Investigator: Simon Greenstreet greenstreet@marlab.ac.uk

Objective/ Goal: To determine the biomass and distribution of sandeels in the sediment of the Firth of Forth study area in Spring, Summer and Autumn, 2001 and 2002. To determine the biomass and distribution of sandeels and other pelagic fish in the water column, and the numbers and distribution of seabirds in flight and on the sea surface of the Firth of Forth study area in Summer 2001 and 2002. To examine spatial, seasonal and between year variation in the hydrography of the Firth of Forth study area in 2001 and 2002.

How are results communicated? Oral presentations, reports and peer reviewed publications

Can results be used to support resource management? Yes, the project will give better scientific basis for linking sandeels and seabird, and basing sandeel fishery closures in the breeding success of seabirds

148. INSTITUTION: Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Robin Cook cookrm@marlab.ac.uk
Research Activity: **Critical interactions between species and their implications for a precautionary fisheries management in a variable environment - a modelling approach (BECAUSE)**
Duration/cost: 2004-07; £24k in 2004/05
Funding: SEERAD, EU
Principal Investigator: Simon Greenstreet greenstreet@marlab.ac.uk

Objective/ Goal: To identify and quantify critical biological interactions between and within commercial target fish species and non-commercial top predators leading to a description of food web structures and the derivation of precautionary reference points for ecosystem oriented fisheries management. Precautionary reference points and limit values accounting for interacting mechanisms with the environment are necessary for the development of adaptive strategies in fisheries management.

How are results communicated? Oral presentations, reports and peer reviewed publications

Can results be used to support resource management? Yes, the project will provide ecosystem indicators of change in the benthos which can be used to gauge the effectiveness of demersal fisheries management measures

149. INSTITUTION: Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Robin Cook cookrm@marlab.ac.uk
Research Activity: **Towards accreditation and certification of age determination of aquatic resources (TACADAR)**
Duration/cost: 2001-05; £12k in 2004/05
Funding: SEERAD, EU
Principal Investigator: Peter Wright wrightp@marlab.ac.uk

Objective/ Goal: TACADAR is a network of excellence with the overall objective to increase reliability of age estimation procedures in the European Community, compatible with the possibility of the future establishment of Europe- wide international fisheries laboratories. TACADAR aims to increase the adoption of procedures that include quality assurance and quality control mechanisms, for the improvement of stock assessment and environmental management techniques. The ultimate objective is to stimulate the achievement of a higher level of quality within and integration between the member institutions of TACADAR, concerning fish age determination.

How are results communicated? Oral presentations, reports and peer reviewed publications

Can results be used to support resource management? Yes, the projects is designed to achieve accreditation for age determinations in fish which are essential for management advice

150. INSTITUTION: Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Robin Cook cookrm@marlab.ac.uk
Research Activity: **Ecosystem effects on fisheries productivity**
Duration/cost: 2002-06; £103k in 2004/05
Funding: SEERAD (MF0754)
Principal Investigator: Mike Heath heathmr@marlab.ac.uk

Objective/ Goal: To establish the relationship between trends in the abundance of key species, and changes in the balance of productivity between pelagic, demersal round-fish, and benthic (shellfish and flatfish) fisheries, and hence of changes in the sustainable structure of regional fisheries. The project has three Tasks: 1. To estimate the regional pattern and long-term trends in annual new primary production for European waters. 2. To estimate trends in the productivity of the pelagic, demersal round-fish and benthic fish communities in the North Sea and west of Scotland from fishery and survey data, and relate these to trends in the key species and in exploitation intensity (linked to external contracts funded by the NERC Marine Productivity programme, MarProd); 3. To establish the connection between oceanographic climate and the trends in *Calanus finmarchicus* and other key species in the North Sea and west of Scotland waters.

How are results communicated? Oral presentations, reports and peer reviewed publications

Can results be used to support resource management? Yes, results show how fisheries and climate have changed the structure and function of the food web

151. INSTITUTION: Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Robin Cook cookrm@marlab.ac.uk

Research Activity: Managing fisheries to conserve groundfish and benthic invertebrate species diversity (MAFCONS)
Duration/cost: 2002-06; £250k in 2004/05
Funding: SEERAD, EU (MF0753 and C735)
Principal Investigator: Simon Greenstreet greenstreet@marlab.ac.uk

Objective/ Goal: To provide scientific advisors to fisheries managers with mathematical models that allow them to quantify the consequences to groundfish and benthic invertebrate species diversity of achieving particular fisheries objectives (eg. specific species Total Allowable Catches, TAC). The major outcome of this project will be the development of mathematical tools to the point where they could be used in the current ICES fisheries stock assessment procedure. This would present ICES with the opportunity of providing the EC and fisheries ministers with advice regarding the impact of fisheries policy on the wider marine ecosystem, as well as on the fish stocks themselves.

How are results communicated? Oral presentations, reports and peer reviewed publications

Can results be used to support resource management? Yes, results show how fisheries have changed the structure and function of the demersal food web, and provide models to predict future consequences of fisheries measures

152. **INSTITUTION:** Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Robin Cook cookrm@marlab.ac.uk
Research Activity: Developing benthic habitat mapping methodology (HABMAP)
Duration/cost: 2005-07
Funding: SEERAD,
Principal Investigator: Simon Greenstreet greenstreet@marlab.ac.uk

Objective/ Goal: To assess the different methods needed to carry out seabed habitat mapping in Scottish waters. The role of habitat mapping in the development of an ecosystem approach to management will be explored by classifying seabed habitat in a series of 3 x 3 NM boxes across the North Sea and west of Scotland using acoustic mapping techniques. Each site chosen for seabed habitat classification will be the area immediately surrounding and including the trawl track of tows collected for the North Sea and west coast IBTS surveys. Sites will also be selected so as to include stations previously sampled for benthic community analysis. Habitat type and heterogeneity will be related to fish and benthic species composition and diversity. Acoustic data and ground truthing sediment samples will be collected and these data will be used to produce maps. Interpretation of these maps, along with reference to benthic and groundfish data collected as part of other projects, will allow FRS to assess the role of habitat mapping in the development of an ecosystem approach to fisheries management.

How are results communicated? Oral presentations, reports and peer reviewed publications

Can results be used to support resource management? Yes, the projects will develop and assess-ment of fish habitat distribution, which will advise fisheries managers on the appropriate spatial scale for management measures.

153. **INSTITUTION:** Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Robin Cook cookrm@marlab.ac.uk
Research Activity: Understanding the role of population structuring in the maintenance of cod stocks under changing fishing and climatic pressures (CODPOP)
Duration/cost: 2004-07; £109k in 2004/05
Funding: SEERAD (MF0756)
Principal Investigator: Peter Wright wrightp@marlab.ac.uk

Objective/ Goal: The overall objective of this project is to develop the basis for advising on how fisheries management measures can be framed to conserve and restore population diversity of cod stocks around Scotland. To do this, requires an understanding of the relative contributions of fishing and climate to changes in the population structure and dynamics of cod.

How are results communicated? Oral presentations, reports and peer reviewed publications

Can results be used to support resource management? Yes, the projects is developing models of cod population dynamics incorporating spatial structure at various scales. It is intended that these could replace existing management models and be used to predict the consequences of different spatial management schemes.

154. **INSTITUTION:** Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Robin Cook cookrm@marlab.ac.uk
Research Activity: Metapopulation structuring within gadoids in the north east Atlantic (METAGADOID)
Duration/cost: 2003-07; £118k in 2004/05
Funding: SEERAD (MF0464)
Principal Investigator: Peter Wright wrightp@marlab.ac.uk

Objective/ Goal: To establish the degree of reproductive isolation of haddock and whiting spawning congregations within the North Sea and V1a using newly developed microsatellite DNA markers for these species. Population structuring will be examined within the context of spatial population theory to consider how differing local dynamics and responses to environ-

mental variability may help in sustaining the overall productivity of the fished stocks. The potential impacts of structuring on current management strategies and the benefits of spatially explicit approaches will be examined.

How are results communicated? Oral presentations, reports and peer reviewed publications

Can results be used to support resource management? Yes, the projects is developing models of gadoid population structure, which will advise fisheries managers on appropriate spatial scale for management measures.

155. INSTITUTION: Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Robin Cook cookrm@marlab.ac.uk
Research Activity: **Ecosystem approach to defining the sustainable level of fishing for sandeels**
Duration/cost: 2000-04; completed
Funding: SEERAD (MF0463)
Principal Investigator: Simon Greenstreet greenstreet@marlab.ac.uk, Mike Heath heathmr@marlab.ac.uk

Objective/ Goal: 1. Establish the source area of young-of-the-year sandeels arriving at Wee Bankie in May, and the relationship between climatic conditions and growth, survival and dispersal of larvae. 2. Determine the spatial and temporal variability in the mortality rate of sandeels due to fishing and predation by seabirds and piscivorous fish, and how this is influenced by weather conditions and oceanographic features. 3. Develop a population dynamics model for the sandeel population on Wee Bankie, including the multi-species interactions with piscivorous fish and seabirds.

How are results communicated? Oral presentations, reports and peer reviewed publications

Can results be used to support resource management? Yes, the project is developing models of sandeel population structure, recruitment and mortality due to fish and seabird predation, which will advise fisheries managers on the appropriate spatial scale for management measures.

156. INSTITUTION: Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Robin Cook cookrm@marlab.ac.uk
Research Activity: **Cod spatial dynamics and vertical movements in European waters and implications for fishery management (CODYSSEY)**
Duration/cost: 2002-06; £58k in 2004/05
Funding: SEERAD, EU
Principal Investigator: Peter Wright wrightp@marlab.ac.uk

Objective/ Goal: To improve understanding of the horizontal migrations and vertical movements of cod and the influence of environmental and biological factors on them in order to provide management relevant information as to the horizontal availability, vertical accessibility and individual vulnerability of cod to fishing activities. The fulfilment of this objective will provide tools for the evaluation of stock assessment methodology, management and conservation of cod stocks in European waters and will be highly relevant to future stock assessment and the management of cod stocks. In order to achieve this aim the project tests the hypotheses that patterns of horizontal and vertical movement of individual cod vary systematically, and that the variation is the consequence of behavioural responses to environmental factors.

How are results communicated? Oral presentations, reports and peer reviewed publications

Can results be used to support resource management? Yes, the project is developing models of cod populations incorporating spatial structure at various scales. It is intended that these could replace existing management models and be used to predict the consequences of different spatial management schemes.

157. INSTITUTION: Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Robin Cook cookrm@marlab.ac.uk
Research Activity: **The role of sub-stock structure in the maintenance of cod metapopulations (METACOD)**
Duration/cost: 2001-05; £120k in 2004/05
Funding: SEERAD, EU
Principal Investigator: Peter Wright wrightp@marlab.ac.uk

Objective/ Goal: To develop the conceptual and mathematical basis for advising on how fisheries management measures might be framed to conserve or restore not only stock biomass, but also sub-stock diversity of cod. This shall be accomplished by studying and developing models based on the cod stocks off Iceland and the west and north of Scotland. The aim will be to establish the extent of genetic substructure in these stocks, how it is maintained, and the extent to which overall population dynamics are dependent on the sub-stocks.

How are results communicated? Oral presentations, reports and peer reviewed publications

Can results be used to support resource management? Yes, the project is developing spatially resolved models of cod population dynamics which will improve the assessment and strategic advice on cod.

158. **INSTITUTION:** Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Robin Cook cookrm@marlab.ac.uk
Research Activity: **Stock effects on recruitment relationships (STEREO).** An operational model of the effects of stock structure and spatio-temporal factors on recruitment
Duration/cost: 1998-2002; completed
Funding: SEERAD, EU (FAIR-CT98-4122)
Principal Investigator: Mike Heath heathmr@marlab.ac.uk

Objective/ Goal: To produce a scheme for refining fisheries stock-recruitment relationships, by including biological, spatial and temporal information on stock structure. The aim was to provide the information necessary for improving the scientific basis of limit reference points in fisheries management. These are the biological criteria against which the state of the stocks are judged. The methodology was developed for cod and haddock stocks around Iceland, Norway and in the North Sea as case studies. The specific aim was to build a modelling system that would predict the probability of contributions by different spatial, temporal and parental components of the spawning stock of a species to the juvenile pre-recruit population some months after spawning.

How are results communicated? Oral presentations, reports and peer reviewed publications

Can results be used to support resource management? Yes, the projects provided a better understanding of the processes affecting recruitment haddock fisheries

159. **INSTITUTION:** Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Robin Cook cookrm@marlab.ac.uk
Research Activity: **The benthic ecology of the western North Sea**
Duration/cost: 2001-04; completed
Funding: DEFRA, SEERAD
Principal Investigator: Simon Greenstreet greenstreet@marlab.ac.uk

Objective/Goal: To provide a strategic evaluation of the status of the benthic communities of the western North Sea in relation to natural and anthropogenic influences as a contribution to the 2004 DEFRA "State of the Seas" assessment for UK waters. This will be achieved through the generation of information on the occurrences and densities of benthic species in the northern North Sea by capitalising on sampling effort in 2001 by FRS accompanied by the completion of a grid of benthic stations off the English east coast sampled by CEFAS. The generation of these data will have the additional benefit of contributing to an ongoing international evaluation of benthic community status in the North sea under the auspices of ICES.

How are results communicated? Oral presentations, reports and peer reviewed publications

Can results be used to support resource management? Yes, the project will provide ecosystem indicators of change in the benthos which can be used to gauge the effectiveness of demersal fisheries management measures

160. **INSTITUTION:** Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Robin Cook cookrm@marlab.ac.uk
Research Activity: **Data-driven, basin scale, modelling of the impact of climate variability on plankton productivity and the abundance and demography of *Calanus finmarchicus* in the North Atlantic**
Duration/cost: 2001-05; £4k in 2004/05
Funding: NERC (MarProd), SEERAD, EU (FAIR-CT98-4122)
Principal Investigator: Mike Heath heathmr@marlab.ac.uk

Objective/ Goal: To elucidate the relationship between oceanic circulation and the abundance of *Calanus finmarchicus* over its whole North Atlantic range. Capitalising and extending on the MarProd Phase 1 spin-up, the project uses automatic optimisation to fit a series of process-based demographic models to existing and projected abundance data. Formal statistical methods are used to evaluate the relative goodness of fit generated by models embodying competing hypotheses, thus allowing us to distinguish between them. For the NERC project, the PI is William Gurney (Strathclyde) with Simon Wood (St Andrews) and Michael Heath (FRS Aberdeen) as Co-Is.

How are results communicated? Oral presentations, reports and peer reviewed publications

Can results be used to support resource management? Yes, results show how climate has changed the structure and function of the food web

161. **INSTITUTION:** Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Robin Cook cookrm@marlab.ac.uk
Research Activity: **Oceanic transport around Scotland**
Duration/cost: 2003-05; £41k in 2004/05
Funding: SEERAD (AE1190)

Principal Investigator: Bill Turrell turrellb@marlab.ac.uk

Objective/ Goal: To quantify the supply of warm oceanic water flowing around Scotland and determine whether this is reducing. Follows earlier work showing that the deep outflow from the Nordic Seas has reduced in concert with climate change

How are results communicated? Oral presentations, reports and peer reviewed publications

Can the results be used to support resource management? Indirectly, provides scientific explanation for many changes that we see in the biology of the North Sea.

162. INSTITUTION: Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Ian Tuck tucki@marlab.ac.uk
Research Activity: **Inshore habitat use by juvenile fish**
Duration/cost: 3 yr; £828k
Funding: SEERAD
Principal Investigator: Ian Tuck

Objective/ Goal: To improve our understanding of the ecology of juvenile fish in inshore waters, addressing issues important for formulating policy in general Coastal Zone Management and more specifically in the 'ecosystem approach' to fisheries management. The work aims to identify potential nursery grounds, investigate the spatial and temporal distribution of juvenile fish in relation to habitats in inshore waters, and develop a pilot GIS for inshore fish, incorporating fish and habitat distribution.

How are results communicated? Results will be published as either FRS reports or International journals.

Can results be used to support resource management? Results will be used to advise managers on a range of issues relevant to CZM and inshore fisheries.

163. INSTITUTION: Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Ian Tuck tucki@marlab.ac.uk
Research Activity: **Exploration of fishing capacity and fishing activity and their utility for effort management control of fishing mortality**
Duration/cost: 3.5 yr; £807k
Funding: SEERAD
Principal Investigator: Ian Tuck, Dick Ferro, Dave Reid

Objective/ Goal: This pilot project investigates factors influencing fishing capacity, to establish relationships between fishing activity, fishing capacity and fishing mortality for part of the Scottish demersal and pelagic fleets, to provide preliminary estimates and guidelines for designing a more comprehensive study. Fishing capacity will be investigated in relation to vessel and gear characteristics. Using this information, the relative contributions to overall fishing mortality from each component fleet can be investigated, enabling the exploration of various methods of effort management in order to control fishing mortality.

