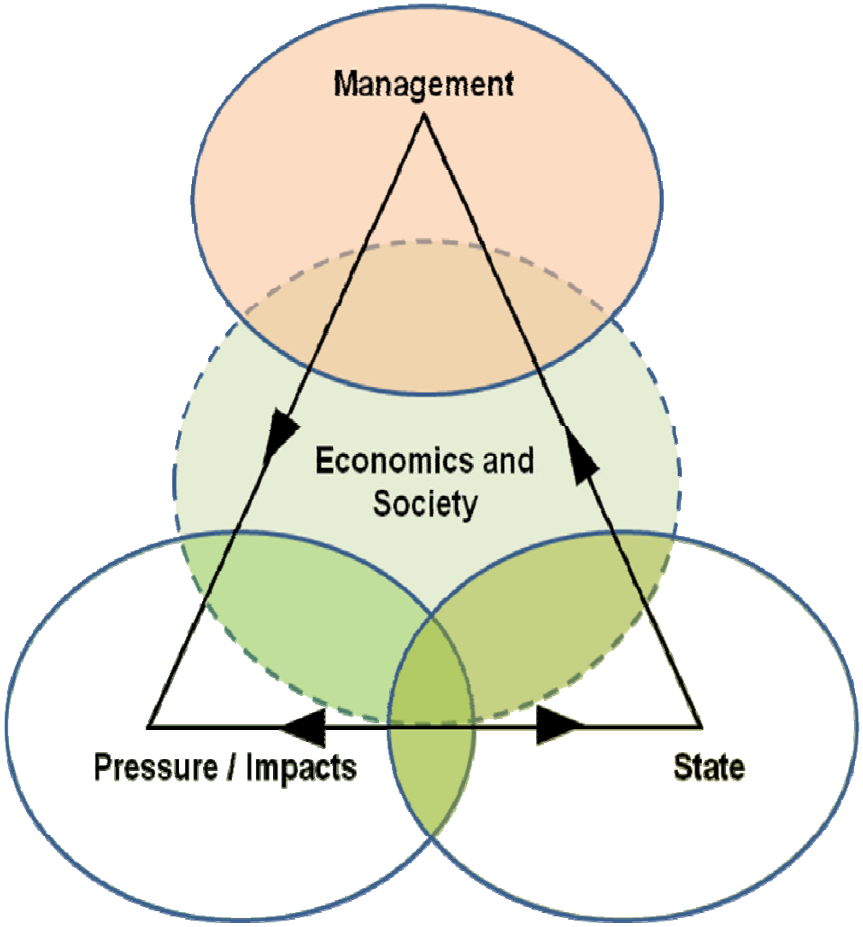
Defra's Marine Environment Research Programme Review:

Stage III Report

Submitted by the Marine Environment Review Group



March 2009

EXECUTIVE SUMMARY

Over the past 18 months Defra's Marine Directorate has been conducting a fundamental review of its Marine Environment (ME) and Marine Biodiversity (MB) Research Programmes. This area of research involves an annual spend of approximately £5m, and research is currently placed under 10 themes. Because of the breadth of this area of research a three stage approach was adopted for the review.

Stage I focussed on research directly related to the impact of human activities on the marine environment. Stage II evaluated research undertaken within the three themes covering ecosystem structure and function, environmental processes and pathways, and marine biodiversity. Stage I and Stage II helped clarify present and future marine related policy drivers, summarised research outputs to date, and identified Defra's future evidence needs.

The aim of Stage III of the review has been to draw together all the evidence gathered during the earlier review work, recommend an appropriate structure for the ME & MB programme and within that new structure:

- Set out the main policy drivers;
- Summarise evidence that is already available;
- Identify the broad requirements for evidence;
- Identify broad priorities for future research, within the proposed new structure;
- Recommend ways of improving research commissioning and management.

This Stage III report is the final delivery of the Marine Environment Review Group. The main output can be summarised as follows:

- The development of a new structure for Marine Environment Research under the programme title "Sustainable Marine Environment Research Programme", and composed of four Themes:
    - Economic and Social Research in the Marine Environment;
    - Human Pressures and Impacts on the Marine Environment;
    - State of the Marine Environment;

    - Science for Integrated Marine Management

- The development of three ‘tools’ – MARMAP, MARTOOL and MARDAT – which will strengthen the links between policy need and research provision, and provide easier access to marine knowledge;
- Improved procedures for the commissioning and management of Marine Environment research.

This report does not mark the end of the review process. Policy’s requirements for evidence continue to evolve, and the detailed content of each of the four new programmes will be developed over the coming months.

Table of Contents

Executive Summary

1. Introduction 6

2. Developing the new programme structure 7

2.1 The need for a research programme structure 7

2.2 The current structure 7

2.3 Considerations for the new structure & re-structure options 8

2.4 Other important considerations – “Practical” links to Policy Drivers 12

2.5 Testing the preferred re-structure option 14

3. The proposed new structure for the marine environment research programme 15

4. Outline of the broad scope and content of the four new programmes 17

4.1 Economic and Social Research in the Marine Environment 17

4.2 Human Pressures and Impacts on the Marine Environment 18

4.3 State of the Marine Environment 19

4.4 Science for Integrated Marine Management 21

5. A more integrated Marine Science Programme – links to the Sustainable Marine Fisheries research programme 23

5.1 Sustainable Marine Fisheries Research Programme 23

5.2 MF10: Impacts of Fishing on the Marine Ecosystem 23

5.3 MF11: Effects of the Environment on fish stocks 24

5.4 MF12: Fisheries Management **24**

5.5 Relationship between the new Sustainable Marine Environment and Marine Fisheries (MF) programmes 25

6. Science to Policy - Improving the utility of Research outputs 26

7. Improving the commissioning and management of research 32

7.1 The need for change 32

7.2 Adopting a formal commissioning process & timeline 33

7.3 Enhancing Policy Ownership of the Research 37

7.4 Improving liaison with other Funders. 37

8. Review Conclusions 38

List of Appendices

Appendix 1 Executive Summaries of Stage I and Stage II Reports
Appendix 2 Members of the Review Group

List of Tables

Table 1: Proposed theme, descriptive and short titles for the four themes within the Sustainable Marine Environment Research Programme

Table 2: Links between the four programme themes and the policy drivers, Marine Objectives and MSFD.

Table 3: Research and policy fields held within MARMAP, MARTOOL and MARDAT

Table 4: Proposed commissioning timetable for the Sustainable Marine Environment Research Programme

List of Figures

Figure 1: The Defra Policy Cycle

Figure 2: Pressure – State – Response (P-S-R) model

Figure 3: Dynamic model showing the relationship between Management, Pressure and State

Figure 4: “Theoretical” model for the new research programme structure

Figure 5: Illustrating similarities between Fisheries and Marine Environment Programmes

Figure 6: Illustration of MARMAP screen

Figure 7: Illustration of MARTOOL screen

Figure 8: Illustration of MARDAT screen

Figure 9: Summary of the proposed commissioning timetable

1. Introduction

Over the past 18 months Defra's Marine Directorate has been conducting a fundamental review of its Marine Environment (ME) and Marine Biodiversity (MB) Research Programmes. Because of the breadth of this area of research - 10 individual themes of research with a total budget in excess of £5m, and over 90 projects - a three stage approach was adopted for the Review. Stage I focussed on research directly relating to the impact of human activities on the marine environment, whilst Stage II evaluated research undertaken within the three themes covering ecosystem structure and function, environmental processes and pathways, and marine biodiversity. Executive summaries of the Stage I and II reports are included in Appendix 1 with a listing of the individual R&D themes given below:

Stage I:

ME11 – Managing Marine Activities: Deposits
ME12 – Managing Marine Activities: Aggregate Extraction
ME13 – Managing Marine Activities: Emergencies
ME14 – Managing Marine Activities: Integrated Management
ME21 – Assessment of Inputs to Sea: Hazardous Substances
ME22 – Assessment of Inputs to Sea: Eutrophication

Stage II:

ME31 – Understanding the Seas: Ecosystem Structure and Function
ME32 – Understanding the Seas: Environmental Processes and Pathways
ME41 – Monitoring and Assessment
MB - Marine Biodiversity

The main outputs from Stage I and Stage II were to help clarify present and future marine related policy drivers, summarise research outputs to date, and identify Defra's future evidence needs.

The aim of Stage III of the review has been to draw together all the evidence gathered during the earlier review work, recommend an appropriate structure for the ME & MB programme and within that new structure:

- Set out the main policy drivers;
- Summarise evidence that is already available;
- Identify the broad requirements for evidence;
- Identify broad priorities for future research, within the proposed new structure;
- Recommend ways of improving research commissioning and management.

This report is the final delivery from the Defra's Marine Environment Review Group (see Appendix 2 for membership). It does not however mark the end of the process. This needs to be ongoing, with priorities revised and updated periodically to ensure the research programme is responsive to policy needs, and takes account of the emerging evidence requirements.

2. Developing the new programme structure

2.1 The need for a research programme structure

R&D supported by Defra needs to be framed within a structure to ensure it can be managed effectively. Adopting a logical programme structure which is made up of discrete but linked blocks of work brings a number of advantages including:

- Help explain the programme content to policy customers;
- Aid identification of research priorities and gaps;
- Help develop collaborative research with other funders;
- Help explain our programme to researchers and others.

Inevitably dividing up a research area into discrete units runs the risk of fragmenting the work and in many cases individual projects may be difficult to assign to a single category because they cover a broad area of research. Nevertheless the advantages of having a clear, workable structure for Defra's research programme outweigh any disadvantages.

2.2 The current structure

In considering a new programme structure the Defra Review Group examined the strengths and weaknesses of the current framework that were identified by t Stages I and II of the review. The present Marine Environment and Marine Biodiversity research areas are two separately run programmes but collectively comprise 10 individual themes which fall roughly under three headings: human impact focussed, ecosystem focussed and biodiversity focussed:

<u>Human focussed:</u>

ME11 – Managing Marine Activities: Deposits
ME12 – Managing Marine Activities: Aggregate Extraction
ME13 – Managing Marine Activities: Emergencies
ME14 – Managing Marine Activities: Integrated Management
ME21 – Assessment of Inputs to Sea: Hazardous Substances
ME22 – Assessment of Inputs to Sea: Eutrophication

<u>Ecosystem focussed:</u>

ME31 – Understanding the Seas: Ecosystem Structure and Function
ME32 – Understanding the Seas: Environmental Processes and Pathways
ME41 – Monitoring and Assessment

<u>Marine Biodiversity focussed:</u>

MB – Marine Biodiversity

Human Impact focussed

Six themes were reviewed in Stage I and the report identified key policy drivers, clear research achievements, and well defined future research needs. However it was recognised that there is a risk that the work in each theme could be somewhat disconnected from the others. The links between research topics could be enhanced, and in particular, the Integrated Management (ME14) theme should build on the results of the other five themes.

Ecosystem focussed

Two of the current ME research themes focus on ecosystem structure and function, and environmental processes and pathways. Stage II of the review concluded that the overall aims of these two themes were less well defined, the links to policy were considered weak, and policy ownership unclear. The research attempted to address big and challenging questions, but often without a clear understanding of how the evidence would be used at the outset. Stage II of the review has shown that even with the help of a number of external evaluators it has not been possible to come up with a clear list of priorities for research, or a comprehensive work plan to deliver the ecosystem approach. The broad conclusion from the Stage II review was that strategic research funded by Defra needs to be predominantly policy lead whilst not ignoring the important role that 'horizon scanning' research has in alerting policy to potential future threats to the marine environment. Linked to this, policy needs to be clearer on what its requirements are for research. Given the breadth of the questions requiring evidence, collaborative research was also identified as a key priority. Defra cannot assemble the significant body of evidence that is required for effective management of the marine environment on its own, and needs to work collaboratively with other funders, both in the U.K. and in Europe.

Biodiversity focussed

Until recently (April 2008) Marine Biodiversity (MB) was funded through a separate policy line, but now forms part of the Marine Directorate's policy area. For completeness it was included in the Stage II review, and will be fully integrated into the new programme structure. The challenges for marine biodiversity research are somewhat similar to those outlined for the ecosystem focussed research, but the policy drivers have been more clearly articulated and the work has clear policy ownership and focus.

During the review, socio-economics was identified as a growing area of importance requiring increased research. Priority areas identified included evaluating goods and services and understanding how the benefits of the marine environment are distributed across society.

2.3 Considerations for the new structure & re-structure options

To be successful the Defra Review Group considered that the new structure needs to satisfy the following five criteria:

- It has to be understandable, both in a policy and scientific sense;
- It has to show clear links to policy need;
- It needs to offer sufficient challenge to engage the interest of the scientific community;
- It needs to have durability, with a time line of at least 5 years;
- It needs to be flexible to accommodate changing evidence requirements.

In developing a new structure for the research programme the Review Group took special account of the following:

1. Defra requires evidence[1] to support sound decisions when developing, shaping and evaluating policy. Research forms an important part of the evidence base, together with monitoring and surveillance, and economic and statistical analysis.

2. There are a number of stages on the standard Defra Policy Cycle, illustrated in Figure 1 below, where evidence is required. For example it is needed to underpin our understanding of the problem that is prompting the need for policy intervention, it needs to help identify and appraise policy options, and following the adoption of measure there is a need to evaluate the success of any management actions.

The Group also noted the following when considering the research programme content:

3. Defra needs to focus much of its research efforts on understanding the impact that pressures (such as pollutants, construction, emergency oil spills) have on the state of the marine environment, assessing whether the impact is of significance, and evaluating alternative management strategies.

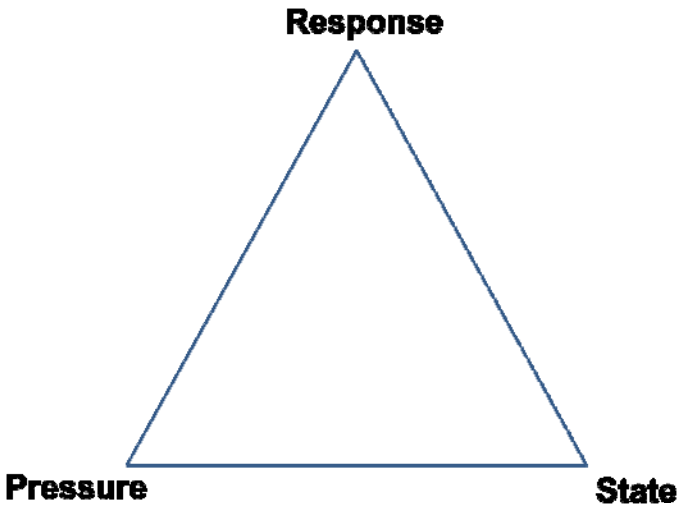
4. Research also helps Defra shape forward-looking policies in order to tackle the causes of problems, not just the symptoms. To achieve this, the Marine Science programme needs to include strategic elements. Whilst it is not necessary for Defra to develop a complete understanding of the whole ecosystem, the programme does need to link with marine science programmes funded by others that are seeking to develop wider understanding of whole Earth systems.

Taking these points into consideration the Group concluded that the widely accepted Pressure-State-Response (P-S-R) model adopted by OECD and others provides a suitable framework around which to develop the new programme. Put simply this model, presented in Figure 2 below, assumes that human activities exert pressures (P) on the environment. These pressures affect its state (S) and society responds (R) to these changes with policies and management action.

[1] Evidence is defined as reliable and accurate information that Defra can use to support sound decisions in developing, shaping, and evaluating policy.

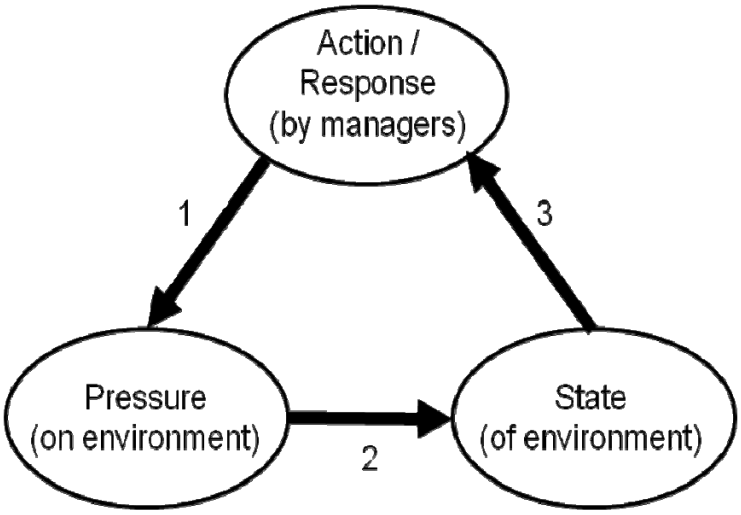
Figure 1: The Defra Policy Cycle

Figure 2: Pressure-State-Response (P-S-R) model



For Defra's purposes this model needs to be developed further to emphasise the important element of 'management' as illustrated in Figure 3, where Arrow 1 denotes how management actions control pressure, Arrow 2 denotes how changes in pressure modify the state of the environment, and Arrow 3 denotes how monitoring the state of the environment helps to inform managers as to whether it meets management objectives.

Figure 3: Dynamic model showing the relationship between Management, Pressure and State



When considering this model for the purpose of developing the new research structure, three further factors need to be taken into account:

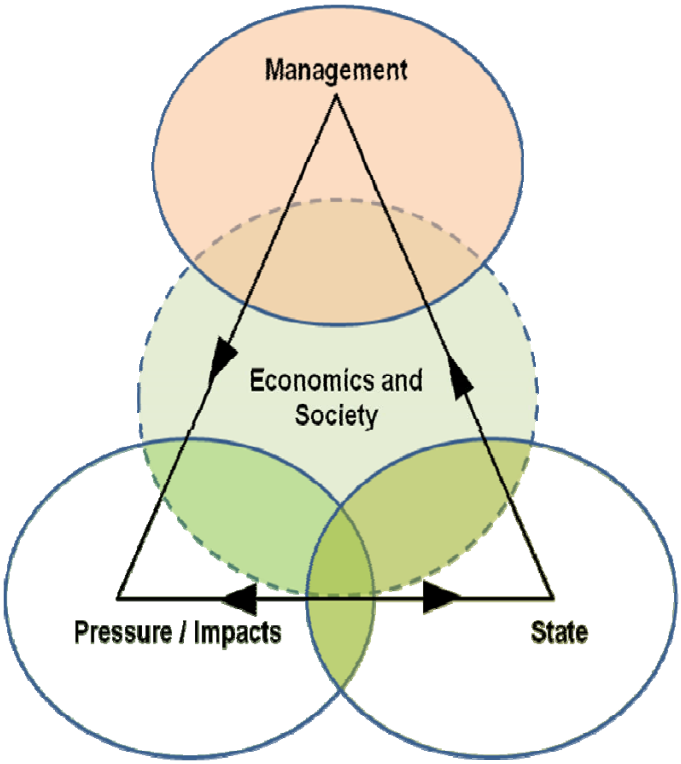
a) Research undertaken on the axis linking Pressure/Impact and State/Environment is, in reality, likely to be somewhat of a continuum, with individual projects including elements of both impact and environment. As a result they may be difficult to categorise and to address this, the Pressure and State ovals need to overlap.

b) 'State' itself is not static. It is subject to natural change and because of this its response to pressures may vary. To illustrate this, the Pressure-State axis needs to incorporate a two-way arrow.

c) A component of economic and social research, largely missing from the current programme, was identified as a priority area in Stages I and II, and needs to be a prominent feature of research in the new structure. One option would be to integrate social and economic research into all three areas - management, pressure/impact and state. However because of the need to give priority to this new area, the Group considered that it should be developed as a separate programme, but with close links to each axis.