How are results communicated? Results will be published as either FRS reports or International journals.

Can results be used to support resource management? The results will provide preliminary estimates of the relationships between fishing activity, fishing capacity and fishing mortality which can be used to advise on the implications of effort control approaches. The results will also be used to develop more comprehensive studies and effort management tools.

164. INSTITUTION: Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Dr H Anne McLay mclaya@marlab.ac.uk
Research Activity: **Policy and knowledge in fisheries management (PKFM); the North Sea cod case**
Duration/cost: 2003-05; €900k
Funding: EU (Q5RS – 2002-01782)
Principal Investigator: Co-ordinator - Poul Degnbol, Inst Fisheries Management, Denmark pd@ifm.dk

Objective/ Goal: To identify and understand specific shortcomings in the European fisheries policy and its implementation which have contributed to the problems evident in several European fisheries and devise means for their rectification. The project focuses on the knowledge production and decision making within the fisheries management system, the interrelationships between these processes and the role played by stakeholders, taking fisheries for North Sea cod as a case study.

How are results communicated? The results of research components within the project will be published in international peer review journals and will contribute to the development of a framework for performance evaluations of fisheries systems being developed by ICES (International Council for the Exploration of the Seas). The outcome of the project includes a policy brief (to be presented to the European Commission which will include an evaluation of options to improve fisheries management.

Can results be used to support resource management? The project directly addresses fisheries resource management. It should be useful to managers, to improve the performance of the management system.

165. INSTITUTION: Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Paul Fernandes fernandespg@marlab.ac.uk
Research Activity: **Fisheries independent survey based operational assessment tools (FISBOAT)**
Duration/cost: 3 yr; €1500k (total)
Funding: EU, SEERAD
Principal Investigator: Paul Fernandes

Objective/Goal: To develop fish stock assessment tools based on survey data only and evaluate how these perform in producing advice within defined management procedures. The project spans several disciplines (population biology, survey methods, stock assessment, management) with the objectives of (1) producing a comprehensive diagnostic of population status using survey-based population demography and biological indices and (2) evaluating its performance in a management context.

How are results communicated? Through publication in annual reports, conferences, and the scientific literature. Website at www.ifremer.fr/drvecohal/fisboat/index.htm.

Can results be used to support resource management? Current fish stock assessment is based primarily on fisheries data (catches/landings) and models of population demography (cohort analysis). Collapse of important fish stocks in the past (e.g. cod in Canada) have revealed that fisheries-based demographic indices suffer from several limitations, most notably illicit fishing activity such as black landing, discarding and misreporting. Fisheries surveys, used to determine the abundance and distribution of marine resources, do not suffer from such problems but are less precise due to relatively small sample size. This project aims to evaluate how less precise but unbiased (or consistent bias) survey methods can be used to evaluate fish stocks.

166. INSTITUTION: Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Paul Fernandes fernandespg@marlab.ac.uk
Research Activity: **Species identification methods for acoustic multifrequency information (SIMFAMI)**
Duration/cost: 3 yr; €2300k (total)
Funding: SEERAD, EU (also contributions by IFREMER, France; IMR, Norway; and IEO, Spain)
Principal Investigator: Paul Fernandes

Objective/Goal: To enable identification of fish species using acoustic methods, using data from a number of frequencies (e.g. 18, 38, 120 & 200 kHz) to characterise the frequency specific response of fish and plankton. Ultimately the project aims to: i) Improve existing acoustic surveys for stock assessment; ii) Allow data to be obtained on the abundance and distribution of some non-target species for consideration of an ecosystem approach; iii) Allow for the implementation of mackerel acoustic surveys; iv) Allow data on fish abundance and distribution to be obtained from other ocean going platforms.

How are results communicated? Through publication in annual reports, conferences, and the scientific literature. The project also has a website at <http://simfami.marlab.ac.uk>.

Can results be used to support resource management? Fisheries acoustic surveys are used to determine the abundance and distribution of a wide variety of pelagic marine and freshwater resources throughout the world, such as herring, anchovy, pollack, and krill. Vertical echosounders are used to collect echoes from the fish, as echotraces: these are then attributed to species. This attribution is based on verification by some other sampling method such as a pelagic trawl. However, trawling on every echotrace is not possible, such that subjective judgements often have to be made to identify the species. This project aims to provide more information to assist in that process and so enhance the precision of acoustic surveys.

167. INSTITUTION: Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Mike Breen breenm@marlab.ac.uk
Research Activity: **An assessment of mortality in fish escaping from trawl codends and its use in fisheries management (SURVIVAL)**
Duration/cost: 3 yr; €2659k (total)
Funding: EU, SEERAD (also other partner contributions)
Principal Investigator: Mike Breen

Objective/ Goal: To provide estimates of mortality in gadoid fish escaping from towed fishing gears. It will utilise and test recently developed technology, to improve currently used protocols and overcome sampling errors, and will also give an estimate of the seasonal variation in survival estimates and a method for inclusion of these estimates in stock assessment models for haddock *Melanogrammus aeglefinus* and cod *Gadus morhua*. This project will provide knowledge on survival in high intensity fisheries and in fish escaping at the surface in side trawling fisheries.

How are results communicated? Via several different channels to meet the needs of the scientific community, the fishing industry, fisheries management and the public. Peer review publications for the scientific literature will be written at the end of each work-package. Folders presenting the project and the results will be produced for distribution to the fisheries organisations of the EU and to the fishing industry and the public in all partner countries. At the end of the project a video will be produced to facilitate the communication with the fishing fleet.

Can results be used to support resource management? The project work-package will focus on the inclusion of mortality data in Virtual Population Analysis (VPA) models. The key problems of including selectivity and mortality data (historically length based) will be addressed in these age-based stock assessments and predictive models. The validity of these approaches will

be assessed by performing sensitivity analysis on the key parameters in the models, including measures of selectivity and escape mortality. In this way, the significance of each data input to the model (ie. landed catch, discard mortality, escape mortality, natural mortality, etc) can be assessed and their relative importance in the management of a fishery recognised.

168. INSTITUTION: Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Dr RST Ferro ferro@marlab.ac.uk
Research Activity: **Fishing gear and fish behaviour studies (1): reducing bycatch in whitefish trawls**
Duration/cost: 3 yr; €210k (for FRS work)
Funding: EU, SEERAD
Principal Investigator: Dr RST Ferro

Objective/ Goal: To develop a species selective fishing gear to reduce the by-catch of juvenile cod in whitefish trawls used in the North Sea whitefish fishery

How are results communicated? EU Periodic and Fianl reports, industry liaison group meetings, fishing industry press, peer-reviewed publications, scientific fora such as ICES

Can results be used to support resource management,? The development of a gear which reduces the fishing effort on cod will help cod recovery plans in the North Sea

169. INSTITUTION: Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Dr RST Ferro ferro@marlab.ac.uk
Research Activity: **Development of a new mesh measurement gauge**
Duration/cost: 3 yr;
Funding: EU, SEERAD
Principal Investigator: Dr FG O'Neill oneillb@marlab.ac.uk

Objective/ Goal: To design, build and test an instrument which provides an objective method of measuring the mesh opening in fishing nets for use by fishing industry, enforcement officers and scientists

How are results communicated? EU reports, video film, publish a protocol on use of instrument, demonstration project to obtain acceptance of use

Can results be used to support resource management? Improved enforcement for technical conservation measures regulating fisheries operations.

170. INSTITUTION: Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Dr RST Ferro ferro@marlab.ac.uk
Research Activity: **Fishing gear and fish behaviour studies (2): reducing bycatch in *Nephrops* trawls**
Duration/cost: 3 yr; €183k (for FRS work)
Funding: EU, SEERAD
Principal Investigator: Dr RST Ferro

Objective/ Goal: To develop a species selective fishing gear to reduce the by-catch of juvenile whitefish in *Nephrops* trawls used in the West of Scotland *Nephrops* fishery. To assess the effect of the improved selection on stocks, landings and discards using estimated selection parameters from commercial trials

How are results communicated? Fishing industry liaison group meetings, EU reports, peer-reviewed publications, fishing industry press

Can results be used to support resource management? Results aim to improve stocks of whitefish by reducing discarding in prawn fishery

171. INSTITUTION: Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Dr RST Ferro ferro@marlab.ac.uk
Research Activity: **Fishing gear and fish behaviour studies (3): species separation**
Duration/cost: 3 yr; £494k
Funding: EU, SEERAD
Principal Investigator: Dr RST Ferro

Objective/Goal: To investigate physical and behavioural principles governing separation of species within mobile fishing gears. To develop methods of separating species in two major UK fisheries. To assess the biological effects of improved exploitation patterns on fish stocks.

How are results communicated? Annual reports to SEERAD, EU reports, industry meetings, articles in fishing press, peer reviewed scientific papers

Can results be used to support resource management? New species selective gears should reduce mortality in by-catch species in the fisheries studied. Selection parameters for the selective devices developed will allow prediction of the effect of their introduction on stocks, landings and discards

172. INSTITUTION: Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Barry O'Neill oneillb@marlab.ac.uk
Research Activity: **Modelling the predictive selectivity of cod-ends**
(Duration/cost) *No information given*
Funding: EU
Principal Investigator: Barry O' Neill

Objective/Goal: The EU project PREMECS-I developed a predictive model of cod-end selection. This model is deterministic in character and based on an understanding of the fundamental mechanical, hydrodynamic and biological processes that govern cod-end selection. The goal of this project is to develop this model, so that it can predict the selectivity of commercially used cod-ends fished in commercial conditions. The influence of (i) netting materials made from thicker and stiffer twines, (ii) the dynamic effects of the interaction of sea state-fishing vessel-trawl gear and cod-end and (iii) fish morphology and fish escape behaviour will be investigated and included in the model.

How are results communicated? Scientific publications and presentations. Through the project web-site.

Can results be used to support resource management, and if so how? The outcome from this project will be an innovative model which will assist fisheries managers to assess the impact of proposed technical measures that are introduced to reduce the catch of undersized fish.

173. INSTITUTION: Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Philip Kunzlik p.kunzlik@marlab.ac.uk
Research Activity: **Creation Of Multiannual Management Plans for Commitment (COMMIT)**
Duration/cost: 3 yr; €23k (for FRS work)
Funding: EU
Principal Investigator: Laurence Kell (CEFAS) l.t.kell@cefasc.co.uk

Objective/Goal: To provide a sound scientific basis for producing long term plans and management strategies, whilst also identifying any short term biological and socioeconomic consequences. The project combines real data with computer models to simulate scenarios for testing management strategies using mixed North Sea fisheries stocks as case studies, although the methods developed will be generic and applicable to other stocks. The project will also identify the commitment level needed to ensure that such strategies support a sustainable and economically viable fishing industry that provides a fair standard of living.

How are results communicated? Through project reports, scientific papers, and plenary meetings and workshops with fisheries managers. Web site: <ftp://ftp.dfu.min.dk/efimas/COMMIT/index.htm>

Can results be used to support resource management? The project has the potential to change the way European fisheries are managed. The tools and methods in development will allow robust management strategies to be formulated that provide greater security to fishers, enabling them to make the most appropriate investment or disinvestments decisions, and ensure sustainability of the resource at a higher level. This, in turn, will allow greater stability in communities dependent upon fisheries.

174. INSTITUTION: Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Dr Emma Hatfield e.hatfield@marlab.ac.uk
Research Activity: **Conservation of diversity in an exploited species: spatio-temporal variation in the genetics of herring *Clupea harengus* in North Sea and adjacent areas (HERGEN)**
Duration/cost: 3 yr; €2170k (total)
Funding: EU
Principal Investigator: Dr Daniel Ruzzante Daniel.ruzzante@dal.ca

Objective/Goal: To provide guidelines for the conservation and management of biodiversity of Atlantic herring in the North Sea and adjoining waters by identifying its genetic population structure, and by quantifying relative stock contributions to the fishery. Within the project there are 6 major objectives: i) estimation of genetic differentiation among spawning aggregations; ii) determination of temporal stability of population differentiation; iii) determination of composition of mixed feeding aggregations; iv) determination of temporal (seasonal and annual) variability in contributions to mixed aggregations; v) proposal for incorporation of findings in management of herring stocks; vi) dissemination of results and guidelines.

How are results communicated? Annual reports to the EC. Peer reviewed and ICES papers. A targeted theme session will be held at ICES ASC 2005. Website: www.hull.ac.uk/hergen

Can results be used to support resource management? Yes. The most appropriate management units and data collection requirements to monitor selected populations will be recommended, taking into account genetic diversity and practical

management issues. The potential of mixed stock analysis in the management and conservation of herring will be examined. A number of the members of this consortium are members of the ICES Herring Assessment Working Group and in 2005 a working document on recommendations from the project was presented to the HAWG.

-
175. **INSTITUTION:** Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Dr Emma Hatfield e.hatfield@marlab.ac.uk
Research Activity: **Multi-disciplinary approaches to stock identification of herring west of the British Isles (WESTHER)**
Duration/cost: 3 yr; €1799k (total)
Funding: EU
Principal Investigator: Dr Emma Hatfield

Objective/Goal: To describe the population structure of herring stocks in western European waters, distributed from the south-west of Ireland and the Celtic Sea to north-west Scotland. This will be achieved by integrating results from several techniques, both innovative and established, including genetic markers and biological tags. The proposed research will therefore set up and improve multidisciplinary tools for herring stock identification, providing a more holistic approach. WESTHER will optimise the determination of stock structure of Atlantic herring in the western area creating a unified database of individual herring characteristics using all techniques.

How are results communicated? Annual reports to the EC. Peer reviewed and ICES papers. A targeted theme session will be held at ICES ASC 2005. Website: www.clupea.net/westher

Can results be used to support resource management? Yes. Project results will be used to provide guidelines for the conservation and management of biodiversity through input to the ICES assessment working group structure and ultimately to management of these stocks. Several members of this consortium are members of the ICES Herring Assessment Working Group and this will ensure that the project results are applied quickly to the assessment and available to fishery managers.

-
176. **INSTITUTION:** Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Coby Needle needlec@marlab.ac.uk
Research Activity: **Operational Evaluation Tools for Fisheries Management (EFIMAS)**
Duration/cost: 4 yr; €7500k (total)
Funding: EU
Principal Investigator: Rasmus Nielsen (DIFRES Denmark) rn@dfu.min.dk

Objective/Goal: To build an inclusive operating-model simulation of the entire fisheries management process, simulating biological processes, data sampling and collation, stock assessment, management advice, management implementation, and the fisheries. This will result in an analysis tool, available to all interested stakeholders, which will facilitate the evaluation of different types of management strategies and approaches. Case studies include North Sea roundfish, Baltic Sea stocks, and Mediterranean swordfish (amongst others).

How are results communicated? Project reports and peer-reviewed publications in (mostly) fishery journals, also more direct dissemination to fisheries stakeholders (scientists, industry, governments, NGOs) through public workshops and seminars.

Can results be used to support resource management? Yes – the aim of the project (as stated above) is to improve the application of fisheries management, by allowing managers and others the freedom to explore the likely consequences of different management actions without necessarily endangering the resource.

-
177. **INSTITUTION:** Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Dr D Reid reiddg@marlab.ac.uk
Research Activity: **Whole gear selectivity**
Duration/cost: 3 yr; €1000k (total)
Funding: SEERAD, EU
Principal Investigator: Dr D Reid

Objective/Goal: Quantify the behaviour and catchability of fish in the standard North Sea bottom trawl survey gear. The broad aim was to use a combination of methods (sonars, TV systems and net modifications) to determine selectivity of the whole survey net, from doors to cod end. The approach was to use the different techniques at appropriate points, (e.g. TV in the net and sonar in front of the net) to observe and quantify the behaviour of the fish –how they entered the net, how many fish escaped and where, what species or size etc. Twin trawls were used to examine gear changes such as ground gear choice. The ultimate aim of this work was to allow the use of bottom trawl surveys to provide absolute abundance estimates.

How are results communicated? Annual reports to the SEERAD. Peer reviewed and ICES papers. Presentations at International conferences and ICES FTFB WG

Can results be used to support resource management? The project aims to improve the quality of the abundance indices generated by bottom trawl surveys, and ultimately to provide absolute values for these. But the results can also show where indices are compromised by differential catchabilities. As such they could provide better and more accurate and comparable

indices for assessment. The work is expensive and time intensive however, and general conclusions require the assumption that catchabilities determined under a small range of conditions can be applied universally.