These three factors are taken into account in Figure 4 below.

Figure 4: “Theoretical” model for the new research programme structure



2.4 Other important considerations – “Practical” links to Policy Drivers

Whilst the above provides a suitable “theoretical” model around which to structure the new programme, to be successful it has to satisfy a number of criteria as set out earlier. In particular it has to demonstrate clear links to Defra’s need for evidence, i.e. the programme needs to be sufficiently “practical”.

In considering this particular criterion, the Defra Review Group has taken account of two new drivers which will have an important bearing on evidence needs over the coming years, namely the Marine Objectives (MO) which Defra has signed up to and the EC Marine Strategy Framework Directive (MSFD).

The Marine Objectives

The UK Government has committed itself to the delivery of a series of high level marine objectives designed to deliver the vision for the marine environment of *clean, healthy, safe, productive and biologically diverse oceans and seas.* In essence these objectives will be the high level framework for the development of policy within Defra and were considered by the Review Group to be a key consideration in shaping the new research programme because:

- the Marine Objectives capture the main essence of Government policies in the marine area, that of achieving good environmental status;

- they are widely supported across the UK, providing a vision for the future;

- the Objectives provide a comprehensive set of outcomes

- science is identified as one of the five Marine Objectives, and is clearly recognised as an integral part of achieving the vision of good environmental status;

- the UK Marine Science Strategy which will be developed by the newly formed Marine Science Coordination Committee will use the Marine Objectives as an important point of reference.

The European Marine Strategy Framework Directive (MSFD)

The second important 'driver' considered was the European Marine Strategy Framework Directive (Directive 208/56/EC) which was adopted in July 2008 and provides a significant marker for marine policy, and for marine research.

The Directive states that "marine strategies will be effective only if they are devised on the basis of a sound knowledge of the state of the marine environment" and that an appropriate framework, including marine research, is needed for informed policy making. In developing the new research programme structure due regard must be made to the new Directive, and the priorities for research that emerge from it.

The Commission's document "Towards a strategy to protect and conserve the marine environment" COM(2002)53A introduced the need for a European-wide marine strategy and sets out some of the main gaps in our knowledge including:

- How is biodiversity affected by human induced changes and natural processes and what is the recovery potential and speed once the drivers of the impact have been reduced or eliminated?

- How does the change in species diversity and structure influence the functioning of marine and coastal ecosystems?

- What is the impact on the elements of marine biodiversity e.g. in terms of decline, losses and timescale?

- How should sustainability be defined in relation to biodiversity and how should the changes be monitored?

The Directive itself puts in place a range of requirements. Those for which research is required can be summarised as follows:

- ongoing monitoring and assessment of the state of the UK's seas including: analysis of the essential features and characteristics of the marine environment; analysis of the predominant pressures and impacts of human activity; economic and social analysis of the use of the marine environment;

- determination of a set of characteristics of good environmental status;

- establishment of a comprehensive set of environmental targets and associated indicators for the marine environment;

- identification of measures which need to be taken in order to achieve or maintain good environmental status, including restoration.

These requirements will require a significant research effort. Initial analysis of the potential research requirements have identified four key areas which require evidence:

a) The need to understand essential characteristics of the marine environment. "Characteristics" include physical and chemical features, habitat types and biological features;

b) The need to analyse pressures and impacts of human activity including physical damage, contamination by hazardous substances, release of substances and nutrient enrichment;

c) The need for economic and social analysis of the use of the marine environment;

d) The need to identify measures to help achieve or maintain good environmental status.

2.5 Testing the preferred re-structure option

Having considered various options, including up-dating the current ME/MB programme, or basing it around Defra's Marine Business Plan, the Defra Review Group concluded that a restructuring around the Marine Objectives appeared to offer a satisfactory option. To test this option further the current research portfolio was brigaded under each of the Marine Objectives, with the following observations:

1. **Marine Objective 1: Achieving a sustainable marine economy:** No projects were allocated to this objective. This is as expected since this is not currently a priority area for Defra.

2. **Marine Objective 2: Ensuring a strong healthy and just society:** Three of the current MB projects were allocated to this objective, but no ME projects. The Stage II Review noted that research into socio-economics was generally weak, and was seen as an area needing further research focus across Defra;

3. **Marine Objective 3: Living within environmental limits:** Approximately two-thirds of the projects were allocated to this objective, but projects fell into two broad categories: 'Ecosystem State' and 'Human Pressures/Impacts'. The 'Ecosystem State' category covers research on gathering evidence on the ecosystem, monitoring natural change, and developing tools to assess state. The 'Human Impact' category covers human pressures on the ecosystem and includes developing tools to assess impact, developing assessment models, and assessing impact of specific pollutants;

4. **Marine Objective 4: Promoting good governance:** Current research involved taking the knowledge from State and Impact and through further research helping Defra to develop effective management measures such as spatial planning. It also entailed assessing the success of previous management measures.

5. **Marine Objective 5: Using sound science responsibly**: No research is undertaken in this area but it was concluded by the Group that this should be the guiding principle on which Defra bases its management of the marine research programme, to include adopting good practice, working with other funders and managing knowledge.

Following this exercise it was concluded that the Marine Objectives provide an important "practical" point of reference for research needs, and a suitable framework around which to base the new research programme structure.

3. The proposed new structure for the marine environment research programme

Having considered both the "theoretical" and "practical" aspects set out above, the Review Group has concluded that a new programme structure should be adopted. It is proposed that the new programme should be titled **"Sustainable Marine Environment Research Programme"**, and be composed of the following four theme headings (see Table 1 for proposed theme, descriptive and short titles):

- Economic and Social Research in the Marine Environment;
- Human Pressures and Impacts on the Marine Environment;
- State of the Marine Environment;
- Science for Integrated Marine Management.

These four research themes link well with both the Marine Objectives and Marine Strategy Framework Directive as shown in Table 2. Further details on the scope and content of the four new programmes are presented in Section 4.

Table 1: Proposed theme, descriptive and short titles for the four themes within the Sustainable Marine Environment Research Programme.

Theme Title	Descriptive Title	Short Title
Social and Economic Research in the Marine Environment	Ensuring a strong, healthy and just society – social and economic research in the marine environment	Economics and Society
Human Pressures and Impacts on the Marine Environment	Living within environmental limits– Human pressures and impact on the marine environment	Pressure/Impact
State of the Marine Environment	Living within environmental limits– State of the marine environment	State
Science for integrated Marine Management	Promoting good governance – science for integrated management of the marine environment	Management

Table 2: Links between the four programme themes and the Policy drivers, Marine Objectives and MSFD.

Theme	**Related Marine Objective**	**Research areas identified in the Marine Strategy Framework Directive**
Economic and Social Research in the Marine Environment	Ensuring a strong healthy and just society	The need for economic and social analysis of the use of the marine environment
Human Pressures and Impacts on the Marine Environment	Living within environmental limits	The need to analyse pressures and impacts of human activity including physical damage, contamination by hazardous substances, release of substances and nutrient enrichment
State of the Marine Environment	Living within environmental limits	The need to understand essential characteristics of the marine environment. "Characteristics" include physical and chemical features, habitat types and biological features
Science for Integrated Marine Management	Promoting good governance	The need to identify measures to help achieve or maintain good environmental status

4. Outline of the broad scope and content of the four new programmes

Section 4 of this report sets out the broad scope and content of the four research programmes. The aim is to define the "boundaries" of each research programme, to summarise the challenges identified by high level policy drivers, and to indicate the broad scope for future research. It does not provide a definitive list of policy drivers or research needs.

4.1 Economic and Social Research in the Marine Environment

Summary Objective

Investigate a range of economic and social factors relevant to marine environment management including: evaluation of ecosystem goods and services and the relationship with marine biodiversity; the impact of human activity on ecosystem services provision; the cost of degradation of the marine environment; and its capacity for recovery. Provide a better understanding of social, economic and environmental aspects related to the marine environment, including how the benefits of marine ecosystems are distributed across society and how this can support marine spatial planning. Investigate the potential scope for market based instruments in managing marine resources effectively.

Key customer purpose

Provide policy with a range of economic and social evidence which helps inform decision making related to marine environment management including: assessing the total economic value of the environment in order to assess the economic impact arising from resource degradation; assessing the potential for developing economic instruments (e.g. licences, incentives, tradable permits that change behaviour to favour the sustainable use of marine resources); assess societal needs related to the marine environment and how the benefits of marine ecosystems are distributed across society.

High Level Statement

The underlying aim of research is to build socio-economic capacity within the Department, and in the research community. Starting from a somewhat low base, research is needed on a number of fronts including: developing methods for valuing ecosystems goods and services provision and the impacts of resource degradation on this; the key socio-economic and environmental drivers of marine ecosystem change; and assessing the potential of developing economic instruments that reinforce the sustainable use of marine resources. Social research is needed to provide qualitative and quantitative information on a range of issues related to the value of the marine environment.

Links to High Level Policy Drivers

A wide variety of marine environment and fisheries policy areas need the support of economic and social evidence.

a) Marine Strategy Framework Directive: Requires an economic and social analysis of the UK seas, including cost of degradation of the marine environment and an understanding of the key tensions between socio-economic and environmental outcomes;

b) Marine Objectives: Understanding how people value the marine environment and how they view different priorities for the use of marine areas;

c) Marine Bill: Socio-economic evidence to support the process of developing marine spatial plans and selecting marine conservation zones;

d) Fisheries: Assess the wider social, economic and environmental benefits and impacts of the fishing industry.

The scope for research

- Valuation exercises on the contribution key habitats and species make to goods and services of the marine environment. Market values for traded goods and services and derived market values for non-traded goods and services.

- Understanding the cost of degradation of the marine environment and its capacity for recovery. In particular how does existing socio-economic activities affect ecosystem service provision, what impact are they expected to have in the future and how should this information be used in marine spatial planning.

- Economic analysis of marine industries to identify the likely future scale of existing industries and development of new ones.

- Valuations of changes in key marine attributes.

- Development of bio-economic models and other tools to assist in the assessment of the impact of climate change on the provision of goods and services from the marine environment.

- Analysis of appropriate market based and other economic instruments to be used in the effective management of marine resources.

- Assessing the impact of industry on the provision of ecosystem goods and services, at the regional scale.

4.2 Human Pressures and Impacts on the Marine Environment

Summary objective

Understand the impact that specific and cumulative human activities (pressures), and climate change, have on key aspects of the marine environment (state).

Key customer purpose

Enable Defra to assess the extent to which human induced changes to the marine environment are significant and if confirmed, help develop alternative management scenarios.

High Level Statement

The overall aim of this area of research is to provide sufficient understanding of how human impacts such as those arising from nutrient enrichment, aggregate extraction, hazardous substances, accidental oil spills and deposits impact on the marine environment and the ecosystems found there in order to assess whether such impacts are sufficiently damaging to warrant management actions. Also to include research into how climate change is impacting on marine ecosystems and predicting future scenarios. The research objectives are to describe the effects of these impacts, from the cellular level through to populations and ecosystems, in order to determine whether these effects are sustainable and, when they are not, to help develop alternative management scenarios. In addition to investigate the potential for adopting measures that will help restoration.

Links to high level policy drivers

a) Marine Objectives: Understand human impact on biodiversity and how to conserve and recover the marine environment to halt the loss of biodiversity.

b) Marine Strategy Framework Directive: Analysis of the predominant pressures and impacts on the status of the marine environment.

c) Marine Bill: Support development of marine spatial plans. Help determine which human activities should be restricted within marine conservation zones (MCZs)

The scope for research

Research will be needed in the following broad areas:

- development of tools, including indicators, to monitor pressure and impact on the marine environment including subtle and sub-lethal effects.
- development of models for a wide range of purposes including translating individual impact to populations, modelling pathways and footprint of pollution events.
- understand how impacts at the cellular level translate through to the whole animal, leading to community change.
- understand the recovery potential once the impact is reduced.
- predict the likely impact that climate change will have on the marine environment.

4.3 State of the Marine Environment

Summary objective

Determine the essential features and characteristics of the marine ecosystem that help define good environmental status, taking into account natural variability.

Key customer purpose

Enable Defra to develop a set of definitions and qualitative descriptors of good environmental status, in order to establish appropriate environmental targets. Develop innovative and cost-effective means of monitoring change in the marine environment.

High level statement

The overall aim of this area of research is to provide sufficient understanding of what is meant by terms such as “healthy marine habitats”, “strong, biodiverse biological communities”, “functioning of healthy, resilient and adaptable marine ecosystem”. Qualitative descriptors for determining good environmental status are for most criteria rather broad and need to be refined. For example criteria state that biological diversity needs to be “maintained”, food webs need to occur at “normal abundance and diversity” and sea bed integrity is at a level that ensures the structure and function of the ecosystem are not “adversely affected”. There is the added complexity that marine systems are subject to annual, inter-annual and decadal natural variation which needs to be taken into account when trying to establish human effects.

Links to high level policy drivers

a) Marine objectives: These imply a need to establish measures of healthy marine habitats that support strong, diverse biological communities, and the functioning of healthy, resilient and adaptable marine ecosystems. There is a need to develop measures of viable populations of rare, vulnerable and valued species, for future adoption by management.

b) Marine Strategy Framework Directive. Establish a set of characteristics for good environmental status for a number of features including physical, chemical, habitat and biological. Provide improved understanding of “ecologically diverse and dynamic oceans and seas which are clean, healthy and productive”.

c) Marine Bill. Inform the selection of marine conservation zones

d) Convention on Biological Diversity. Inform how to halt the loss of biodiversity

The scope for research

Research will be needed in the following broad areas:

- develop tools and technologies to take forward marine habitat mapping and improve current understanding of extent of habitats and resources;
- understand natural variability in the ecosystem
- understand resilience and productivity of the marine environment.

- understand the abundance and distribution of key habitats and species of interest and the threats to their status

- understand the connections between habitats and species in order to implement the ecosystem approach

- develop indicators of biodiversity and other aspects of the environment;

- develop cost-effective tools for monitoring environmental state.

4.4 Science for Integrated Marine Management

Summary objective

Assimilate and analyse the evidence emerging from the Pressure/Impact and State research themes and, through further focussed research, support the development of management strategies, such as spatial planning, the ecosystem-based approach, and integrated coastal zone management. Evaluate the effectiveness of measures once adopted.

Key customer purpose

Assist Defra in developing a more holistic and fully integrated approach to the management of the marine environment, and assess the effectiveness of management measures.

High level statement

This programme aims to gather together the output from the Pressures/Impact and State research themes and, through further focussed research, help Defra develop effective management strategies, such as spatial planning, adopting the ecosystem approach and integrated coastal zone management. Research will also help to monitor how effective management measures are, once adopted.

Links to high level policy drivers

a) Marine Objectives. Management mechanisms need to be responsive and work effectively together, for example through integrated coastal zone management. The use of the marine environment needs to be spatially-planned and based on an ecosystem approach which takes account of climate change.

b) Marine Strategy Framework Directive. Ensure the use of the marine environment is at a level that is sustainable. Help develop and implement a marine strategy. Identify measures which need to be taken in order to achieve or maintain good environmental status.

c) Marine Bill. Help establish the effectiveness of marine conservation zones as a management approach for marine conservation; assess the effectiveness of marine planning tools in delivering the objectives of the marine spatial planning.

The scope for research

- develop modelling and other approaches that assist in the effective management of the marine environment, including responding to accidental pollution events, handling contaminated dredged material, and adopting spatial planning.

- contribute to the practical application of the ecosystem based approach at a regional level.

- As part of adopting the ecosystem approach, contribute to the development of management objectives, based on evidence gathered in the State theme.

- advise on the likely consequences of adopting alternative management objectives for the marine environment.

- examine how management systems can be used to modify pressure in order to meet management objectives.

- determine characteristics that help define good environmental status.

- assess alternative management measures for achieving and maintaining good environmental status.

- evaluate the success of policies.

5. A more integrated Marine Science Programme – links to the Sustainable Marine Fisheries research programme

5.1 Sustainable Marine Fisheries Research Programme

Defra undertook a major review of the Sustainable Marine Fisheries (MF) research programme in 2006, and adopted a new structure for this programme in 2007. Within the new structure, research has been brigaded under three themes:

- Impact of Fishing on the Marine Ecosystem (MF10);
- Effects of the Environment on fish stocks (MF11); and
- Fisheries Management (MF12).

Research assists managers in achieving three key outcomes:

- Restoring and maintaining healthy fish stocks;
- Adopting an ecosystem based approach to fisheries management;
- Promoting and supporting a profitable and sustainable fishing industry.

The following briefly describes the scope and content of the three programmes.

5.2 MF10: Impacts of Fishing on the Marine Ecosystem

Summary objective

To understand the impact of fishing on the wider marine ecosystem, including vulnerable species and habitats. Develop suitable mitigating measures, including discard reduction.

Key customer purpose

To adopt an ecosystem-based approach to management which achieves sustainability of the fisheries, fish stocks and the environment.

High level statement

In order to develop an ecosystem-based approach to fisheries management we need to understand the impact that fishing has on the wider marine environment including on sensitive habitats and species. We need to develop robust and meaningful indicators of the status of marine ecosystems, and appropriate measures to help us avoid and mitigate against damage.

5.3 MF11: Effects of the Environment on fish stocks

Summary objective

To understand how environmental variability and climate change affect fisheries productivity, at relevant spatial and temporal scales.

Key customer purpose

To ensure that management measures take account of short-term and longer-term environmental changes, through an understanding of how biological processes and the environment help to determine stock size.

High level statement

Changes in the marine environment in the form of natural fluctuations can have a major effect on fish and shellfish stocks, and the ecosystems of which they are part. Environmental variability is the key driver of the major annual variations in recruitment and of medium-term fluctuations in abundance, and such changes may affect food webs and productivity at a range of spatial and temporal scales. It is therefore necessary to understand how the environment is affecting stocks in order to be able to explain and forecast changes in fish and shellfish distribution, recruitment and growth, and to distinguish the effects of environmental factors from the impacts of fishing when making management decisions. Climate change is likely to have a significant impact on fish stocks, and fisheries managers need to predict possible future scenarios.