178. INSTITUTION: Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Dr D Reid reiddg@marlab.ac.uk
Research Activity: **Combining acoustic and trawl data to enhance fish assessment (CATEFA)**
Duration/cost: 3 yr; €250k
Funding: SEERAD, EU
Principal Investigator: Dr D Reid

Objective/Goal: Explore the links between acoustic survey data and bottom trawl data collected during a series of bottom trawl surveys in the North Sea. The aim was to determine if there were correlations between the acoustic observations of fish and the catches in the bottom trawl. Links were then planned to be used to improve the accuracy and precision of the survey estimates. Data exploration was done using linear and additive modelling, geostatistics, fuzzy logic and neural nets. New survey designs to optimise the approach were part of the objective.

How are results communicated? Reports to the EC; peer reviewed and ICES papers; targeted theme session at ICES 2005.

Can results be used to support resource management? In theory, results could be used to generate new abundance indices for key demersal species. Actual results showed very weak relationships between trawl and acoustic data. Although acoustic data did show a consistent pattern on and between trawl stations, it was concluded that the noise in both methods precluded the development of useable indices.

179. INSTITUTION: Scottish Executive (Fisheries Research Services)
DEPARTMENT/ UNIT: FRS Marine Laboratory
Address: 375 Victoria Road, Aberdeen AB11 9DB
Contact person: Liz Clarke e.d.clarke@marlab.ac.uk
Research Activity: **Development of simulation framework for fishery management strategies**
Duration/cost: 3 yr; £200k
Funding: SEERAD
Principal Investigator: Liz Clarke

Objective/Goal: The European Commission's reforms of the CFP include a refocus of management away from annual quotas to a multi-annual approach to securing sustainable fisheries using harvest control rules. This project is a first step towards the development of specific tools for use in the Scottish context and seeks to provide immediate benefits to Scotland. The main objective is to develop a simulation framework to evaluate and compare alternative fishery management strategies with application to Scottish fish stock case studies. The project is closely linked to two EU funded projects: EFIMAS and COMMIT.

How are results communicated? Through internal reports, peer-reviewed papers, conference presentations, articles in fisher's publications and industry liaison meetings.

Can results be used to support resource management? The aim of the project is to support resource management through the development of predetermined rules to apply to fish stocks. These rules should ensure that more rapid remedial action is applied in the event of stock difficulties. Prior agreement on the rules between stakeholders and management should reduce disagreement when remedial action is required.

180. INSTITUTION: University of Aberdeen
DEPARTMENT/ UNIT: School of Biological Sciences
Address: Lighthouse Field Station, George Street, Cromarty, Ross-shire IV11 8YJ
Contact person: Paul Thompson ighthouse@abdn.ac.uk
Research Activity: **Environmental impacts of offshore wind farms**
Duration/cost: 2005-08; £167k
Funding: EU, Industry (Talisman Energy UK Ltd)
Principal Investigator: Paul Thompson

Objective/ Goal: DOWNVinD is an EU 6th Framework project that aims to develop the technology required to construct wind farms in deep water. As part of this larger project, we aim to use these demonstration facilities to study some potential impacts of construction and operation of offshore turbines. In particular, we aim to: 1. Test the performance of acoustic propagation models for estimating levels of noise resulting from construction activity. 2. Determine whether cetacean behaviour or distribution is affected by construction noise. 3. Develop techniques for estimating the probability of collisions between seabirds and the wind turbines, and the extent to which seabirds change their flight and foraging behaviour to avoid active turbines.

How are results communicated? Through formal EU reporting procedures. Early results will be integrated into EA procedures and become available to regulatory and stakeholder groups; peer-reviewed journal articles.

Can results be used to support resource management? The project has been developed specifically to support industries and agencies involved in planning the development of offshore renewable energy projects.

181. INSTITUTION: University of Aberdeen
DEPARTMENT/ UNIT: School of Biological Sciences
Address: Tillydrone Avenue, Aberdeen UK, AB24 2TZ

Contact person: Dr C Tara Marshall c.t.marshall@abdn.ac.uk
Research Activity: Time series analysis of cod bioenergetics with application to fish stock management
Duration/cost: 2004-07; ~£53k
Funding: BBSRC (studentship)
Principal Investigator: L Sandeman nhy303@abdn.ac.uk; Supervisor Dr C T Marshall

Objective/ Goal: Temporal variation in lipid reserves of fish impacts stock biomass, yield, mortality, maturation, fecundity, and possibly recruitment. In cod, lipids are stored in the liver. This study aims to: 1) conduct a time series analysis of the temporal variation in the liver weights of cod in the Barents Sea using a highly resolved Russian database; 2) identify biotic and abiotic influences on cod liver weights using environmental data having a similar degree of temporal resolution, e.g., temperature and feeding success; 3) develop practical guidelines for the optimal design of sampling programmes that will routinely monitor the lipid reserves of cod.

How are results communicated? In addition to publishing scientific articles, the student will participate in relevant Working or Study Groups that meet regularly to discuss practical issues related to fisheries management. This will be an effective means for disseminating the results of the project and will enhance the student's training in applied fisheries management.

Can results be used to support resource management? Yes. Liver reserves of cod impact the proportion that will mature. Additional research will be undertaken to determine if a predictive model that could be used to project maturity in the upcoming year can be developed.

182. INSTITUTION: University of Aberdeen
DEPARTMENT/ UNIT: School of Biological Sciences
Address: Tillydrone Avenue, Aberdeen AB24 2TZ
Contact person: Dr C Tara Marshall c.t.marshall@abdn.ac.uk
Research Activity: Testing for developmental thresholds in herring maturation
Duration/cost: 2005-07; £15k
Funding: Univ of Aberdeen
Principal Investigator: Dr C Tara Marshall

Objective/ Goal: To determine whether maturation in herring depends on the magnitude of stored energy (a developmental threshold) the null hypothesis that will be tested is: is the somatic lipid content in individual herring is uncorrelated with their probability of being mature after controlling for the effects of body size. In 2005 herring will be sampled onboard the annual acoustic survey of the North Sea conducted by the FRS Marine Laboratory. This study will use novel technology to instantaneously measure the somatic lipid content of herring thus, allowing lipid content of North Sea herring to be mapped. Logistic models will be fit to these data to assess whether somatic lipid content contribute to variation in maturity.

How are results communicated? Project results will be published and presented at conferences. Collaboration with scientists at the FRS Marine Laboratory is also an essential part of the project. A good working relationship is developing between my lab and a local pelagic fishing company who provides herring for related research.

Can results be used to support resource management? Yes. The variability in the proportion of age 2 and age 3 herring becoming mature creates difficulties when predicting biomass for the upcoming fishing year. Developing a predictive model of maturation would have immediate applications to annual stock assessment undertaken by ICES.

183. INSTITUTION: University of Aberdeen
DEPARTMENT/ UNIT: School of Biological Sciences
Address: Tillydrone Avenue, Aberdeen AB24 2TZ
Contact person: Dr C Tara Marshall c.t.marshall@abdn.ac.uk
Research Activity: Understanding the mechanisms of stock recovery (UNCOVER)
Duration/cost: 2006-09; £120k requested for WP4.1
Funding: EU (submitted for STREP-SSP4 call)
Principal Investigator: Dr C Tara Marshall

Objective/ Goal: (for WP4.1) Synthesis of process information and models for implementation in management evaluation tool. The objective of UNCOVER is to apply all available and relevant data to identify changes experienced during the stock decline and the consequences for the prospects of stock recovery. The goal of sub-task WP4.1 is to collate the data, information and models necessary to simulate the rates of stock recovery for a variety of strategic questions. Information will then be formatted so that it can be fed into the management evaluation tool (software suite developed at CEFAS using the statistical program R).

How are results communicated? As is customary for EU projects, the results of the sub-task are a series of deliverables that will be communicated directly to other sub-tasks and, in this way, contribute to the ultimate deliverable of the project: a 2-3 page document summarizing recommendations related to the design and implementation of recovery programmes.

Can results be used to support resource management? Yes. The project is expected to provide a general discussion of the mechanisms of stock recovery and identify the features of effective recovery plans. For selected case study stocks the results of the project must indicate the following: evaluation of the potential for recovery, identification of unforeseen problems relating to existing recovery plans.

184. INSTITUTION: University of Aberdeen
DEPARTMENT/ UNIT: School of Biological Sciences
Address: Tillydrone Avenue, Aberdeen AB24 2TZ
Contact person: Dr Graham Pierce g.j.pierce@abdn.ac.uk

Research Activity: Marine biology and fisheries [details below]
Duration/cost: Various
Funding: NERC, EU, private sector and others
Principal Investigator: Dr G Pierce

Objective/ Goal: Studies on interactions between marine mammals and fisheries and factors affecting distribution and abundance of resource species. Currently involved in range of projects the most relevant being: 1. Cephalopod stocks in European waters: review, analysis, assessment and sustainable management (CEPHSTOCK; CEC Framework 5 Concerted Action: Coordinator). 2. Bio-diversity processes in heterogeneous environments (NERC). 3. Changing distribution patterns and behaviour of bottlenose dolphins off the North East coast of Scotland. (TotalFinaElf Exploration, Talisman Energy, Kerr-McGee North Sea). 4. Promoting higher added value to a finfish species rejected to sea (ROCKCOD; CEC DG Fisheries CRAFT project). 5. Collaborative research into the occurrence, distribution and habitat preferences of cetaceans on the west coast of Scotland. (Dstl Commercial Services, MoD). 6. Overview of cephalopods relevant to the SEA5 area and a study of spawning areas and contaminant burdens in squid (GEOTEK).

How are results communicated? EU reports, peer-reviewed papers, conferences

Can results be used to support resource management? Yes. EU projects geared towards directly applicable research

185. **INSTITUTION:** University of Aberdeen
DEPARTMENT/ UNIT: School of Biological Sciences (Oceanlab)
Address: Main Street, Newburgh, Aberdeenshire. AB41 6AA
Contact person: Dr Martin Solan www.oceanlab.abdn.ac.uk/
Research Activity: Coastal ocean benthic observatories
Duration/cost: 3 yr; €192k
Funding: EU
Principal Investigator: Dr Martin Solan m.solan@abdn.ac.uk

Objective/Goal: To integrate emerging and innovative technologies from different disciplines (physics, chemistry, biology) to provide *in situ* monitoring of sediment ecosystems, a key subsystem of the coastal environment, to understand the complex interactions between biota (their functioning and diversity) and their chemical environment. The combination of innovative interdisciplinary instruments will provide powerful tools to advance our understanding of organism-sediment relations under dynamic coastal conditions and enhance predictive capability. The project represents a logical stepping stone towards the development of permanently operating benthic observatories for coastal management to give economic, scientific and societal gains.

How are results communicated? The project website, along with links to similar clustered projects, will showcase activity and progress to the public. Open days at partner institutes will promote technical developments and key issues to the wider public along with new developments aired at international committees on ocean science. Use of media where appropriate. Engineering and ecological scientific papers.

Can results be used to support resource management? Yes. The ability to carry out realistic, *in situ* experiments with dedicated multi-disciplinary technology will provide critical input into the development of predictive models to forecast the responses of marine coastal ecosystems to a changing environment.

186. **INSTITUTION:** University of Aberdeen
DEPARTMENT/ UNIT: School of Biological Sciences
Address: Lighthouse Field Station, George Street, Cromarty, Ross-shire IV11 8YJ
Contact person: Paul Thompson lighthouse@abdn.ac.uk
Research Activity: Response of marine top predators to natural and anthropogenic changes in the marine environment
Duration/cost: Ongoing; £50-100k pa
Funding: Government, industry, environmental charities, Leverhulme Trust and others
Principal Investigator: Paul Thompson

Objective/ Goal: To understand the relative role of bottom-up (eg. climate variation and changes in food availability) and top-down (eg. predation and by-catch) influences on the dynamics of marine top predator populations. We also aim to understand the relative influence of natural and anthropogenic environmental change on these populations. Our research is based upon a suite of long-term ecological studies of populations of seabirds (1950-present), harbour seals (1987-present) and bottlenose dolphins (1989 - present). Building upon this core- programme of population monitoring, we aim to explore causal links between environmental variation and population change through interdisciplinary studies at molecular and whole animal levels.

How are results communicated? Through peer-reviewed journal articles; close collaboration with environmental and government organisations; extensive links with the media; active engagement with stakeholder groups

Can results be used to support resource management? Much of the work has been supported by organisations interested in the conservation or management of these populations; informing management of seal-fisheries interactions, mitigation of human activities with EU Special Areas of Conservation.

187. **INSTITUTION:** University of Aberdeen
DEPARTMENT/ UNIT: School of Biological Sciences
Address: Lighthouse Field Station, George Street, Cromarty, Ross-shire IV11 8YJ
Contact person: Paul Thompson lighthouse@abdn.ac.uk
Research Activity: A Bayesian framework for integrating science and marine resource management

Duration/cost: 2003-06; £84k
Funding: Leverhulme Trust
Principal Investigator: Paul Thompson (with Steve Brooks, Cambridge; Phil Hammond, St Andrews; John Armstrong, FRS Aberdeen)

Objective/ Goal: To develop a Bayesian framework to integrate multiple sources of uncertain and evolving data into models that can inform current marine conservation and management issues. The project uses two case studies to develop a series of related modelling frameworks. 1. Interactions between seals and Scottish salmon fisheries; where the focus is upon accounting for uncertainty in complex ecological models. 2. Conservation of UK dolphins and the EU Habitats Directive; which aims to illustrate how one can incorporating evolving datasets into conservation monitoring and reporting.

How are results communicated? Through peer-reviewed journal articles; close collaboration with environmental and government organisations; active engagement with stakeholder groups

Can results be used to support resource management? The case studies have been selected to ensure that they can directly support the work of SNH and SERAD, and inform other management related for a such as the NERC SCOS.

188. INSTITUTION: University of Aberdeen
DEPARTMENT/ UNIT: School of Biological Sciences
Address: Tillydrone Avenue, Aberdeen AB24 2TZ
Contact person: Dr Beth Scott b.e.scott@abdn.ac.uk
Research Activity: **Interactions between the marine environment, predators and prey: implications for the sustainable sandeel fisheries (IMPRESS)**
Duration/cost: 2000-04; £188k (c £2m total)
Funding: EU
Principal Investigator: (EU coordinator) Kees Camphuysen camphuys@nioz.nl

Objective/ Goal: (for WP5) To determine how oceanographic features (mixed-layer depth, onset and breakdown of stratification, seasonal progress of primary production) should be used to define seabird foraging habitats, and whether variability in any of these features could be causative in controlling variability in prey availability. The work provided a first-order picture of the 3-D structure of the study area such that predictions of structure and primary production at specified positions and on specified time scales can be made both historically and forward in time under defined climatic conditions.

How are results communicated? (For WP5) primary literature: 4 published or in press, 1 in review and 4 in preparation. Conferences: oral presentations at 6 international conferences and 2 workshops. EU reports: 4 annual reports and 1 final report.

Can results be used to support resource management? Yes. With the use of long-term population and a detailed 1-D physical-biological model we have shown how integrated and biologically meaningful region- and year-specific oceanographic variables can provide new insights into the mechanisms which link multiple meteorological conditions with seabird breeding success. In particular, we have used the timing of stratification and the spring bloom as possible indicators of sandeel availability. Our approach allows us to separately quantify fishing and climate effects and indicates that the presence of a local sandeel fishery decreases breeding success of Isle of May kittiwakes by 0.66 chicks/pair whereas every 5 day delay in the date of the spring bloom increases breeding success by 0.13 chicks/pair. In a system where experimental manipulation is impossible, this type of approach is extremely promising in the search for causal relationships among ecosystem components.

189. INSTITUTION: University of Aberdeen
DEPARTMENT/ UNIT: School of Biological Sciences
Address: Tillydrone Avenue, Aberdeen AB24 2TZ
Contact person: Dr Beth Scott b.e.scott@abdn.ac.uk
Research Activity: **Quantifying fishermen's spatial and temporal knowledge**
Duration/cost: 2004; completed
Funding: EU
Principal Investigator: B Scott

Objective/ Goal: The interactive use of a spatial and temporally explicit model of North Sea cod and haddock by fishermen and social scientist such that behavioural knowledge of fishes and fisherman can be quantified. A 'user friendly' version of a model which explicitly represents seasonal and spatial locations of length classes of cod and haddock is now available (due to ongoing work that originated from an EU project that finished in 2003). The population and local effect of choices in the location, timing and degree of effort of fishing can be viewed graphically and spatially on maps. Modelling studies on the effectiveness of closing areas at critical times could be one use of such a model. It is also envisioned that such a model could be enhanced to be even more interactive, to enable interaction with fishermen, biologists and social scientists to quantify fishermen's knowledge.