5.4 MF12: Fisheries Management

Summary objective

To provide the tools for better fisheries management including improved understanding of the status of stocks, and biological and fisheries interactions.

Key customer purpose

To support strategic and tactical fisheries management decisions including the development of management plans, the adoption of technical conservation measures, and assessing novel approaches to management.

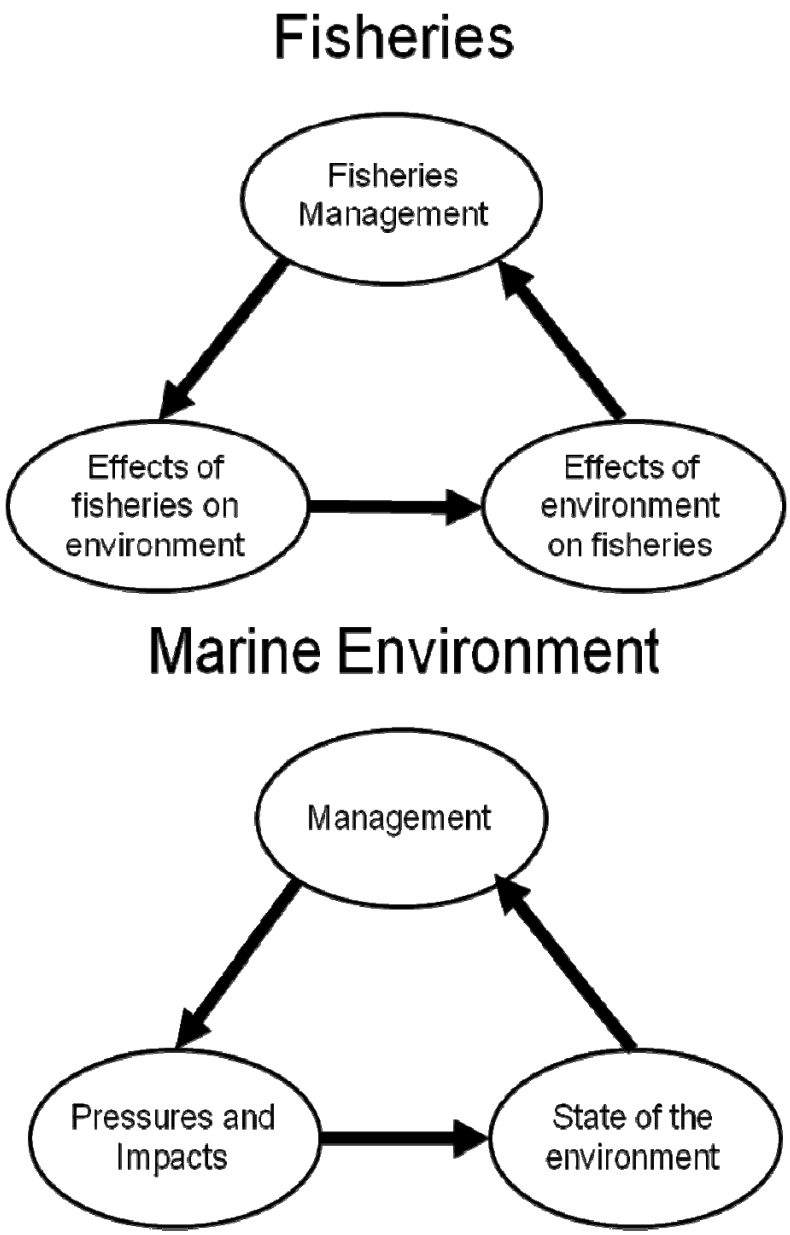
High level statement

Fishery management decisions are taken against a background of considerable biological and economic uncertainty and complexity. Areas of biological uncertainty includes: the size and status of the fish stocks, the effects of the environment on recruitment, the interactions between predators and their prey, and the impact that fishing has on stocks. Areas of economic complexity includes the interaction between fleets in mixed fisheries and the response of fishermen to management measures. Since it is not generally possible to test alternative policies and management strategies experimentally, managers have to rely on computer models to help answer ‘what-if’ questions. The focus for MF12 therefore is the development of computer-based tools that can be used to test the performance of current and alternative strategies for management. An important driver is to reduce uncertainty and thus improve management plans.

5.5 Relationship between the new Sustainable Marine Environment and Marine Fisheries (MF) programmes

Figure 5 below illustrates the similarities between the Sustainable Marine Fisheries programme structure and that of the Sustainable Marine Environment. Both programmes align closely with each other, and present opportunities for closer links to be developed in the future.

Figure 5: Illustrating similarities between Fisheries and Marine Environment Programmes



6. Science to Policy - Improving the utility of Research outputs

Given the breadth of policy drivers against which the marine R&D programme must deliver, and the range of policy officials requiring this evidence base, the Defra Review Group through consultation with policy colleagues have developed three 'tools' to aid the transfer of evidence to policy. These are:

1. **MARMAP 'Marine Policy/Research Map'** which links R&D projects according to the Marine Fisheries Directorate Business Activity. This tool will provide a quick reference point for policy officials wishing to find out what research is currently being undertaken across the Marine Directorate in relation to the 'activity' with which they have delivery responsibility;

2. **MARTOOL 'Current Evidence/Policy Need Tool'** which maps the existing R&D projects according to the Marine Objective it is delivering the evidence for and contains details on the summary objectives and key customer purpose of the project; who the MFScU Science Lead for the project is; which policy areas the outputs are relevant to; and who (Defra Policy Officials and organisations outside of Defra) should be aware of the project. MARTOOL will be used to manage the R&D in a more co-ordinated way and will be of considerable use in ensuring policy officials are aware of all research occurring across the portfolio relevant to their policy need. It is intended that policy officials will also be able to access this document and complete searches on what research is occurring according to policy area, policy driver etc;

3. **MARDAT** '**Database of Marine Projects - Past and Present**' which presents a full listing of all Fisheries and Marine research projects completed since 1990. This registry has been designed to promote access to a significant source of 'knowledge'. For example key word searches can help identify past and present projects of relevance.

Details of the research and policy fields held in each of the above are presented in Table 3. To help illustrate how MARMAP, MARTOOL and MARDAT can be used, Figure 6, Figure 7, and Figure 8 each present screen shots arising from a specific question posed to each tool. It is intended that these tools will be made available via a dedicated MFScU intranet webpage.

The principal aim of these tools is:

- to ensure clear links between research, policy and the marine programme activity areas;
- Identify 'owners' of individual research projects to ensure policy steer through the duration of the project

Collectively, these tools will also aid in effective and efficient programme management of the marine R&D budget through:

- Identifying gaps;
- Avoiding duplication;
- Analysing budget spend by area;
- Assessing the overall balance across the programme;
- Assisting with the undertaking audits of science areas.

MARDAT especially will help make the available research evidence more accessible to policy.

The three tools are still undergoing development, and will be revised and refined over the coming months to become the principal access route to Defra's marine science.

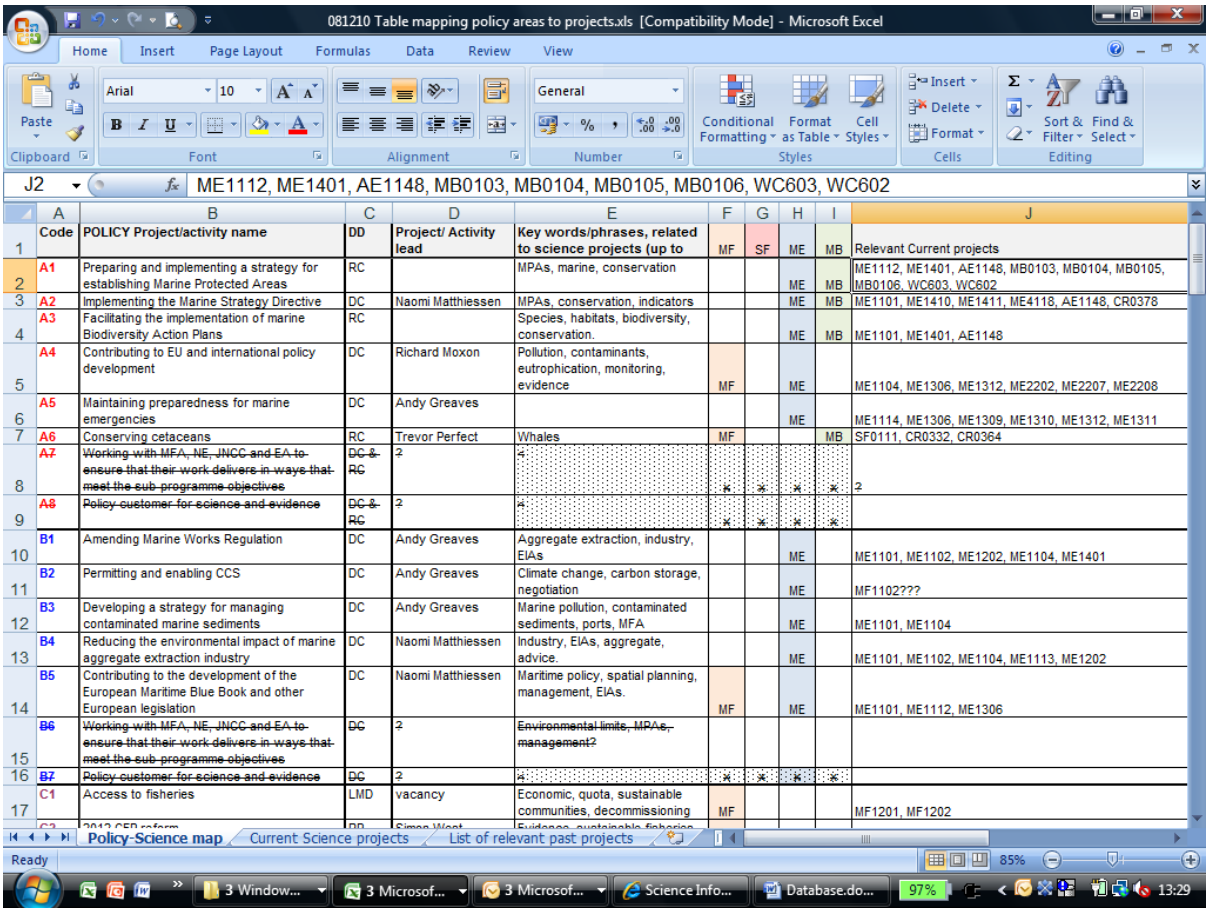
Table 3: Research and policy fields held within MARMAP, MARTOOL and MARDAT

Tool	Column Headers
MARMAP Marine Policy/Research Map	Code POLICY Project/activity name DD Project/ activity lead Key words/phrases related to science projects (up to 6) MF/SF/ME/MB Relevant Current projects
MARTOOL Current Evidence/Policy Need Tool	Project Code Title Summary Objective Key Customer Purpose Start Date End Date Cost Contractor Primary Marine Objective Being Delivered Against Secondary Marine Objective Delivered Against Which Policy Divisions is it relevant to (*policy lead) Key Policy Drivers Key word Marine Policy lead Other Policy Areas With an Interest (within Marine) Policy Areas With an Interest (wider Defra) Outside Organisations with an Interest Link to Marine-Sub-Programme Plan Activity MFScU Scientific Lead
MARDAT All present and historical MFScU projects Database of Marine Projects – Past and Present	Project Code Title Marine Objective Programme area Start Date End Date Summary Objective Key Customer Purpose Contractor Project Leader Contact email Primary Policy Area Other Policy Area Key Policy Driver Marine Policy Lead Other Policy Area Outside organisations with an interest Policy project Link to Marine-Sub-Programme Plan Final report received Final report signed off Electronic copy filed Hardcopy filed MERP number SAF number

Figure 6: Illustration of MARMAP screen

Question: I'm working on policy project area A2 "Implementing the Marine Strategy Directive". What current projects are we funding that are relevant to this policy area?

Answer : Policy Area is shown in columns A and B, and column J provides a list of current projects that include research on the Directive

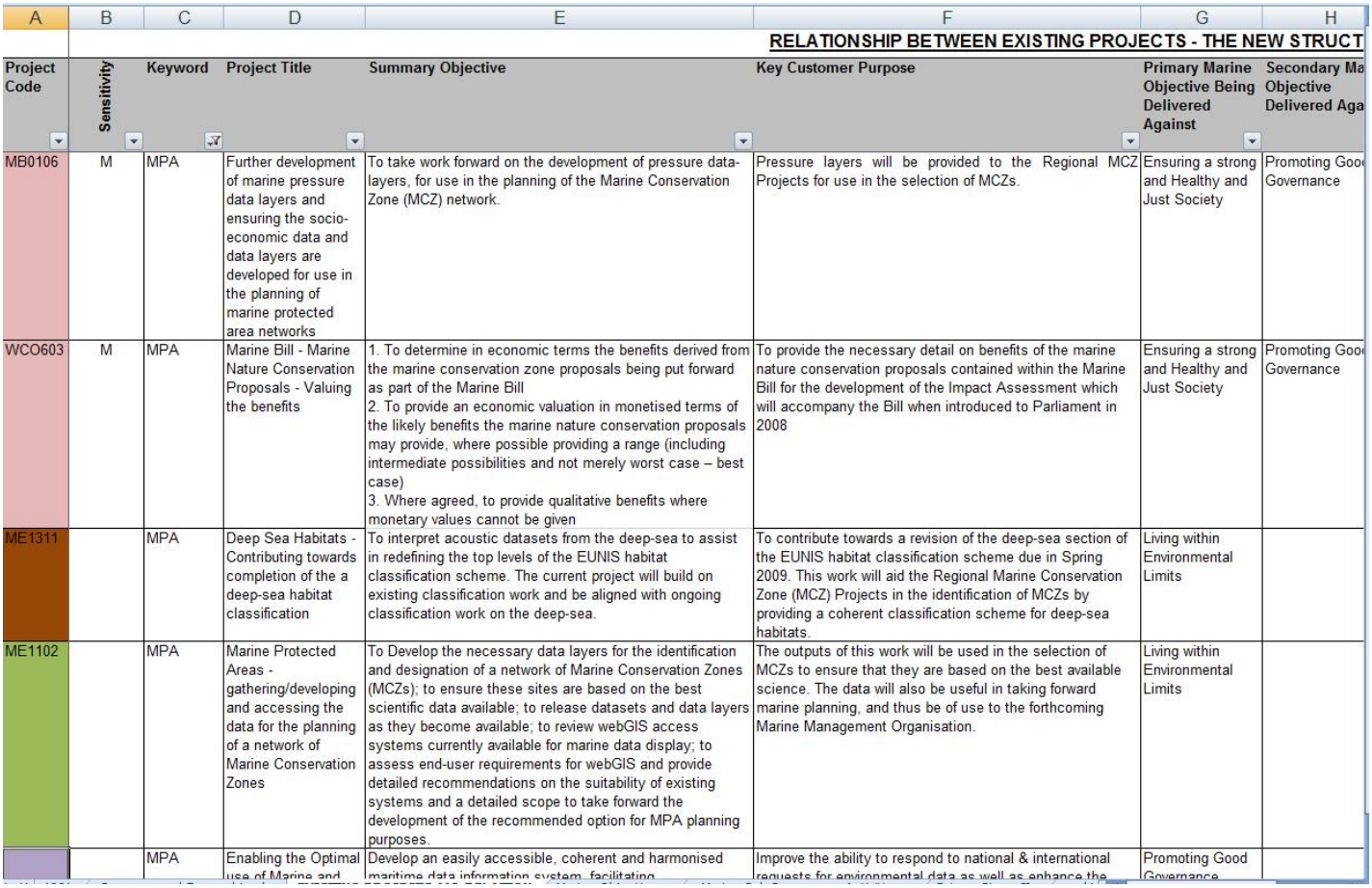


	A	B	C	D	E	F	G	H	I	J
1	Code	POLICY Project/activity name	DD	Project/ Activity lead	Key words/phrases, related to science projects (up to	MF	SF	ME	MB	Relevant Current projects
2	A1	Preparing and implementing a strategy for establishing Marine Protected Areas	RC		MPAs, marine, conservation			ME	MB	ME1112, ME1401, AE1148, MB0103, MB0104, MB0105, MB0106, WC603, WC602
3	A2	Implementing the Marine Strategy Directive	DC	Naomi Matthiessen	MPAs, conservation, indicators			ME	MB	ME1101, ME1410, ME1411, ME4118, AE1148, CR0378
4	A3	Facilitating the implementation of marine Biodiversity Action Plans	RC		Species, habitats, biodiversity, conservation.			ME	MB	ME1101, ME1401, AE1148
5	A4	Contributing to EU and international policy development	DC	Richard Moxon	Pollution, contaminants, eutrophication, monitoring, evidence	MF		ME		ME1104, ME1306, ME1312, ME2202, ME2207, ME2208
6	A5	Maintaining preparedness for marine emergencies	DC	Andy Greaves				ME		ME1114, ME1306, ME1309, ME1310, ME1312, ME1311
7	A6	Conserving cetaceans	RC	Trevor Perfect	Whales	MF			MB	SF0111, CR0332, CR0364
8	~~A7~~	~~Working with MFA, NE, JNCC and EA to ensure that their work delivers in ways that meet the sub programme objectives~~	~~DC & RC~~	~~?~~	~~?~~	~~x~~	~~x~~	~~x~~	~~x~~	?
9	~~A8~~	~~Policy customer for science and evidence~~	~~DC & RC~~	~~?~~	~~?~~	~~x~~	~~x~~	~~x~~	~~x~~	
10	B1	Amending Marine Works Regulation	DC	Andy Greaves	Aggregate extraction, industry, EIAs			ME		ME1101, ME1102, ME1202, ME1104, ME1401
11	B2	Permitting and enabling CCS	DC	Andy Greaves	Climate change, carbon storage, negotiation			ME		MF1102???
12	B3	Developing a strategy for managing contaminated marine sediments	DC	Andy Greaves	Marine pollution, contaminated sediments, ports, MFA			ME		ME1101, ME1104
13	B4	Reducing the environmental impact of marine aggregate extraction industry	DC	Naomi Matthiessen	Industry, EIAs, aggregate, advice.			ME		ME1101, ME1102, ME1104, ME1113, ME1202
14	B5	Contributing to the development of the European Maritime Blue Book and other European legislation	DC	Naomi Matthiessen	Maritime policy, spatial planning, management, EIAs.	MF		ME		ME1101, ME1112, ME1306
15	~~B6~~	~~Working with MFA, NE, JNCC and EA to ensure that their work delivers in ways that meet the sub programme objectives~~	~~DC~~	~~?~~	~~Environmental limits, MPAs, management?~~					
16	~~B7~~	~~Policy customer for science and evidence~~	~~DC~~	~~?~~	~~?~~	~~x~~	~~x~~	~~x~~	~~x~~	
17	C1	Access to fisheries	LMD	vacancy	Economic, quota, sustainable communities, decommissioning	MF				MF1201, MF1202

Figure 7. Illustration of MARTOOL screen.