How are results communicated? Primary literature, national and inter-national conferences, local and national press.

Can results be used to support resource management? Yes. The use of such a model has shown that annual mean egg size (via the size and location of female spawners and the number of females not killed during the spawning season – using spatial fishing effort information) is a far better predictor of recruitment than SSB. The use of a spatially and temporally explicit model could be very helpful in predicting when and where it is best to encourage or control fishing effort and to help quantify fishermen's knowledge.

190. INSTITUTION: University of Aberdeen
DEPARTMENT/ UNIT: School of Biological Sciences (Fisheries parasitology)
Address: Tillydrone Avenue, Aberdeen AB24 2TZ

Contact person: Neil Campbell Neil.Campbell@abdn.ac.uk
Research Activity: **Stock identification of herring using parasites as tags**
Duration/cost: 2003-05; £193k
Funding: EU (Contract QLRT-2001-01056)
Principal Investigator: Dr Ken MacKenzie K.MacKenzie@abdn.ac.uk

Objective/ Goal: Determining the identity and integrity of stocks should be the fundamental first step in any management plan. Along with partners at the University of Liverpool, we are currently working towards improving understanding of stock structure, recruitment and movements in herring (*Clupea harengus*) in the seas to the west of the British Isles, a project known as WestHer. We are using classical parasitological study to identify species that are good indicators of population movement and developing new techniques to study the population genetics of fish parasites with a view to applying this tool to future studies.

How are results communicated? Through various media, in order to reach the broadest possible audience. Results have been communicated to the European Commission via annual reports, to the wider scientific community via peer-reviewed publication, presentations to ICES and to parasitological fora, and to the stakeholder community via our website, the combined project website (www.clupea.net/westher), and articles in the lay-press.

Can results be used to support resource management? The results we produce are strongly oriented towards incorporation in management actions. Results for a previous project, HOMSIR (QLRTPL1999-01438, www.homsir.com) looking at stock identity in the Atlantic horse mackerel *Trachurus trachurus* were presented to the ICES working group on Mackerel, Horse Mackerel and Sardine. Our results supported current management of the fishery as two stocks in European Atlantic waters, but that the position of the demarcation between "western" and "southern" stocks was wrong. This advice was taken onboard by the working group and changes were made in the methods of stock assessment.

191. **INSTITUTION:** University of Hull
DEPARTMENT/ UNIT: Scarborough Centre for Coastal Studies
Address: Filey Rd, Scarborough, YO11 3AZ
Contact person: Dr Magnus Johnson m.johnson@hull.ac.uk
Research Activity: **Socioeconomic and ecological interactions of static gear fishers and their prey**
Duration/cost: 3yr; £35k
Funding: University funded PhD
Principal Investigator: Dale Rodmell d.rodmeell@hull.ac.uk

Objective/ Goal: To develop an understanding of interactions of inshore fishing communities, conflicts with other marine resource users and the relationship between fishers and their prey. The structure of fishing communities is being investigated using network analysis and case studies of current conflicts are contributing to an understanding of management issues for inshore fisheries. Information on fishing grounds is obtained by asking fishers to highlight areas of interest on fishing charts.

How are results communicated? Close liaison with collaborating fishing communities, also presentations at meetings, publication of proceedings from the "Who Owns the Sea Conference", regular publication of "The Forum" (newsletter for fishermen off the NE coast) and publications in peer reviewed journals (eventually)

Can results be used to support resource management? An understanding of how information is transmitted through fishing communities should be useful in helping institutions communicate effectively with fishers. Results are expected to demonstrate effective ways for collaborating with inshore fishers to manage coastal resources

192. **INSTITUTION:** University of Hull
DEPARTMENT/ UNIT: Scarborough Centre for Coastal Studies
Address: Filey Rd, Scarborough, YO11 3AZ
Contact person: Dr Magnus Johnson m.johnson@hull.ac.uk
Research Activity: **Investigation into ecological interactions between economically important crustacea on the Yorkshire Coast**
Duration/cost: 1yr; £2k
Funding: BES, University of Hull
Principal Investigator: Dr Magnus Johnson

Objective/ Goal: To conduct some preliminary investigations into the ecological relationships between economically important crustacea on the Yorkshire coast. Particular attention paid to the impact of the invasive velvet swimming crabs on traditionally important species such as the lobster and edible crab.

How are results communicated? Conference presentation at the BES in 2006, dissemination of results to fishermen at association meetings, hopefully publication of results in a peer reviewed journal

Can results be used to support resource management? An understanding of the impact of velvet fiddler crabs may assist in planning the future of the inshore static gear fishery in this area.

193. **INSTITUTION:** University of Leicester
DEPARTMENT/ UNIT: Biology
Address: University Road, Leicester, LE1 7RH
Contact person: Matt Sheehy mrjs2@le.ac.uk
Research Activity: **Use of age pigments for age determination of lobster *Homarus gammarus***
Duration/cost: 5 yr 5 mo; £211k
Funding: DEFRA (MF0215)

Principal Investigator: M.R.J. Sheehy and P.M.J. Shelton

Objective/ Goal: 1. To determine the usefulness of lipofuscin pigment for age determination of the European lobster *Homarus gammarus*. 2. To develop rapid lipofuscin quantification procedures. 3. To assess the implications of the lobster ages obtained for stock assessment.

How are results communicated? To date: International journal papers (7); international and national conference/workshop presentations (6); international and national seminars and lectures (6); post-graduate research training (3); national and international media including newspaper, magazine, newsletter, TV and radio (15+); reports to Policy Customer, DEFRA project officers and fishing industry representatives (numerous). Reports and other material at www.le.ac.uk/biology/staff/blmrs.htm

Can results be used to support resource management? Results are of direct relevance to DEFRA for improving stock assessment and management. Accurate ageing of lobsters has not only highlighted deficiencies in traditional models dependent on size and steady state but also permitted refinement of population assessment parameters. It has yielded unique insights on growth, longevity, refugia, selective fishing impacts, yield forecasting, the effects of global climate change, arguments about spawner protection or restocking, and the spawner–recruit relationship.

194. **INSTITUTION:** University of Leicester
DEPARTMENT/ UNIT: Biology
Address: University Road, Leicester, LE1 7RH
Contact person: Matt Sheehy mrjs2@le.ac.uk
Research Activity: **Age structure and population parameters of the edible crab *Cancer pagurus*: data for resource management**
Duration/cost: 4 yr 4 mo; £364k
Funding: DEFRA (MF0225)
Principal Investigator: MRJ Sheehy

Objective/ Goal: To obtain demographic information for edible crab in the main regional fisheries that can be used for new stock assessments, thus strengthening the basis for management. The acquisition of such information has been identified as a scientific priority. Because crabs cannot be aged by conventional procedures this project will employ a novel lipofuscin age pigment-based approach, as successfully applied to lobsters in MF 0215. The proposal is highly relevant to Policy because crab stocks support the most valuable crustacean fishery in England and Wales and DEFRA is responsible for crab management under both EU and national legislation.

How are results communicated? To date: international journal papers (2); international and national conference/workshop presentations (2); international and national invited seminars/lectures (3); postgraduate research training (1); national print media (2); reports to Policy Customer, DEFRA project officers and fishing industry representatives (numerous). Reports and other material at www.le.ac.uk/biology/staff/blmrs.htm

Can results be used to support resource management? The unique spatially and physiologically-resolved demographic data produced by the project are of direct relevance to DEFRA for refining population parameters and thus improving regional stock assessment and management of crabs. The project was included in DEFRA's four year programme review in 2003, and the results to date and techniques were noted by the reviewer to be 'state of the art', 'revolutionizing crustacean stock assessment' and 'likely to become widely used'.

195. **INSTITUTION:** University of Leicester
DEPARTMENT/ UNIT: Biology
Address: University Road, Leicester, LE1 7RH
Contact person: Matt Sheehy mrjs2@le.ac.uk
Research Activity: **Use of lipofuscin for aging Caribbean spiny lobster *Panulirus argus***
Duration/cost: 3yr; US \$115k
Funding: US Dept of Commerce - NOAA
Principal Investigator: T Matthews, C Derby, MRJ Sheehy

Objective/ Goal: The first objective is to make accurate age determinations of Caribbean spiny lobster. The second is to develop a complete growth curve and age-length key to understand the general growth parameters for use in fisheries modelling. Specifically, by understanding the age-growth relationship we can evaluate the cause of the size distribution and size at reproductive maturity differences between lobster in the Dry Tortugas National Park and in the fishery to characterize the actual reproductive contribution of female lobster by age in the Dry Tortugas Marine Protected Area and non-protected areas.

How are results communicated? International journal papers; international and national conference/workshop presentations; postgraduate research training; press release; formal and informal oral and written reports to sponsor, fishery managers and other participants. Reports and other material at www.le.ac.uk/biology/staff/blmrs.htm

Can results be used to support resource management? This project will provide critical information on the age and growth of the spiny lobster. Age and growth are the most basic population parameters required for effective fishery management. By understanding these parameters, fishery managers will be able to evaluate current fishing-effort limitation programs and assess the actual reproductive contribution of female lobster by age in a Marine Protected Area.

196. **INSTITUTION:** University of Leicester
DEPARTMENT/ UNIT: Biology
Address: University Road, Leicester, LE1 7RH
Contact person: Matt Sheehy mrjs2@le.ac.uk

Research Activity: Factors affecting the accumulation of arthropod neurolipofuscin and its use as an ecological tool for age determination
Duration/cost: 4yr; US \$110k
Funding: CNPq (Brazilian National Council for Scientific & Technological Development)
Principal Investigator: DB Fonseca (PhD candidate), MRJ Sheehy & PMJ Shelton (supervisors)

Objective/Goal: Age pigments are a useful tool for studying the biological ageing process, for age determination, and for understanding the population dynamics of crustaceans, particularly with regard to the assessment of commercially important stocks. Expansion of, and refinements to, the application of the ageing method are desirable and much remains to be discovered in regard to the endogenous and external factors that may affect lipofuscin accumulation. The project will explore these areas.

How are results communicated? Thesis; international journal papers; conference presentations; departmental seminars; reports to sponsor; international technology transfer by overseas student return to home country

Can results be used to support resource management? The results indirectly support ecosystem-wide resource management by developing, validating and refining the lipofuscin ageing method as tool for understanding the population dynamics of important exploited and keystone species.

197. **INSTITUTION:** University of Leicester
DEPARTMENT/ UNIT: Biology
Address: University Road, Leicester, LE1 7RH
Contact person: Paul J B Hart pbh@le.ac.uk
Research Activity: Conservation effects of a closed area off the south Devon coast
Duration/cost: 3 yr; ~£30k
Funding: DEFRA, Isle of Man Government
Principal Investigator: R E Blyth rebs@esfjc.co.uk, M J Kaiser Michel.Kaiser@bangor.ac.uk

Objective/Goal: The inshore fishery off south Devon catches crabs and a variety of fin fish. The inshore area was partitioned in the late 1970s to segregate mobile and static gear. This created an area of about 450 km² that was never trawled. This project examined the influence of these no-trawling areas on the diversity of the benthic community, the sizes of the major fishes species caught in the area and the reproductive potential of the scallop populations within and without of the closed area. Sport anglers were surveyed to examine their attitudes towards a willingness to pay for the maintenance of closed areas which have a conservation effect.

How are results communicated? Papers in refereed journals: Blyth RE, Kaiser MJ, Edwards-Jones G & Hart PJB. (In press) Protecting fish: the refuge effect of a limited-access fishery management system in temperate waters, *Conservation Biology*; Blyth, RE, Kaiser, MJ, Edwards-Jones G. & Hart PJB. (2004) Implications of a zoned fishery management system for marine benthic communities *J Appl Ecol*.41, 951–61; Blyth RE, Kaiser MJ, Edwards-Jones G. & Hart PJB. (2002). Voluntary management in an inshore fishery has conservation benefits. *Environmental Conservation* 29 493-508

Can results be used to support resource management? Yes. The results show that closed areas have important conservation effects on the biodiversity of both exploited and unexploited species.

198. **INSTITUTION:** University of Leicester
DEPARTMENT/ UNIT: Biology
Address: University Road, Leicester, LE1 7RH
Contact person: Paul J B Hart pbh@le.ac.uk
Research Activity: The effects of climate change on the western English Channel; a study using Ecopath with Ecosim
Duration/cost: 4 yr; ~£60k
Funding: CAPES Brazil (studentship support)
Principal Investigator: Julio Araujo jna3@mail.cfs.le.ac.uk

Objective/Goal: An ecosystem model of the western English Channel has been built for 1973 and 1995. These years represent a relatively cold and warm periods. The model is being used to examine possible mechanisms for species changes in the fish community as shown by an analysis of trawl data collected by the MBA. Further studies will examine the likely changes in the ecosystem as a result of global warming and how these changes will influence the fishing industry in SW England.

How are results communicated? Araujo JN, Mackinson S, Ellis JR & Hart PJB (in press) An Ecopath model of the western English Channel ecosystem with an exploration of its dynamic properties CEFAS Technical Report..Also refereed papers and a PhD thesis.

Can results be used to support resource management? The results can be used to support resource management and will suggest consequences of climate change and different management strategies.

199. **INSTITUTION:** University of Leicester (with University of Hull)
DEPARTMENT/ UNIT: Biology/ Coastal Studies Unit, Scarborough
Address: University Road, Leicester LE1 7RH
Contact person: Paul J B Hart pbh@le.ac.uk / Magnus Johnson m.johnson@hull.ac.uk
Research Activity: Economics and behaviour of the south Yorkshire inshore fishery.
Duration/cost: 5 yr; ~£30k
Funding: University of Hull
Principal Investigator: Dale Rodmell D.Rodmell@hull.ac.uk

Objective/ Goal: The inshore crab and lobster fishery off the Yorkshire coast between Scarborough and the Wash is carried out in the face of many other uses of the sea. Gas caverns, pipe lines and the prospect of wind farms are all making it harder for the inshore fishers to make a living. This study will document the way in which the fishers are reacting to the disruption of their activities and will hope to make recommendations as to how the various uses of the inshore area can be reconciled.

How are results communicated? They will be published in refereed scientific journals

Can the results be used to support resource management? The results will be used to assist in developing management strategies for the area and will help the small scale inshore fishers defend their livelihood against intrusion from more powerful economic units, such as power companies.

200. INSTITUTION: University of Liverpool
DEPARTMENT/ UNIT: Port Erin Marine Laboratory
Address: Breakwater Rd, Port Erin, Isle of Man IM9 6JA
Contact person: Dr Bryce Beukers-Stewart brycebs@liv.ac.uk
Research Activity: **Scallop Fisheries Biology and Impacts**
Duration/cost: 1981 – 2006; currently £120k pa
Funding: Isle of Man Government
Principal Investigator: Dr Andrew Brand arbrand@liv.ac.uk, Dr Bryce Beukers-Stewart

Objective/ Goal: 1. Continue long-term assessment of scallop stocks and the impact of fishing around the Isle of Man. 2. Maintain and analyse long-term datasets on commercial fishing effort and catch rates around the Isle of Man. 3. Develop predictive models aimed at generating short to medium term forecasts of stock abundance. 4. Examine long-term trends in by-catch composition, determine mechanisms of dredge-induced damage and assess the consequences for benthic communities. 5. Examine the utility of closed area management for balancing the needs of fisheries and conservation.

How are results communicated? Peer-reviewed publications; conference and workshop presentations (national and international); annual report to the IoM Government; bi-annual Research Newsletters to the Manx Fishing industry; presentations and meetings with stakeholders and the general public; local and national newspaper articles and radio interviews; website www.liv.ac.uk/peml/projects/scallop.htm

Can results be used to support resource management? Yes. Monitoring stocks and commercial catch and effort allows assessment of current regulations aimed at sustaining the fishery. The ability to make short to medium-term forecasts provides potential for adaptive management. By-catch research provides an assessment of the wider ecosystem affects of the fishery and information for the design of more “environmentally friendly” fishing gear. Work on closed area management suggests scallop fisheries are particularly suited to this approach. Within protected areas there has been substantial recovery of scallop stocks and benthic communities and improvements in commercial CPUE on surrounding fishing grounds.