Question: What current research projects relate to policy on marine protected areas?

Answer: The figure below shows the 'Keyword' column, filtered to select projects that contain the keyword 'MPA'.

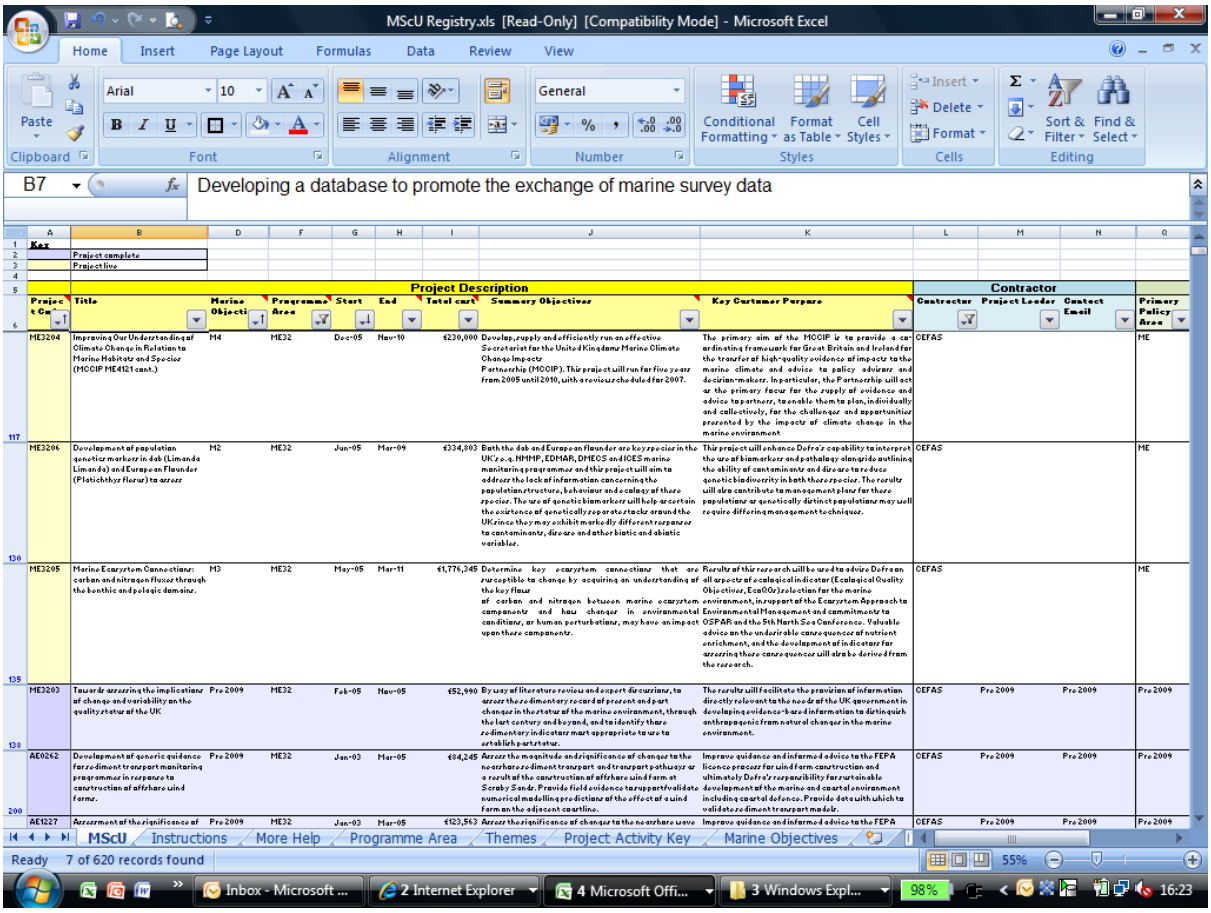


A	B	C	D	E	F	G	H
					RELATIONSHIP BETWEEN EXISTING PROJECTS - THE NEW STRUCT		
Project Code	Sensitivity	Keyword	Project Title	Summary Objective	Key Customer Purpose	Primary Marine Objective Being Delivered Against	Secondary Ma Objective Delivered Aga
MB0106	M	MPA	Further development of marine pressure data layers and ensuring the socio-economic data and data layers are developed for use in the planning of marine protected area networks	To take work forward on the development of pressure data-layers, for use in the planning of the Marine Conservation Zone (MCZ) network.	Pressure layers will be provided to the Regional MCZ Projects for use in the selection of MCZs.	Ensuring a strong and Healthy and Just Society	Promoting Goo Governance
WCO603	M	MPA	Marine Bill - Marine Nature Conservation Proposals - Valuing the benefits	1. To determine in economic terms the benefits derived from the marine conservation zone proposals being put forward as part of the Marine Bill 2. To provide an economic valuation in monetised terms of the likely benefits the marine nature conservation proposals may provide, where possible providing a range (including intermediate possibilities and not merely worst case – best case) 3. Where agreed, to provide qualitative benefits where monetary values cannot be given	To provide the necessary detail on benefits of the marine nature conservation proposals contained within the Marine Bill for the development of the Impact Assessment which will accompany the Bill when introduced to Parliament in 2008	Ensuring a strong and Healthy and Just Society	Promoting Goo Governance
ME1311		MPA	Deep Sea Habitats - Contributing towards completion of the a deep-sea habitat classification	To interpret acoustic datasets from the deep-sea to assist in redefining the top levels of the EUNIS habitat classification scheme. The current project will build on existing classification work and be aligned with ongoing classification work on the deep-sea.	To contribute towards a revision of the deep-sea section of the EUNIS habitat classification scheme due in Spring 2009. This work will aid the Regional Marine Conservation Zone (MCZ) Projects in the identification of MCZs by providing a coherent classification scheme for deep-sea habitats.	Living within Environmental Limits	
ME1102		MPA	Marine Protected Areas - gathering/developing and accessing the data for the planning of a network of Marine Conservation Zones	To Develop the necessary data layers for the identification and designation of a network of Marine Conservation Zones (MCZs); to ensure these sites are based on the best scientific data available; to release datasets and data layers as they become available; to review webGIS access systems currently available for marine data display; to assess end-user requirements for webGIS and provide detailed recommendations on the suitability of existing systems and a detailed scope to take forward the development of the recommended option for MPA planning purposes.	The outputs of this work will be used in the selection of MCZs to ensure that they are based on the best available science. The data will also be useful in taking forward marine planning, and thus be of use to the forthcoming Marine Management Organisation.	Living within Environmental Limits	
		MPA	Enabling the Optimal use of Marine and	Develop an easily accessible, coherent and harmonised maritime data information system, facilitating	Improve the ability to respond to national & international requests for environmental data as well as enhance the	Promoting Good Governance	

Figure 8: Illustration of MARDAT screen

Question: How many current CEFAS projects are under the programme area ME32 “Understanding the Seas: Environmental Processes and Pathways”..

Answer: The figure below shows the ‘ME programme area’ column, filtered to select all projects with ME 32 code.



7. Improving the commissioning and management of research

7.1 The need for change

Stages I and II of the review identified a number of weaknesses in the current system for commissioning research. In particular the review and subsequent discussions identified the need for:

- Improved arrangements to allow Defra to prioritise research against policy needs;
- A clear and transparent timeline for the assessment and commissioning of research;
- A clear coherent statement of policy priorities and the associated evidence requirements;
- A better balance within the programme between small, highly targeted projects and larger projects that require longer-term investment to achieve the policy goals;
- A programme that contains an element of horizon scanning to identify future priority areas for evidence and policy development;
- Improvements in the communication of science to ensure engagement and commitment by policy customers for research, and uptake of final research outputs;
- A need to attract the widest range of appropriate scientific expertise including that not traditionally engaged in the research programme.

The review also highlighted the need to achieve better integration, coherence and linkages to other research funders of marine science in order to enhance the delivery of the marine environment research programme. A key recommendation was that mechanisms should be explored to maximise benefit to Defra of research funded by others and that they in turn benefit from Defra's own research investment.

The Review Group concluded that the commissioning of marine environment research should be set within the general principles of Marine Objective 5, "Using sound science responsibly", namely that:

1. Our understanding of the marine environment continues to develop through new scientific research and data collection.
2. Sound evidence and monitoring underpins effective marine management and policy development.
3. The precautionary principle is applied consistently in accordance with Government's sustainable development policy.

Having considered all the comments and suggestions emerging from the earlier stages of the review, a revised framework for the commissioning and management of research has been developed in order to promote clarity and transparency of the process for both policy and research organisations. This will also encourage a greater sharing of knowledge with other funders and facilitate both the identification of collaborative opportunities and minimise duplication of effort. In particular closer liaison with the research programmes of the research councils (especially NERC) and European Commission and internationally funded activities will be sought. Particular changes from the current process include:

- The establishment of a Policy Budget Holder Group (PBHG) which will help ensure that all projects commissioned by Defra Marine have a business 'owner';
- The establishment of a Research Liaison Group (RLG) which will improve linkages and consultation with other funders;
- the adoption of a clear and transparent commissioning timetable and associated series of template documents to standardise research concepts submitted and the evaluation of these research notes;
- An annual research publication which will promote the profile of marine research being completed within the programme and explain how the results are being used.

7.2 Adopting a formal commissioning process & timeline

Drawing on the experience of commissioning arrangements already in place for Marine Fisheries and Marine Biodiversity, the Marine and Fisheries Science Unit (MFScU) has developed a structured and pro-active approach to the commissioning of R&D which:

- Streamlines procedures and brings ME into line with the rest of the R&D programme.