201. INSTITUTION: University of Liverpool
DEPARTMENT/ UNIT: Port Erin Marine Laboratory
Address: Breakwater Rd, Port Erin, Isle of Man IM9 6JA
Contact person: Dr Bryce Beukers-Stewart brycebs@liv.ac.uk
Research Activity: **Isle of Man scallop re-seeding project**
Duration/cost: 2003 – 06; £100k
Funding: Bord Gáis Éireann
Principal Investigator: Dr Andrew Brand arbrand@liv.ac.uk

Objective/ Goal: 1. To investigate the potential of stock enhancement and rotational seabed closure for improving scallop fishery yields. 2. To compare the cost-effectiveness of two different methods of stock enhancement a) direct seeding of juvenile scallops on the seabed, b) suspended culture of scallop spat followed by seeding of juveniles. 3. To involve and train Isle of Man fishermen in the techniques of scallop stock enhancement.

How are results communicated? Peer reviewed publications; conference and workshop presentations); annual reports to Bord Gáis Éireann and the IoM government; bi-annual Research Newsletters to the Manx Fishing Industry; presentations and meetings with stakeholders and the general public; local and national newspaper articles and radio interviews

Can results be used to support resource management? Yes. Rotational closure and stock enhancement has revolutionised and revitalised scallop fisheries in other parts of the world (eg China, Japan, New Zealand). However, the effect-iveness of this method has rarely been tested in European waters. Along with the potential for improving yields, this manage-ment method may reduce the negative environmental impacts of scallop fishing. Ideally stock enhancement and rotational harvesting will concentrate fishing effort on small but highly productive areas, leaving other areas relatively undisturbed.

202. INSTITUTION: University of Liverpool
DEPARTMENT/ UNIT: Port Erin Marine Laboratory
Address: Breakwater Rd, Port Erin, Isle of Man IM9 6JA
Contact person: Dr Bryce Beukers-Stewart brycebs@liv.ac.uk
Research Activity: **Conservation and fishery replenishment effects of a mobile fishing gear closure**
Duration/cost: 2003 – 06; £18k to Liverpool University (£150k in total)
Funding: Esmée Fairbairn Foundation
Principal Investigator: Dr Callum Roberts (Univ of York) cr10@york.ac.uk

Objective/ Goal: Part of a consortium project “Towards a network of marine protected areas in the British Isles”. The Isle of Man / Liverpool University component has three main objectives. 1. To develop genetic markers to distinguish imported

scallops (see Isle of Man scallop re-seeding project) from local Irish Sea stocks, and use them to investigate dispersion of scallops and export of larvae from a closed area. 2. To translate scientific results on the fishery and conservation benefits of a closed area into a form that can be used to promote No-Take Zones locally and more widely in Britain. 3. To involve the local community in developing a network of protected areas around the Isle of Man.

How are results communicated? Peer reviewed publications; conference and workshop presentations (national and international); reports to the Esmée Fairbairn Foundation and IoM government; bi-annual Research Newsletters to the Manx Fishing Industry; presentations and meetings with stakeholders and the general public; local and nationally targeted displays, posters and leaflets; local and national newspaper articles and radio interviews.

Can results be used to support resource management? Yes. Investigating and quantifying the dispersal and larval export of commercial species from closed areas is essential for evaluating their utility as fisheries management tools. However, almost no empirical studies have addressed this issue to date. Bridging the gap between the scientific community, government and stakeholders in the management process is seen as a key component of the ecosystem-based approach. This project will serve as a valuable learning experience for moving this process forward.

203. INSTITUTION: University of London (with Glasgow University)
DEPARTMENT/ UNIT: University Marine Biological Station Millport
Address: Millport, Isle of Cumbrae, Ayrshire KA28 0EG
Contact person: Dr Rupert Ormond (Director) rupert.ormond@millport.gla.ac.uk
Research Activity: Marine conservation and No Take Zones (NTZs)
Duration/cost: Ongoing; ~ £100k
Funding: EU, British Council, Esmee Fairburn Trust
Principal Investigator: Dr Rupert Ormond, Dr Philip Smith

Objective/ Goal: To provide a scientific basis for the management of Marine Protected Areas (MPAs), to investigate key issues in MPA management and to assess the extent to which NTZs may provide an effective tool for fisheries management. Issues under investigation include the effects of coral damage by visitors (in Egypt), of scallop dredging (in Scotland), and public attitudes towards MPAs (in Egypt and Scotland). Research on NTZs has been investigating the mechanisms of increased fish catch in adjacent waters, behavioural mechanisms underlying density-dependent population processes in MPAs, the application of NTZs to Norway lobster fisheries, and the potential for establishing NTZs in Scotland.

How are results communicated? Through project reports and scientific papers e.g. Galal N, Ormond RFG & Hassan O. (2002) Effect of a network of no-take reserves in increasing catch per unit effort and stocks of exploited reef fish at Nabq, South Sinai, Egypt. *Mar & Freshwater Res*, 53, 199-205; Ashworth JS & Ormond RFG (2005) Effects of fishing pressure and trophic group on abundance and spillover across boundaries of a no-take zone. *Biol Conservation* 121, 333-44; Ormond RFG & Gore MA (2004) No-take zones: does behaviour matter? in: Spedicato MT, Marmulla G & Lembo G (eds.) *Aquatic Telemetry: Advances and Applications*, FAO & COISPA, Rome. pp.1-19; Smith IP, Jensen AC & Pickering H (2003) Modelling fishery exclusion zones in Norway lobster fisheries. In *The value of exclusion zones as a fisheries management tool: a strategic evaluation and the development of an analytical framework for Europe*. (ed. Pickering H), pp. 183-218. CEMARE, Univ of Portsmouth,

Can results be used to support resource management? Yes, the results are of direct relevance to the search for better ways of achieving sustainable exploitation of inshore fish stocks. Related work is directed at securing effective management of MPAs, a critical tool for the sustainable management of marine biodiversity and renewable resources.

204. INSTITUTION: University of London (with Glasgow University)
DEPARTMENT/ UNIT: University Marine Biological Station Millport
Address: Millport, Isle of Cumbrae, Ayrshire KA28 0EG
Contact person: Dr Rupert Ormond (Director) rupert.ormond@millport.gla.ac.uk
Research Activity: Large marine vertebrates
Duration/cost: 2002-08; ~ £350k (current grants)
Funding: Darwin Initiative, Save Our Seas Foundation, British Council etc
Principal Investigator: Dr Mauvis Gore Mauvis.Gore@millport.gla.ac.uk, Dr Rupert Ormond,

Objective/ Goal: To research the ecology and behaviour of large marine vertebrates, with a view to understanding their role in marine ecosystems and securing their long-term management and conservation. Research includes projects on whales and dolphins (in W Scotland, N E Indian Ocean, Red Sea and Caribbean), seals (Scotland) and large sharks (Scotland, Red Sea and Indian Ocean), especially the largest planktivorous species – Whale Shark (Seychelles) and Basking Shark (Scotland).

How are results communicated? Through project reports, conference presentations and scientific papers eg. Minton G, Collins T, Findlay K, Baldwin R, Rosenbaum H, Kennedy F & Cockcroft V (2002) Preliminary investigations of Humpback whale distribution and habitat use off the coast of Oman. IWC SC/54/H3, International Whaling Commission 20pp; Minton G, Collins TJQ & Findlay KP (2003) A note on re-sights of individually identified humpback whales (*Megaptera novaeangliae*) off the coast of Oman. International Whaling Commission SC/55/O10. 1-7; Parsons ECM, Warburton CA, Weoods-Ballard A, Hughes A & Johnston P (2003) The value of conserving whales: the impacts of cetacean-related tourism on the economy of rural West Scotland. *Aquatic Conservation* 13, 397-415.

Can results be used to support resource management? Yes. Findings are directly relevant to the management and conservation of species of high conservation interest and resource value (eg Humpback Whale, Basking Shark, Grey Seal). Indirectly, there is recent support for the view that top predators play key roles in structuring marine ecosystems, and that in their absence population effects cascade to lower trophic levels.

205. INSTITUTION: University of London (with Glasgow University)
DEPARTMENT/ UNIT: University Marine Biological Station Millport

Address: Millport, Isle of Cumbrae, Ayrshire KA28 0EG
Contact person: Dr Rupert Ormond (Director) rupert.ormond@millport.gla.ac.uk
Research Activity: Shellfish fisheries biology
Duration/cost: Ongoing; ~ £500k over 10 yr
Funding: NERC, SEERAD, SNH, Highland Council, Food Industry
Principal Investigator: Prof RJA Atkinson gbfa03@udcf.gla.ac.uk

Objective/ Goal: Shellfish research at UMBSM has focused on Norway lobster *Nephrops norvegicus* which is of major economic importance to Scotland. Crabs *Necora puber*, squat lobsters *Munida* spp, razor clams *Ensis* spp. and scallops *Pecten maximus*, *Aequipecten opercularis* have also received attention. Topics under current or recent investigation include refinement of methods for stock assessment, analysis of fishery discards, evaluation of capture methods, analysis of creel fisheries, assessment of the environmental impact of fishing gear, and investigation of population dynamics. For *Nephrops*, aspects of product quality are also under investigation, including disease- and stress-moderated phenomena using molecular, microbiological, and other methods.

How are results communicated? project reports and scientific papers eg Marrs SM, Tuck ID, Atkinson RJA, Stevenson TDI & Hall C (2002) Position data loggers and logbooks as tools in fisheries research: results of a pilot study and some recommendations. *Fisheries Res.* 58, 109-17; Hall Spencer JM, Grall J, Moore PG & Atkinson RJA (2003) Bivalve fishing and maerl-bed conservation in France and the UK – retrospect and prospect. *Aquatic Conserv: Mar. Freshw. Ecosyst.* 13, S33-S41; Smith CJ, Marrs SJ, Atkinson RJA, Papadopoulou K-N & Hills JM (2003) Underwater television for fisheries-independent stock assessment of *Nephrops norvegicus* from the Aegean (eastern Mediterranean) Sea. *Mar Ecol Prog Ser.* 256, 161-70; Marrs Working Group on *Nephrops* stocks. Galway, Ireland, 18-26 March 2003.

Can results be used to support resource management? Of direct relevance to fisheries; also of wider relevance in relation to ecosystem impacts of fishing.

206. INSTITUTION: University of London (with Glasgow University)
DEPARTMENT/ UNIT: University Marine Biological Station Millport
Address: Millport, Isle of Cumbrae, Ayrshire KA28 0EG
Contact person: Dr Rupert Ormond (Director) rupert.ormond@millport.gla.ac.uk
Research Activity: Habitat conservation and mapping
Duration/cost: Ongoing
Funding: EU, SNH
Principal Investigator: Prof PG Moore pmoore@udcf.gla.ac.uk

Objective/Goal: There has been much UMBSM research on the ecology, biodiversity and conservation of benthic habitats, in particular maerl beds formed by coralline algae. This habitat supports an exceptionally high diversity of invertebrates, and serves as a key nursery ground for commercial fish and mollusc species. More recently habitat mapping has featured both as a component of conservation work and in fishery-related studies. UMBSM staff undertook the extensive NCC-funded Sealochs Survey and have recently undertaken RV-based mapping studies for SNH at sites in both the outer and inner Hebrides. Recent research has also been undertaken on the ecology, behaviour and physiology of burrowing megafauna.

How are results communicated? Through reports, scientific papers and relevant agencies. Kamenos NA, Moore PG & Hall-Spencer JM (2004) Nursery area function of maerl grounds for juvenile queen scallops *Aequipecten opercularis* and other invertebrates. *Mar.Ecol. Prog. Ser.* 274: 183-9; Jackson CM, Kamenos NA, Moore PG & Young M (2004) Meiofaunal bivalves in maerl and other substrata; their diversity and community structure. *Ophelia*, 58, 49-60; Scottish Biodiversity Forum, 2005. *Scotland's biodiversity: it's in your hands. Strategy Implementation Plans, 2005-2007.* Scottish Biodiversity Forum, 80pp. Kamenos NA, Moore PG & Hall-Spencer JM (2005) The role of maerl grounds as nursery areas. SNH, Edinburgh.

Can results be used to support resource management? Understanding the ecology and distribution of benthic habitats is essential both for conservation and management of their resources and for the management of commercially exploited stocks that depend upon them. The Strategy Implementation Plans 2005-2007 (Scottish Biodiversity Forum, 2005) pointed out "more work needs to be done on the sensitivity of habitats and species, to complement existing distribution and mapping information".

207. INSTITUTION: University of London (with Glasgow University)
DEPARTMENT/ UNIT: University Marine Biological Station Millport
Address: Millport, Isle of Cumbrae, Ayrshire KA28 0EG
Contact person: Dr Rupert Ormond (Director) rupert.ormond@millport.gla.ac.uk
Research Activity: Environmental impacts of fisheries
Duration/cost: Ongoing; total cost ~ £500k
Funding: EU, Highland Council, SNH, Shellfish Association of Great Britain, etc.
Principal Investigator: Prof PG Moore pmoore@udcf.gla.ac.uk, Prof RJA Atkinson gbfa03@udcf.gla.ac.uk

Objective/ Goal: Secondary effects of fisheries include impacts on vulnerable habitats, on by-catch species, the impacts of discarding practices and knock-on effects on ecosystems. Relevant research projects at UMBS over the past 10 yr have included: the impacts of demersal towed gears (otter trawls, scallop dredges, hydraulic dredges); SCUBA diver exploitation of razor-fish; discarding from *Nephrops* fisheries; and impacts on fragile habitats, like maerl beds and *Limaria* reefs. Current research (the PARTANS project) in North Scotland (Caithness) is investigating the biological and socio-economic impact of the creel-based crab and lobster fishery.

How are results communicated? Through reports and scientific papers, eg Croxall J, Furness R, Hammond P, Jennings S, Kaiser M, Macpherson E, Moore G & Rogers S (2000) *Commercial Fishing: The Wider Ecological Impacts.* Ed G Moore & S Jennings, BES/ Blackwell, Ecol Issues No. 8, 72pp; Hauton C, Atkinson RJA & Moore PG, (2003) The impact of hydraulic blade dredging on a benthic megafaunal community in the Clyde Sea area, Scotland. *J Sea Res* 50, 45-56.

Can results be used to support resource management? A more holistic, ecosystem approach is required for realistic and sustainable fisheries management. This will need to encompass issues relating both to conservation of biodiversity and habitat integrity, and requires biological data on target and non-target species and ecosystems.

208 . **INSTITUTION:** University of London (with Glasgow University)
DEPARTMENT/ UNIT: University Marine Biological Station Millport
Address: Millport, Isle of Cumbrae, Ayrshire KA28 0EG
Contact person: Dr Rupert Ormond (Director) rupert.ormond@millport.gla.ac.uk
Research Activity: **Plankton ecology**
Duration/cost: Planned longterm cost ~ £60k
Funding: Sheina Marshall Bequest, Save Our Seas Foundation
Principal Investigator: Dr Fiona Hannah, Dr Mauvis Gore Mauvis.Gore@millport.gla.ac.uk,

Objective/ Goal: Much classic work on phytoplankton and zooplankton was undertaken in the Clyde from UMBSM. For example, the typical seasonal patterns in species abundance, and the dependence of herring on copepod food (eg Marshall 1924, Marshall & Orr 1927). Over the past 2-3 years we have re-started routine plankton sampling at stations near UMBSM, and sampling elsewhere in the Firth of Clyde on a more irregular basis, to study how plankton abundance and dynamics may have responded to changes in annual temperature and in nutrient levels and distribution. Such changes have become apparent in the Firth over the last decade due to climate change and improved water quality.

How are results communicated? Through project reports and scientific papers; preparation of first papers is in hand.

Can results be used to support resource management? Plankton abundance and dynamics are key drivers within pelagic food chains, and also influence sea-bed ecosystems, since most benthic invertebrates and demersal fish species have a larval stage that spends significant time in the plankton. Changes in timing and abundance of planktonic prey species have been imputed as a factor in the decline in UK cod stocks, and perhaps also Basking Sharks.

209. **INSTITUTION:** University of London (with Glasgow University)
DEPARTMENT/ UNIT: University Marine Biological Station Millport
Address: Millport, Isle of Cumbrae, Ayrshire KA28 0EG
Contact person: Dr. Rupert Ormond (Director) rupert.ormond@millport.gla.ac.uk
Research Activity: **Finfish fisheries**
Duration/cost: Longterm; ~ £200k
Funding: EU, SNH, FRS, Sheina Marshall Bequest
Principal Investigator: Prof RJA Atkinson gbfa03@udcf.gla.ac.uk, Dr Rupert Ormond

Objective/ Goal: Studies of finfish at UMBSM have included investigations of the biology of both commercial and non-commercial species. Recent studies have been into the importance of inshore areas in Scottish waters as nursery grounds for commercially important fish species, particularly gadoids, and the energetics and migratory behaviour of salmon. Previous commercially relevant studies have looked at inshore wrasse (when species were used as cleaners by the salmon farming industry) and aspects of the diet and ecology of flatfish. The ecological role of fish in tropical environments (particularly butterflyfishes, triggerfishes, emperors, and groupers) has also received attention.

How are results communicated? Through project reports and scientific papers eg Chen T-C, Ormond RFG & Mok H-K (2001) Feeding and territorial behaviour in juveniles of three co-existing triggerfishes. *J Fish Biol* 59, 524-32; Kamenos NA, Moore PG & Hall-Spencer JM (2004) Small-scale distribution of gadoids in shallow inshore waters; what role does maerl play? *ICES J Mar Sci* 61, 422-9; Ware SJ (2005) The importance of inshore areas on the west coast of Scotland as nursery grounds for commercially important fish species. PhD thesis. Univ of London.

Can results be used to support resource management? Yes. Studies have been largely directed at understanding the ecology and population dynamics of exploited species. Work on non-target species is critical to an understanding of ecological interactions between species and guilds.

210. **INSTITUTION:** University of Newcastle upon Tyne
DEPARTMENT/ UNIT: School of Marine Science & Technology
Address: Dove Marine Laboratory, Cullercoats, North Shields, NE30 4PZ
Contact person: Prof CLJ Frid C.L.J.Frid@ncl.ac.uk
Research Activity: **European fisheries ecosystem plan**
Duration/cost: 3 yr; €1400k
Funding: EU
Principal Investigator: Prof CLJ Frid

Objective/ Goal: Review ecosystem management issues for North Sea fisheries, consult stakeholders on issues and acceptability and effectiveness of management regimes, develop an integrated Fisheries Ecosystem Plan for the North Sea.

How are results communicated? Reports to sponsors, conferences, academic publications, public presentations, press releases. Dissemination strategy including 'glossy' and stakeholder/focus groups.

Can results be used to support resource management? Yes – by incorporation into CFP.

211. **INSTITUTION:** University of Newcastle upon Tyne
DEPARTMENT/ UNIT: School of Marine Science & Technology
Address: Dove Marine Laboratory, Cullercoats, North Shields, NE30 4PZ

Contact person: Prof CLJ Frid C.L.J.Frid@ncl.ac.uk
Research Activity: **Sustainable fisheries in Northumberland**
Duration/cost: 3 yr; £30k
Funding: English Nature
Principal Investigator: Prof CLJ Frid

Objective/ Goal: Review existing fisheries activity in the nearshore fisheries operating in the EMS. Consider ecological impacts of fisheries on key features Recommend monitoring and management responses

How are results communicated? Reports to sponsors, conferences, academic papers, public presentations, press releases

Can results be used to support resource management? Yes – by En and NSFC in formulation of by-laws.

212. **INSTITUTION:** University of Newcastle upon Tyne
DEPARTMENT/ UNIT: School of Marine Science & Technology
Address: Dove Marine Laboratory, Cullercoats, North Shields, NE30 4PZ
Contact person: Prof CLJ Frid C.L.J.Frid@ncl.ac.uk
Research Activity: **Use of biological traits analysis to characterise ecological functioning in marine benthos**
Duration/cost: 3 yr; £50k (PhD studentship)
Funding: CEFAS
Principal Investigator: Prof CLJ Frid

Objective/ Goal: To examine the potential use of BTA for characterising changes in infaunal and epibenthic assemblages in the face of fishing pressure.

How are results communicated? Reports to sponsors, conferences, academic papers, public presentations, press releases.

Can results be used to support resource management? Yes – as part of EcoQO regime for habitat quality.

213. **INSTITUTION:** University of Newcastle upon Tyne
DEPARTMENT/ UNIT: School of Marine Science & Technology
Address: Dove Marine Laboratory, Cullercoats, North Shields, NE30 4PZ
Contact person: Prof CLJ Frid C.L.J.Frid@ncl.ac.uk
Research Activity: **Biogeochemistry of fishing events**
Duration/cost: 3 yr; £45k (PhD studentship)
Funding: NERC
Principal Investigator: Prof CLJ Frid, P Percival

Objective/ Goal: Study of influence of physical disruption and altered bioturbation on nutrient regeneration rates.

How are results communicated? Reports to sponsors, conferences, academic papers, public presentations, press releases.

Can results be used to support resource management? Yes – as part of EcoQo regime for healthy habitats!

214. **INSTITUTION:** University of Newcastle upon Tyne
DEPARTMENT/ UNIT: School of Marine Science & Technology
Address: Dove Marine Laboratory, Cullercoats, North Shields, NE30 4PZ
Contact person: Prof CLJ Frid C.L.J.Frid@ncl.ac.uk
Research Activity: **Discarding in the *Nephrops* fishery**
Duration/cost: 3 yr; £75k
Funding: NERC, ESRC (joint awards PhD studentship)
Principal Investigator: Prof CLJ Frid, TL Catchpole,

Objective/ Goal: To investigate ecological and socio-economic aspects of discarding in the *Nephrops* fishery.

How are results communicated? Reports to sponsors, conferences, academic papers, public presentations, press releases.

Can results be used to support resource management? Yes – see Catchpole et al. Marine Policy 2004.

215. **INSTITUTION:** University of Newcastle upon Tyne
DEPARTMENT/ UNIT: School of Marine Science & Technology
Address: Dove Marine Laboratory, Cullercoats, North Shields, NE30 4PZ
Contact person: Prof CLJ Frid C.L.J.Frid@ncl.ac.uk
Research Activity: **Ecosystem approach to benthic management**
Duration/cost: 3 yr; £60k (PhD studentship)
Funding: Univ of Newcastle
Principal Investigator: Prof CLJ Frid, LA Robinson

Objective/ Goal: To examine aspects of the scientific basis of ecosystem based management for the benthos.

How are results communicated? Reports to sponsors, conferences, academic papers, public presentations, press releases.

Can results be used to support resource management? Yes – through adoption into the EcoQO elements for benthos and habitats.

216. **INSTITUTION:** University of Newcastle upon Tyne
DEPARTMENT/ UNIT: School of Marine Science & Technology
Address: Ridley Building, University of Newcastle NE1 7RU
Contact person: Nicholas Polunin n.polunin@ncl.ac.uk
Research Activity: **Marine Protected Areas as a management tool for conflict reduction in coastal fisheries and conservation**
Duration/cost: 2005-07; ~€200k
Funding: EU (INCO)
Principal Investigator: (WP Coordinator) Nicholas Polunin

Objective/ Goal: To improve the basis for planning of MPAs on offshore continental shelves with a view to reconciling demands especially of fisheries, biodiversity conservation and industrial uses, based on the following specific objectives: i) compile data for four selected case studies of MPAs on continental shelves (Mexico, China, North Sea); ii) compare and contrast the stated objectives, operation, and known effectiveness of the MPAs existing and planned with respect to location, resource and other factors; iii) gather model data for South China Sea; iv) develop Ecospace models for the North Sea, South China Sea and southern Gulf of Mexico shelf systems; v) Conduct simulations of existing MPAs where feasible with respect to stock benefits/costs, and derive objective criteria for the placement of MPAs in all three case studies; vi) consider possible alternatives for design of MPA networks in the shelf systems; vii) develop conceptual models for the planning of MPAs on continental shelves, and apply these to the China and Mexico case studies

How are results communicated? Workshops, scientific literature, popular media where appropriate

Can results be used to support resource management? Directly relevant to understanding of marine protected areas/reserves/fishery closures as resource and ecosystem management tools in the marine environment.

217. **INSTITUTION:** University of Newcastle upon Tyne
DEPARTMENT/ UNIT: School of Marine Science & Technology
Address: Ridley Building, University of Newcastle NE1 7RU
Contact person: Nicholas Polunin n.polunin@ncl.ac.uk
Research Activity: **Marine Protected Areas: a review of lessons learnt**
Duration/cost: 2005; £28k
Funding: DEFRA
Principal Investigator: Nicholas Polunin

Objective/ Goal: DEFRA is in the process of responding to the Strategy Unit Report 'Net Benefits'. The Marine Environment Working Group (MEWG) has responsibility for considering Report recommendations relating to the environmental aspect of fisheries. In particular, that Marine Protected Areas (MPAs) "should be established on an experimental basis, and the economic and biological impacts carefully studied...in areas which give multiple benefits to multiple uses of the marine environment" Before considering an experimental programme of MPAs or carrying out further field research, a review of existing MPAs is required to establish what has worked and what has not, to provide evidence on 'lessons learned', and to direct further work effectively. The review scope includes the key concepts, processes and issues for a variety of MPA types, providing a valuable information source for policy makers.

How are results communicated? Meetings, reports, popular media where appropriate

Can results be used to support resource management? Directly relevant to understanding of marine protected areas/reserves/fishery closures as resource and ecosystem management tools in the marine environment

218. **INSTITUTION:** University of Newcastle upon Tyne
DEPARTMENT/ UNIT: School of Marine Science & Technology
Address: Ridley Building, University of Newcastle NE1 7RU
Contact person: Nicholas Polunin n.polunin@ncl.ac.uk
Research Activity: **Ecological assessment of Yorks no-trawl areas**
Duration/cost: 2005-06; £100k
Funding: North Eastern Sea Fisheries Committee
Principal Investigator: Nicholas Polunin

Objective/ Goal: Preliminary survey and mapping of main habitats will provide a basis for the ecological work and sampling design. Subsequent work will involve input from marine survey, marine invertebrate and marine fish specialists based in the Newcastle School of Marine Science & Technology working with the NE Sea Fisheries Committee in the period May- Nov 2005.. Working on the three no-trawl areas (NTAs) off Whitby, Filey and Hornsea the project will: i) produce a map of marine habitat of the three NTAs and adjacent waters, for sampling design and use of the wider community; ii) compare densities and whole assemblages of soft-bottom fauna between NTAs and adjacent similar habitats; and iii) assess whether large fish species are more abundant in NTAs compared with adjacent similar habitat.

How are results communicated? Scientific literature, reports, popular media where appropriate

Can results be used to support resource management? Directly relevant to understanding of impacts of small-scale marine protected areas/reserves/fishery closures as resource and ecosystem management tools in the marine environment.

219. **INSTITUTION:** University of Newcastle upon Tyne
DEPARTMENT/ UNIT: School of Marine Science & Technology
Address: Ridley Building, University of Newcastle NE1 7RU

Contact person: Nicholas Polunin n.polunin@ncl.ac.uk
Research Activity: **Dynamics of inshore food webs supporting fisheries recovering from exploitation**
Duration/cost: 2004-07; ~€346k
Funding: Italian CNR (Progetto Coordinato – Agenzia 2001)
Principal Investigator: Fabio Badalamenti fbadala@tin.it

Objective/ Goal: To use an effective trawling ban to explore the dynamics of inshore food webs supporting fisheries recovering from exploitation and progress understanding of the methodological underpinnings of resource and environmental management. Objectives include: i) deriving size spectra and relationships between $\delta^{15}\text{N}$ and body size of marine fishes; ii) testing whether these relationships can predict the trophic structure of the fish community; iii) describing the trophic structure of the whole fish community based on these and gut-contents data; iv) comparing size spectra and assemblage composition between no-trawl and trawled areas; v) making detailed investigations of the food webs of key fishery species; vi) elucidating interaction strengths between fishery components based on before/after analyses of fishery assemblage in and out of the no-trawl zone.

How are results communicated? Scientific papers, scientific meetings, media releases where appropriate

Can results be used to support resource management? The project will explore scarcely-known outcomes of management with respect to resource species and the wider community, thus improving understanding of the impacts of trawl bans.

220. INSTITUTION: University of Newcastle upon Tyne
DEPARTMENT/ UNIT: School of Marine Science & Technology
Address: Ridley Building, University of Newcastle NE1 7RU
Contact person: Selina Stead selina.stead@ncl.ac.uk
Research Activity: **Role of fishermen's (stakeholders') knowledge in advancing governance, management, policy and science**
Duration/cost: 2000-02; ~£200k
Funding: SEERAD, EU and Univ of Aberdeen
Principal Investigator: Selina Stead (Co-PI, Anne McLay, FRS Aberdeen)

Objective/ Goal: This interdisciplinary study investigated how fishers' knowledge can complement developments in fisheries governance, management, policy and science in a meaningful way. During 2001 and 2002, face-to-face, semi-structured interviews of 80 skippers of demersal boats in NE Scotland were conducted at or near Aberdeen, Fraserburgh and Peterhead. The interviews identified variables such as management restrictions, intuition, personal motivation and bank loans as influential in Scottish demersal skippers' decision-making processes on fishing practices. Various multivariate statistical analyses (error and biplots, PCA, RDA, discriminant analysis and regression trees) helped to depict patterns in fishers' decision making processes.

How are results communicated? Scientific papers, scientific meetings, FRS Aberdeen information fact sheets, informal feedback to stakeholders.

Can results be used to support resource management? The findings highlighted the individuality of skippers' views regarding their decision-making, making the task of formulating management and policy that will be endorsed by all stakeholders more challenging. The results can be directly used to compliment existing information on resource management.

221. INSTITUTION: University of Newcastle upon Tyne
DEPARTMENT/ UNIT: School of Marine Science & Technology
Address: Ridley Building, University of Newcastle NE1 7RU
Contact person: Selina Stead selina.stead@ncl.ac.uk
Research Activity: **Socio-economic impacts of coral bleaching on coastal communities in Kenya, Tanzania, Seychelles and Reunion**
Duration/cost: 2004-07; ~£120k
Funding: WIOMSA, Leverhulme Trust, Wildlife Conservation Society, Univ of Newcastle
Principal Investigator: Selina Stead (Co-PI for socio-economic component)

Objective/ Goal: The overall project will evaluate effects of coral bleaching and mortality on the coral reef communities, fish and fisheries in the western Indian Ocean through a combination of field studies before and after the coral bleaching event in 1998. Ecological project investigators are repeating fish community surveys in four regions (Kenya, Tanzania, Seychelles and Reunion) that were conducted before 1998 to determine the changes and effects of coral mortality, management, and remoteness on the changes in fish communities. Ecological work is being followed by complementary socioeconomic surveys to understand the effects of ecological changes on people and possible ways to mitigate these effects. Stakeholders' views on how best to conserve coral reefs in ways complementary to local management regimes will be explored, time permitting.

How are results communicated? Scientific papers, scientific meetings, TV, radio, press releases, feedback to stakeholders.

Can results be used to support resource management? Understanding how socioeconomic factors influence resource use, the degree of dependence, and alternatives can assist resource managers in identifying root causes of environmental problems and help apply limited funds to protection, restoration and management activities based on local knowledge. Managers can use this information to demonstrate to the public and policy makers the importance of protecting the natural environment including coral reef, and to support their actions in planning new management policies.

222. INSTITUTION: University of Portsmouth
DEPARTMENT/ UNIT: Centre for the Economics and Management of Aquatic Resources (CEMARE)
Address: Boathouse No 6, College Road, HM Naval Base, Portsmouth PO1 3LJ
Contact person: Sean Pascoe sean.pascoe@port.ac.uk

Research Activity: Invest in Fish (SW) Bioeconomic modelling
Duration/cost: 2004-06; ~ £200k
Funding: DEFRA, EU
Principal Investigator: Sean Pascoe

Objective/ Goal: To assess the benefits and costs of stock recovery in the South West. A dynamic bioeconomic model is being developed that includes the main biological processes in the fishery, environmental impacts from fishing, a recreational fishing sector and the regional economy, as well as the fishing fleet that operates in the area. The model is to be used to assess the biological, environmental and economic impact of various management strategies proposed by industry and other stakeholders.

How are results communicated? Through workshops and meetings with industry and other stakeholder groups. Meetings will be interactive in that stakeholders will assess the outcomes of the different management strategies and propose variants for testing. Results are also to be communicated to the academic and research community through journal article publication and conferences. A communications officer has been employed to ensure dissemination through the popular press.

Can results be used to support resource management? It is expected that results will have a direct impact on resource management. One of the project aims is to determine a management strategy that will be adopted by government as well as stakeholder groups.

223. INSTITUTION: University of Portsmouth
DEPARTMENT/ UNIT: Centre for the Economics and Management of Aquatic Resources (CEMARE)
Address: Boathouse No 6, College Road, HM Naval Base, Portsmouth PO1 3LJ
Contact person: Sean Pascoe sean.pascoe@port.ac.uk
Research Activity: Assessment of excess fishing capacity in the Scottish fleet
Duration/cost: 2003-04; ~ £40k
Funding: SEERAD
Principal Investigator: Diana Tingley diana.tingley@port.ac.uk

Objective/ Goal: To assess the level of excess capacity in the Scottish fleet (on a fleet segment basis), and to estimate the economic impacts (in terms of rent generation and employment) through removing the excess capacity.

How are results communicated? Results were presented in a report to SEERAD. Two journal articles based on the analysis have been submitted to journals.

Can results be used to support resource management? Results can be directly used to support policy in that key fleet segments that are most in need of decommissioning have been identified.

224. INSTITUTION: University of Portsmouth
DEPARTMENT/ UNIT: Centre for the Economics and Management of Aquatic Resources (CEMARE)
Address: Boathouse No 6, College Road, HM Naval Base, Portsmouth PO1 3LJ
Contact person: Sean Pascoe sean.pascoe@port.ac.uk
Research Activity: Operational evaluation tools for fisheries management options (EFIMAS)
Duration/cost: 2004-08; €317k
Funding: EU
Principal Investigator: Sean Pascoe

Objective/ Goal: Generic bio-economic models are being developed to provide a toolbox for fisheries managers and scientists to assess management options. The models are being tested on case studies across Europe. CEMARE is involved in studies on North Sea roundfish, North Sea flatfish and *Nephrops* fisheries. The project team is international and multidisciplinary.

How are results communicated? Through publications and conferences. The target audience is scientists and the more quantitative managers. The results from the case studies will be presented to fisheries managers in each member state.

Can results be used to support resource management? The intention is that the models will be used to support rational management decision-making within Europe. The models should also be adaptable for fisheries outside Europe, so may have an international impact.

225. INSTITUTION: University of Portsmouth
DEPARTMENT/ UNIT: Centre for the Economics and Management of Aquatic Resources (CEMARE)
Address: Boathouse No 6, College Road, HM Naval Base, Portsmouth PO1 3LJ
Contact person: Sean Pascoe sean.pascoe@port.ac.uk
Research Activity: Creation of multiannual management plans for commitment (COMMIT)
Duration/cost: 2004-07; ~€137k
Funding: EU
Principal Investigator: Sean Pascoe

Objective/ Goal: To consider multiannual management measures in European fisheries. The impact of the management measure on compliance (and the subsequent effectiveness of the management measure) is also to be included in the analysis. The project is linked with EFIMAS so that economies in terms of model development can be achieved. The project will employ Bayesian belief networks to consider the probability of compliance (and effects of compliance).

How are results communicated? Through publications and conferences. The target audience is scientists and the more quantitative managers. The results from the case studies will be presented to fisheries managers in each member state.

Can results be used to support resource management? The intention is that the models will be used to support rational management decision-making within Europe. The models should also be adaptable for fisheries outside Europe, so may have an international impact.

226. INSTITUTION: University of Portsmouth
DEPARTMENT/ UNIT: Centre for the Economics and Management of Aquatic Resources (CEMARE)
Address: Boathouse No 6, College Road, HM Naval Base, Portsmouth PO1 3LJ
Contact person: Sean Pascoe sean.pascoe@port.ac.uk
Research Activity: **Modelling fishermen behaviour under new regulatory regimes**
Duration/cost: 2002-04; €70k
Funding: EU
Principal Investigator: Sean Pascoe

Objective/ Goal: To use a cost function approach to estimate the future direction of change in vessel size and the potential economic benefits from fleet reduction. The direction of change was based on the assumption that, under a property rights based system, fishers would eventually adjust their vessel and quota holdings to minimise their costs of production.

How are results communicated? To date, 2 conference papers and 1 journal article have been produced. Also EU reports.

Can results be used to support resource management? Results are of potential interest to managers, but would probably not have an impact on management decision-making.

227. INSTITUTION: University of Portsmouth
DEPARTMENT/ UNIT: Centre for the Economics and Management of Aquatic Resources (CEMARE)
Address: Boathouse No 6, College Road, HM Naval Base, Portsmouth PO1 3LJ
Contact person: Sean Pascoe sean.pascoe@port.ac.uk
Research Activity: **Multiple objectives in the management of EU fisheries**
Duration/cost: 2000-03; €1014k
Funding: EU
Principal Investigator: Simon Mardle simon.mardle@port.ac.uk

Objective/ Goal: To investigate the objective structure in EU fisheries management from the perspectives of different interest groups, with focus on resource allocation under the Common Fisheries Policy (CFP). Attitudes and opinions were elicited from all applicable representatives, ie fishers, managers, scientists, environmentalists etc. Multi-criteria decision analysis methods were used. A modelling and analysis framework, based on the multiple objectives of the CFP and fisheries management, was developed to investigate the many relevant management questions and potential effects of management controls.

How are results communicated? Through the publication of journal articles, conferences, and a workshop. Also progress reports to the EC, task reports and a final report. The EC's electronic technological implementation plan (eTIP) was completed.

Can results be used to support resource management,? Multiple objective bioeconomic modelling with inclusion of interest group preferences could contribute significantly to policy design and implementation for fisheries management. Analysing effects of potential management strategy on fleet and stock dynamics of given fisheries from the viewpoints of key interest groups could play an invaluable role in identifying and developing consensus amongst groups. As opinion and the effects of that opinion become more explicit, more realistic targets can be set for achievement from management. Several subsequent benefits may arise: eg the inclusive nature of the process (rather than the often perceived opposite by many), and the scientific qualities that result. A more global consensus and confidence in the policy may be achievable, leading to better compliance, as a policy developed with direct input from "the ground" may be more acceptable.

228. INSTITUTION: University of Portsmouth
DEPARTMENT/ UNIT: Centre for the Economics and Management of Aquatic Resources (CEMARE)
Address: Boathouse No 6, College Road, HM Naval Base, Portsmouth PO1 3LJ
Contact person: Sean Pascoe www.port.ac.uk/cemare
Research Activity: **Technological developments and tactical adaptations of important EU fleets**
Duration/cost: 2002-05; €3344k
Funding: EU
Principal Investigator: Simon Mardle simon.mardle@port.ac.uk

Objective/ Goal: To address the poor understanding of the links between management tools, fleet developments and the pressure exerted on fishing communities. The aim is to supply fisheries managers with a modelling tool to allow the evaluation of the impact of regulations (i.e. TACs, MAGPs, area and season closures, subsidies) on fishing mortality and fleet dynamics (technological advances in gears and vessel equipment, also tactical adaptation of fishing vessels).

How are results communicated? Through journal articles and conferences. Links to ICES Working Groups have been established. Yearly progress reports to the EC, task reports and a final report are planned, and the EC's electronic technological implementation plan (eTIP) will also be completed.

Can results be used to support resource management? This project will help ensure sustainability of fisheries by improving the efficiency of management tools in regulating fleet dynamics, fish resources and in the support of fisheries socio-economics.

229. INSTITUTION: University of Portsmouth
DEPARTMENT/ UNIT: Centre for the Economics and Management of Aquatic Resources (CEMARE)

Address: Boathouse No 6, College Road, HM Naval Base, Portsmouth PO1 3LJ
Contact person: Sean Pascoe sean.pascoe@port.ac.uk
Research Activity: **Understanding the mechanisms of stock recovery (UNCOVER)**
Duration/cost: 4 yr (start date TBC); €6369k
Funding: EU
Principal Investigator: Simon Mardle simon.mardle@port.ac.uk

Objective/ Goal: To enhance the understanding of mechanisms of fish stock recovery and provide recommendations for the recovery of EC fish stocks which are outside safe biological limits. A number of exploited fish stocks in European waters are currently at historically low levels and are in danger of collapse. This project will synthesise and integrate relevant information from previous and ongoing research to evaluate and develop strategies for the rebuilding of stocks. This project will investigate the failures and successes of previous stock recovery activities and will try to define constraints of recovery plans for the future.

How are the results communicated? Four main elements: i) expert workshop and a final Conference; ii) a project website; iii) a CD and brochure synthesising the results and the final project report; and iv) scientific publications and presentation at international scientific meetings. The final Conference is provisionally entitled "an International Conference on Stock Recovery" and is planned for the final phase of the project.

Can results be used to support resource management? The new CFP Regulation is explicit in the requirement that the Council adopts as a priority, recovery plans for fisheries exploiting stocks which are outside safe biological limits (2371/2002). Furthermore, the EU is now committed to the Johannesburg World Summit on Sustainable Development, including targets to restore depleted fish stocks by 2015. To this end, UNCOVER advances the state of the art in development and application of recovery plans for endangered fish stocks as well as in strategic medium- to long-term fisheries management strategies.

230. **INSTITUTION:** University of Portsmouth
DEPARTMENT/ UNIT: Centre for the Economics and Management of Aquatic Resources (CEMARE)
Address: Boathouse No 6, College Road, HM Naval Base, Portsmouth PO1 3LJ
Contact person: Sean Pascoe sean.pascoe@port.ac.uk
Research Activity: **Effective management for biodiversity conservation (EMBIOc)**
Duration/cost: 3yr (2 projects); £188k
Funding: DEFRA
Principal Investigator: Dr P Wattage p.wattage@port.ac.uk

Objective/ Goal: 1. To extend understanding of specific socio-economic and institutional factors that mediate the relationship between humans, wetland ecosystems and the socio-economic carrying capacity of those ecosystems. 2. To extend understanding of the potential for natural wetland ecosystems to address the challenges of population growth and consumer demand on wetland resources. 3. To advise and train users of mangroves on best management practices while maintaining mangrove ecosystem integrity. 4. To estimate the human demand for wetland resources and ecosystem services– the ecological footprint – functionally required in supporting human activities, eg prawn farming, in the project area (Sri Lanka).

How are results communicated? Project meetings and workshops (more than 10 with all stakeholders); international conference; leaflets for wetland users in local languages; journal articles; project webpage; project reports (available online).

Can results be used to support resource management? Results were used in policymaking process. Also education of all stakeholders and school children

231. **INSTITUTION:** University of Portsmouth
DEPARTMENT/ UNIT: Centre for the Economics and Management of Aquatic Resources (CEMARE)
Address: Boathouse No 6, College Road, HM Naval Base, Portsmouth PO1 3LJ
Contact person: Sean Pascoe sean.pascoe@port.ac.uk
Research Activity: **Policy research for sustainable shrimp farming in Asia (PORESSFA)**
Duration/cost: 3yr; €650k
Funding: EU
Principal Investigator: Dr P Wattage p.wattage@port.ac.uk, Dr Denis Bailly denis.bailly@univ-brest.fr

Objective/ Goal: To address the sustainable development issues of shrimp farming activities in Asia. In particular, to answer the development policy question: Under which social, institutional and environmental conditions can shrimp farming be a reliable factor for rural development and national economic growth for Asian countries within the new globalization environment? To address this issue, the project will carry out a comparative analysis of four major producing countries in Asia (Bangladesh, India, Thailand and Vietnam) and investigate the socio-institutional conditions and policy orientations necessary to promote the sustainable development of the shrimp farming industry in Asia within the general context of trade liberalisation.

How are results communicated? Project meetings; workshops in all participating countries; International conference; journal articles; project web page; project reports (available online)

Can results be used to support resource management? Results will be used in policy making process.

232. **INSTITUTION:** University of Portsmouth
DEPARTMENT/ UNIT: Centre for the Economics and Management of Aquatic Resources (CEMARE)
Address: Boathouse No 6, College Road, HM Naval Base, Portsmouth PO1 3LJ
Contact person: Aaron Hatcher aaron.hatcher@port.ac.uk
Research Activity: **Fishery regulation and the economic responses of fishermen: perceptions and compliance**

Duration/cost: 3yr; €875k
Funding: EU
Principal Investigator: Aaron Hatcher

Objective/ Goal: To develop a better understanding of how European fishermen respond to regulations. This includes their knowledge of the regulations which apply to them; their perceptions of the economic implications of regulations; experience of enforcement and formal sanction; normative and other 'psychic' responses to regulations (eg judgements about the 'rightness' of compliance and the perceived legitimacy of regulations and of the regulatory authorities); perceptions of the attitudes and behaviour of fellow fishermen, and how all these various factors affect their fishing behaviour and compliance with regulations.

How are results communicated? Results of case-studies have been disseminated nationally by means of seminars for administrators and fishermen. Papers given at the 2003 conference of the European Association of Fisheries Economists (Brest, 2003) and at an International Symposium (Bergen, June 2003). Article in *Land Economics*, February 2005; other articles in submission or preparation.

Can results be used to support resource management? Compliance with regulations is a significant problem in most fisheries and is essential if fisheries management objectives are to be met. There is need for levels of compliance in European fisheries to be improved and this project contributes to the understanding of the factors which affect compliance. The European dimension is particularly significant due to the structure of the Common Fisheries Policy which means that fishermen from different EU Member States fish for the same stocks and often on the same fishing grounds. Results from this project are expected to increase awareness of the importance of the way in which regulations are designed and implemented in achieving regulatory compliance, and thereby inform future policy design at both national and European levels.

233. **INSTITUTION:** University of Portsmouth
DEPARTMENT/ UNIT: Centre for the Economics and Management of Aquatic Resources (CEMARE)
Address: Boathouse No 6, College Road, HM Naval Base, Portsmouth PO1 3LJ
Contact person: Aaron Hatcher aaron.hatcher@port.ac.uk
Research Activity: **Performance evaluation of fisheries management regimes**
Duration/cost: 3yr; ~€1000k
Funding: EU (STREP proposal)
Principal Investigator: Aaron Hatcher

Objective/ Goal: To develop a practical framework for evaluating the economic performance of fisheries management regimes in terms of fleet economic efficiency, costs of implementation and robustness with respect to uncertainty and changing economic and biological conditions. The project will also develop a decision support model for determining the most appropriate management regimes given a set of objectives and their importance in a given situation. The evaluation framework will be developed based on existing theoretical and empirical work supplemented by study visits to a number of important and innovative fishery management regimes outside the EU. The evaluation framework and decision support tool will be tested in a variety of EU/EEA case-studies.

How are results communicated? Initially by means of a final project report to the EC and (probably) a presentation at DG Fish. Subsequently, a non-technical report summarising the project's main conclusions will be made available to policy makers and fishery managers in the EEA and beyond. Research results will also be presented to Regional Advisory Committees, including a demonstration on how to use the decision support tool. It is expected that there will also be publications in peer-reviewed, journals and presentations at international conferences.

Can results be used to support resource management? The potential positive societal impact of the project is considerable if it leads to fisheries management that is more cost effective and which permits the fishing industry to operate more efficiently while at the same time meeting key biological targets. These benefits will accrue both to the industry itself (in terms of profitability and competitiveness) and, more generally, to society in terms of a more efficient use of scarce resources.

234. **INSTITUTION:** University of Portsmouth
DEPARTMENT/ UNIT: Centre for the Economics and Management of Aquatic Resources (CEMARE)
Address: Boathouse No 6, College Road, HM Naval Base, Portsmouth PO1 3LJ
Contact person: Prem Wattage p.wattage@port.ac.uk
Research Activity: **Marine Protected Areas for ecosystem conservation & fisheries management (PROTECT)**
Duration/cost: 2005-08; €2961k (total, 14 partners)
Funding: EU
Principal Investigator: Erik Hoffmann, DIFRES Denmark (project co-ordinator)

Objective/ Goal: 1. To evaluate the potential of MPAs to protect deep water coral ecosystems from the effects of fishing as a tool for ocean governance, in the context of EU fisheries and marine environmental policies. 2. To outline and develop a suite of implementation, monitoring, assessment and management tools for MPAs for deep water coral ecosystems. These methods are intended to assist managers in assessing i) the fisheries impact on coral and coral communities, ii) the impact of introducing MPAs with varying level of protection on the ecosystem, and iii) the impact of MPAs on the fisheries operating in deep water coral areas and related socio-economic effects. 3. To improve the linkage between science and management when designing and introducing future MPAs, including guidance on i) timing and level of stakeholder involvement required to achieve legitimacy and to ensure that the best knowledge is applied and ii) follow-up actions after the implementation of MPAs, ensuring achievement of objectives or introduction of necessary modifications.

How are results communicated? Project meetings, reports, conferences, workshops and peer reviewed journal articles.

Can results be used to support resource management? The project will provide an opportunity for dialogue between scientists, policy makers and stakeholders on the issues of MPA design and management.

235. INSTITUTION: University of Portsmouth
DEPARTMENT/ UNIT: School of Earth and Environmental Sciences
Address: Burnaby Building, Burnaby Road, Portsmouth PO1 3QL
Contact person: Dr Clive Trueman clive.trueman@port.ac.uk
Research Activity: **Long-term records of diet in Atlantic salmon recovered from archived scale samples**
Duration/cost: 2yr; £24k
Funding: DEFRA
Principal Investigator: Dr Clive Trueman

Objective/ Goal: To recover records of open ocean diet retrospectively from the stable isotope (d13C d15N) composition of archived salmon scales, and investigate driving forces behind open ocean mortality of salmon. Records of diet composition extending 30-50 years are recovered from stable isotope analyses of archived scales. Temporal patterns in diet composition of salmon are compared to population data and records of sea surface conditions, to identify mechanisms linking ocean conditions and mortality. Project focuses on developing analytical protocols suitable for recovery of stable isotope signals from scales, and applying them to recover long-term dietary records from the North Sea salmon.

How are results communicated? Through reports to CEFAS, scientific literature and conferences.

Can results be used to support resource management? The long-term goal is to establish a predictive relationship between measurable ocean conditions, salmon behaviour and mortality

236. INSTITUTION: University of Portsmouth
DEPARTMENT/ UNIT: School of Earth and Environmental Sciences
Address: Burnaby Building, Burnaby Road, Portsmouth PO1 3QL
Contact person: Dr Clive Trueman clive.trueman@port.ac.uk
Research Activity: **Validating geochemical proxies for recovery of open marine life history information in *Salmo salar***
Duration/cost: 1yr; £16k
Funding: NERC
Principal Investigator: Dr Clive Trueman

Objective/ Goal: An experimental controlled feeding study aimed at supporting future research using trace element chemistry as a sensitive and cost effective measure of stock identity and or migration, and stable isotope chemistry as a record of dietary composition. Using Atlantic salmon as a target organism, this project investigates the relationship between tissue (otolith, scale, muscle, liver, bone) composition and water and diet composition as a function of temperature and growth rate. The incentive for this work is the emerging importance of otolith and scale chemistry as proxy records to track the spatial distribution, structure and dietary behaviour of marine fish stocks.

How are results communicated? Through scientific literature and conferences.

Can results be used to support resource management? Results will directly impact the use of otolith and scale micro-chemistry as alternatives to DNA fingerprinting to establish stock identity and location. Tissue microchemistry is likely to play an important role in traceability studies but must be validated before use.

237. INSTITUTION: University of Portsmouth
DEPARTMENT/ UNIT: School of Earth and Environmental Sciences
Address: Burnaby Building, Burnaby Road, Portsmouth PO1 3QL
Contact person: Dr Clive Trueman clive.trueman@port.ac.uk
Research Activity: **Otolith elemental fingerprints as biological tracers of fish stocks and fish behaviour**
Duration/cost: ongoing; institution supported
Funding: University student projects – pending application to Leverhulme (~ £90k)
Principal Investigator: Dr Clive Trueman

Objective/ Goal: Trace element composition of otoliths has emerged as a powerful method to identify regionally-distinct fish stocks. Resolution and utility depend upon the biology of the stocks and the geology/oceanography of their habitat region(s). Our ongoing work revolves around investigating new elemental fingerprints, and applying techniques to distinguish between individual stocks and identify source region. Analyses are performed by state-of-the-art mass spectrometry. Our group consists of analytical geochemists and a specialist in biominerals chemistry. Atlantic salmon and orange roughy are target species in current work. Pending grant focuses on North Sea, English Channel and Baltic cod.

How are the results communicated? Results will be communicated through scientific literature and conferences.

Can results be used to support resource management? Results will directly impact the use of otolith and scale micro-chemistry as alternatives to DNA fingerprinting to establish stock identity and location. Tissue microchemistry is likely to play an important role in trace-ability studies but must be validated before use.

238. INSTITUTION: University of St Andrews
DEPARTMENT/ UNIT: Sea Mammal Research Unit
Address: Gatty Marine Laboratory, St Andrews KY16 8LB

Contact person: Prof Ian Boyd (Director) ilb@st-andrews.ac.uk
Research Activity: Marine mammals
Duration/cost: Longterm; ~ £3000k pa
Funding: NERC, DEFRA, SEERAD, EU, DARDNI, Others
Principal Investigator: Prof Ian Boyd

Objective/ Goal: The SMRU mission is to undertake world class research on marine mammals and to support the statutory duty of NERC to advise the UK Government on the management of seal populations.

How are results communicated? Scientific publications in peer-review literature; reports to customers; report of the UK Special Committee on Seals (SCOS www.smru.stand.ac.uk/CurrentResearch.htm/scos.htm); knowledge transfer and PUS activities; Committee membership (especially IWC, ICES and SEERAD)

Can results be used to support resource management? They are used continuously to support resource management, e.g. the SCOS process, and within OSPAR and ICES.

239. INSTITUTION: University of St Andrews
DEPARTMENT/ UNIT: Geography and Geosciences
Address: Irvine Building, St. Andrews, Fife, KY16 9AL
Contact person: Michael Bird michael.bird@st-andrews.ac.uk
Research Activity: Monitoring ecosystem health and environmental change using seabird guano
Duration/cost: 2 yr; £50k
Funding: Various. Pilot work complete, applications to Leverhulme and Carnegie Trust submitted
Principal Investigator: Michael Bird

Objective/ Goal: To develop seabird guano (excrement) as a sensitive and integrative indicator of ecosystem health and ecosystem change, through the analysis of the stable carbon and nitrogen isotope composition of the guano (both the insoluble uric acid and residual 'organic' components) and the determination of 'diffuse pollutants' in the guano (trace elements and persistent organic pollutants).

How are the results communicated? Via publication in international journals and presentation at conferences

Can results be used to support resource management? Yes. Guano potentially provides a sensitive tool for monitoring ecosystem health in terms of changes in trophic level and food sources of individual species, and in the levels of anthropogenic pollutants. Advantages of guano over other materials are that: i) it can be sampled without capturing or killing birds; ii) it can be easily and rapidly sampled at regular intervals from the same locations (nests and habitual perches) without undue disturbance to the birds, allowing detailed time series to be built up; iii) it broadly integrates an ecosystem-level signal; iv) it is responsive to comparatively short term changes; and v) there are locations where long histories of environmental change are available from guano accumulated over thousands of years, allowing recent changes to be assessed against longer-term natural variability.

240. INSTITUTION: University of Strathclyde
DEPARTMENT/ UNIT: Statistics & Modelling Science
Address: Livingston Tower, Richmond Street, Glasgow G1 1XT
Contact person: Professor Bill Gurney bill@stams.strath.ac.uk
Research Activity: Modelling the distribution and abundance of *Calanus finmarchicus* in the N Atlantic
Duration/cost: 6 yr; £700k
Funding: NERC
Principal Investigator: Bill Gurney

Objective/Goal: To construct a physiologically and spatially-structured demographic model of the copepod *Calanus finmarchicus* describing its distribution and abundance over the range 30°-80°N and 80°W-90°E. To determine physical and biotic driving functions for this model from one or more General Circulation Ocean Models and from satellite and biochemical observations. To fit the model to spatially and physiologically-resolved observations of *Calanus* abundance over the region of interest.

How are results communicated? Paper on methodology published in *J Anim Ecol*; paper on applying the model to the NE Atlantic/Norwegian Sea in press (*Fisheries Oceanography*); paper describing the full model in review (*Mar Ecol Prog Ser*).

Can results be used to support resource management? The specific insights concerning *Calanus* have strong implications for future management-oriented whole ocean ecosystem models, but the model itself probably has limited resource management relevance. The methodology is highly suited to resource management models of fish stocks (see #241 below).

241. INSTITUTION: University of Strathclyde
DEPARTMENT/ UNIT: Statistics & Modelling Science
Address: Livingston Tower, Richmond Street, Glasgow G1 1XT
Contact person: Professor Bill Gurney bill@stams.strath.ac.uk
Research Activity: Modelling the distribution and abundance of *Gadus morhua* on the European continental shelf
Duration/cost: 3 yr; £150k
Funding: DEFRA (subcontract through CEFAS)
Principal Investigator: Bill Gurney

Objective/ Goal: To construct a physiologically and spatially structured demographic model of Atlantic Cod *Gadus morhua* describing its distribution and abundance over the range 48°-62°N and 12°W-12°E. To determine physical and biotic driving

functions for this model for the period 1969-2003 from a statistical characterisation of the Hamburg Ocean Model and from fisheries management observations tabulated by ICES. To fit the model to spatially and physiologically resolved observations of Cod abundance over the region of interest.

How are results communicated? One paper describing the full model in review (*Mar Ecol Progr Ser*).

Can results be used to support resource management? The methodology is highly suited to resource management models of fish stocks. Its computational efficiency allows a fully spatially and physiologically resolved model to be fitted to observations using numerical optimisation techniques.

242. **INSTITUTION:** University of Wales Bangor
DEPARTMENT/ UNIT: School of Ocean Sciences
Address: Menai Bridge, Anglesey, LL59 5EY
Contact person: Dr MJ Kaiser mjkaiser@bangor.ac.uk
Research Activity: **Sustainable mussel cultivation**
Duration/cost: 3 yr; £146k
Funding: NERC
Principal Investigator: MJ Kaiser

Objective/ Goal: To understand the ecology of mussel cultivation in order to minimise negative environmental impacts and to maximise potential yield from limited mussel resources. The project examined the effects of cultivation on invertebrate communities, bird populations and modelled density dependent growth rates.

How are results communicated? Final NERC report, Shellfish News, 6 peer-reviewed publications and one PhD thesis.

Can results be used to support resource management? Direct management advice given in relation to stocking density vs direct environmental effects. Advice given to industry re methods of improving yield and reducing losses to predators, advice taken up by industry and currently implemented. Evidence of environmental effects provided for Countryside Council for Wales. Research relevant in wider international context.

243. **INSTITUTION:** University of Wales Bangor
DEPARTMENT/ UNIT: School of Ocean Sciences
Address: Menai Bridge, Anglesey, LL59 5EY
Contact person: Dr MJ Kaiser mjkaiser@bangor.ac.uk
Research Activity: **Sustainable mussel cultivation: a multidisciplinary approach**
Duration/cost: 3 yr; £297k
Funding: BBSRC
Principal Investigator: MJ Kaiser

Objective/ Goal: To understand the interaction between physical and ecological processes that govern growth and mortality and spatial dynamics in cultivated beds of mussels. To understand the limits of carrying capacity in systems subject to mussel cultivation and hence to minimise risk of over-stocking and negative effects on other components of the system.

How are results communicated? BBSRC, Shellfish News, peer reviewed publications and PhD thesis. In year 2 of project.

Can results be used to support resource management? Direct management advice given in relation to stocking density vs direct environmental effects. Advice given to industry re methods of improving yield and reducing losses to predators, advice taken up by industry and currently implemented. Evidence of environmental effects provided for Countryside Council for Wales. Research relevant in wider international context.

244. **INSTITUTION:** University of Wales Bangor
DEPARTMENT/ UNIT: School of Ocean Sciences
Address: Menai Bridge, Anglesey, LL59 5EY
Contact person: Dr MJ Kaiser mjkaiser@bangor.ac.uk
Research Activity: **Subtidal seed mussel ecology**
Duration/cost: 3 yr; £62k
Funding: DEFRA and SEAFISH
Principal Investigator: MJ Kaiser

Objective/ Goal: To understand the ecology of ephemeral beds of seed mussels, their role in the marine ecosystem and utilisation by other biological components.

How are results communicated? Industry, media and peer-reviewed publications; attendance at aquaculture meetings, direct contact with industry, Shellfish News. Study currently in year 2 of project.

Can results be used to support resource management? Direct management advice given in relation to the ecological importance of mussel seed and opportunities to maximise potential of harvested beds by utilising alternative strategies. Evidence of environmental effects provided for Countryside Council for Wales. Research relevant in wider international context.

245. **INSTITUTION:** University of Wales Bangor
DEPARTMENT/ UNIT: School of Ocean Sciences
Address: Menai Bridge, Anglesey, LL59 5EY
Contact person: Dr MJ Kaiser mjkaiser@bangor.ac.uk

Research Activity: Essential fish habitat
Duration/cost: 3 yr; £302k
Funding: DEFRA (MF0805)
Principal Investigator: MJ Kaiser

Objective/ Goal: To understand the relationship between key commercial species and seabed habitats and thereby identify those habitats that have an important role in the life history of adult stages of these fish.

How are results communicated? Industry, media and peer-reviewed publications; attendance at aquaculture meetings; direct contact with industry; Shellfish News. Study completed, Nov 2004. International symposium on fish habitat (July 2005, Bangor).

Can results be used to support resource management? Direct management advice given in relation to the spatial distribution of fish in relation to habitat resources. Temporal variability in habitat use identified. Key habitats identified for some species, others more generalist and hence not dependent upon a particular habitat. Importance of regional vs local scale in management context highlighted with respect to habitat conservation.

246. **INSTITUTION:** University of Wales Bangor
DEPARTMENT/ UNIT: School of Ocean Sciences
Address: Menai Bridge, Anglesey, LL59 5EY
Contact person: Dr MJ Kaiser mjkaiser@bangor.ac.uk
Research Activity: Indicators and models of fishing disturbance
Duration/cost: 3.5 yr; £179k
Funding: DEFRA/CEFAS (MF0731)
Principal Investigator: MJ Kaiser

Objective/Goal: To understand the response of benthic communities to different regimes of fishing disturbance across different habitats in the North Sea and to determine how this affects habitat quality for demersal fish such as cod and haddock.

How are results communicated? Industry, media and peer-reviewed publications; attendance at aquaculture meetings; direct contact with industry; Shellfish News. Study in year 2. International symposium on fish habitat (July 2005, Bangor).

Can the results be used to support resource management, and if so how? Direct management advice given in relation to scenarios of fishing disturbance that can be used to model the outcome of imposing closed areas and displacing fishing effort to other seabed areas. Energetic consequences for fish identified from relating spatial distribution and habitat use to fish condition.

247. **INSTITUTION:** University of Wales Bangor
DEPARTMENT/ UNIT: School of Ocean Sciences
Address: Menai Bridge, Anglesey, LL59 5EY
Contact person: Dr MJ Kaiser mjkaiser@bangor.ac.uk
Research Activity: Response of benthic communities to different regimes of fishing disturbance (RESPONSE)
Duration/cost: 3 yr; £137k
Funding: EU
Principal Investigator: MJ Kaiser

Objective/Goal: To understand the response of benthic communities to different regimes of fishing disturbance across different habitats in the Irish Sea. To determine how this affects benthic community composition and structure for macro- and meiofauna.

How are results communicated? Industry, media and peer-reviewed publications; attendance at aquaculture meetings; direct contact with industry, Fishing News. Study in year 3.

Can results be used to support resource management? Direct management advice given in relation to scenarios of fishing disturbance that can be used to model the effects of imposing closed areas and displacing fishing effort to other seabed areas.

248 **INSTITUTION:** University of Wales Bangor
DEPARTMENT/ UNIT: School of Ocean Sciences
Address: Menai Bridge, Anglesey, LL59 5EY
Contact person: Dr MJ Kaiser mjkaiser@bangor.ac.uk
Research Activity: Biological and socio-economic benefits of different inshore fisheries management regimes
Duration/cost: 3 yr; PhD Studentship
Funding: ESRC
Principal Investigator: MJ Kaiser

Objective/Goal: To investigate the costs and benefits of different approaches to inshore fisheries management in inshore areas of the UK focussing on Wales. The project will integrate habitat risk assessment in relation to the negative effects of various fishing activities and relate this to benefits of differing approaches to managing inshore fisheries including recreational fishing. A socio-economic analysis will generate the outcome of the different management scenarios.

How are results communicated? Industry, media and peer-reviewed publications, attendance at aquaculture meetings; direct contact with industry; Fishing News. Study in year 3.

Can results be used to support resource management? Direct management advice given in relation to scenarios of inshore fishery can be modelling to demonstrate social and economic responses and hence aid assessment of the most desirable outcome to achieve conservation, social and economic benefits.