- Enables MFScU and the Policy Budget Holders Group (PBG**)** to draw-down R&D funds during the year and to ensure that all R&D budgets are fully committed;

- Allows policy to define their specific research requirements well in advance of the budget year and for MFScU to provide a portfolio of projects which match policy priorities within the constraints of the budget. This will help to achieve a more strategic and proactive approach to commissioning research;

- Identify and publish key policy requirements;

- Enables Defra to advise Cefas of likely commitments against their High Level Agreement (HLA);

- Promotes transparency of Defra's policy requirements and thus research agenda to allow a wider portfolio of researchers involved in delivering the current evidence base.

A detailed annual commissioning timetable has been developed which sets out the actions for commissioning work both with Cefas and with other research organisations. Several key steps to the process have been identified including project policy ownership. Not included is the review process which takes place every 4-5 years and which assesses the quality of the work being delivered.

Figure 9 below sets out the proposed commissioning timetable, and Table 4 provides further details. It is anticipated that the new timetable will be established in early 2009 and will help address some of the concerns raised during the review. The process itself will need to be reviewed in a year's time to consider whether further improvements can be made.

Figure 9: Summary of the proposed commissioning timetable

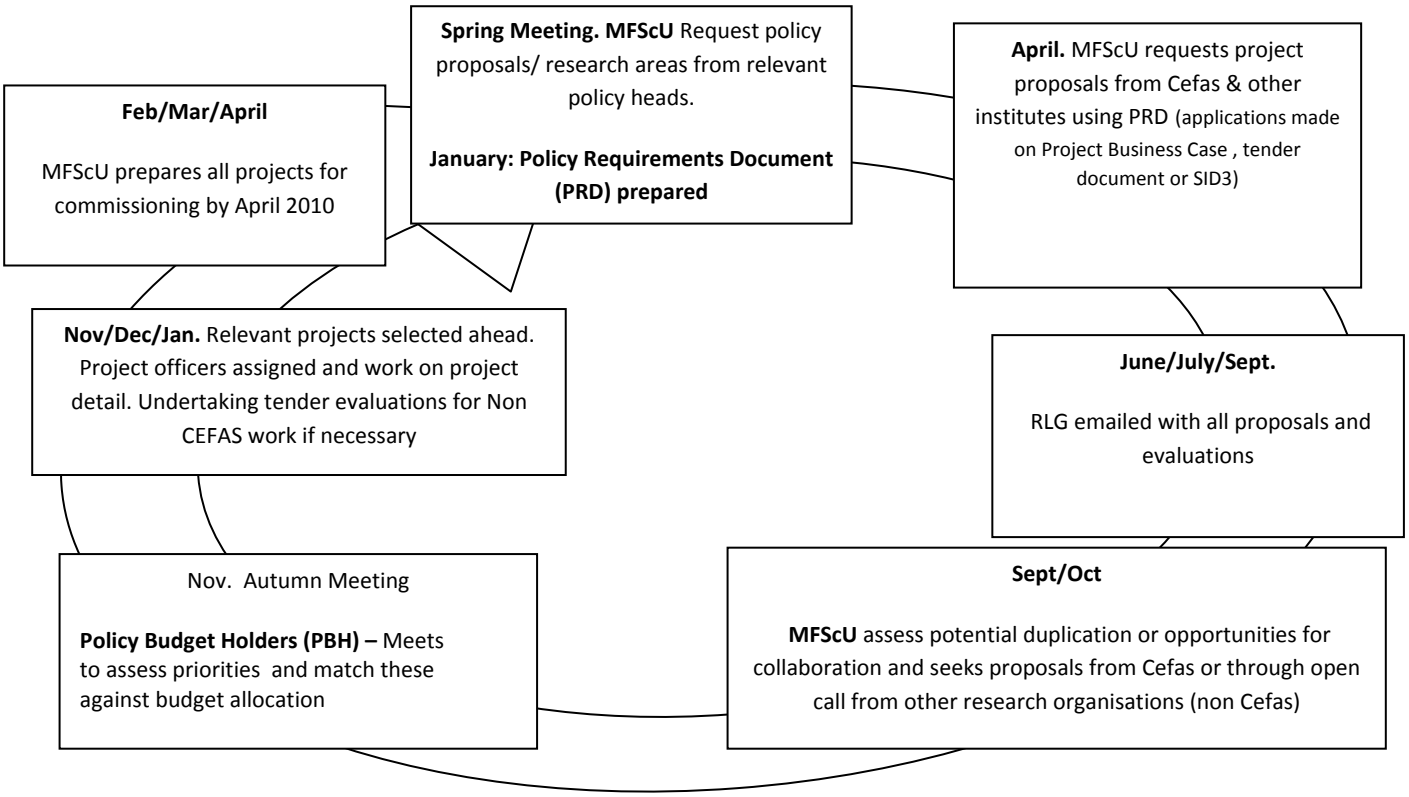


Table 3: Proposed commissioning timetable for the Sustainable Marine Environment Research Programme

Time Period	Task
Stage 1: **Timing: January**	Preparation of the **Policy Requirement Document** by the policy leads (see Figure 9) The PRD provides a description and purpose of project, what the project is intended to do (i.e. what evidence is needed) and why it is necessary (i.e. what is the policy question to be answered). The policy document will also say how the results will be used, who will use them and what benefits are expected. Where a specific policy is to be addressed this should be highlighted.
Stage 2: **Timing: Feb/March /April (Spring Meeting)**	The **Policy Budget Holders Group (PBHG)** consisting of: the Marine Strategy and Evidence Policy G5, Policy heads & MFScU meet to discuss new R&D priorities for the year ahead i.e. for work to start the following Spring for the next financial year plus one in the light of ongoing projects and funds likely to become available when current projects finish. The outcome of any recent reviews and new policy requirements as detailed in the PRD should also be taken into account.
	In advance of the meeting, the MFSCU will have prepared the budget tables for both the Cefas HLA and the non CEFAS research programme to show the available spend on research for the next financial year plus one.
	Each of the pre-prepared Policy Requirement Documents (PRD) will be available which should provide sufficient detail to enable MFScU to put out research calls.
	The PBHG will review each of the PRDs, and prioritise in terms of policy importance, notionally allocating the expected spend to each policy requirement and determining the preference for whether the research should form part of the Cefas HLA, or be commissioned through Open competition or Single Tender Action (STA).
Stage 3: **Timing: April**	A summary of the PRD and the priority settings are collated by MFScU are then circulated by email to the **Research Liaison Group** (RLG) for information. Any comments are then fed back the Marine Strategy and Evidence Policy G5 and Policy heads. Any changes to the call in light of RLGs' comments can be actioned accordingly.
Stage 4: **Timing: April/May/June**	MFScU seeks proposals from both CEFAS & other research institutes to match these priorities using the Policy Research Document (PRD) as a basis. Proposals will be invited, using standard forms (Project Business Case, pre tender documents for CEFAS HLA proposals and SID3s for non CEFAS HLA proposals) by an invited tender to CEFAS and an open call to Non Cefas organisations against an agreed subject list, addressing policy requirements. CEFAS will be encouraged to consider collaborative proposals where necessary. For all proposals an external peer review process will be undertaken to evaluate the proposals.

Stage *5:* **Timing*:* June/July/September**	A summary of the proposals and evaluations are collated by MFScU and circulated by email to the Research Liaison Group. The proposals, evaluations and comments from the RLG are then considered in November by the **Policy Budget Holders (PBH)**
Stage 6: **Timing: October/November (Autumn Meeting)**	The **Policy Budget Holders (PBH)** sets a priority for each proposal and, if there are sufficient funds in the programme, provides each project with an allocation. Once proposals have an allocation, subject to approval by Science and Policy Grade 5s (and, at present, subject to any other Departmental approval procedure) projects can be developed, if not already, as full SID3s. By November, the G5 Policy Budget Holder agrees the bulk of new work to be commissioned with CEFAS and other Institutes for the next financial year.
	It should be noted that some CEFAS projects could placed through the open call fund provided they are deemed to be of good quality.
	MFScU will discuss the new CEFAS proposals with the PBH group and agreement reached on which proposals should be submitted as full projects with any required amendments. If necessary, meetings can be arranged between policy heads and contractors on the setting up of the new work.
Stage 7: **Timing: November/December/January**	MFScU works with all contractors to ensure complete SID3s are in place to enable the work to start in April 2010. Any evaluations or fuller calls of work can also be undertaken in this period. If necessary final decisions can also be made on any remaining funds, based on the PES outcome. There will, of course be opportunities between January and March for MFScU to meet with PBHs to discuss progress and consider any new policy priorities that have emerged and may need to be funded urgently.
Stage 8: **Timing: January**	In January, final decisions are made on remaining funds, based on the PES outcome.
Stage 9: **Timing: April preceding year**	New work commences

7.3 Enhancing Policy Ownership of the Research

It is proposed that a Policy Budget Holders Group (PBHG) will be established to help improve arrangements for prioritising policy needs for evidence and ensuring policy has ownership of the outputs. The PBHG will meet during the course of the commissioning process to agree policy priorities, and allocation of the funding available. The PBHG will consist of the policy leads within the Marine Environment Group. The PBHG will consist of;

- Head of the Marine and Fisheries Science Unit (Chair)
- Head of Marine Strategy and Environment Division;
- Head of Sustainable Marine Development and Climate Impacts Team;
- Head of Integrated Marine Policy;
- Head of European Marine Environment Policy Branch;
- Head of Marine Contaminants Branch;
- Head of International & IUU fishing;
- ME R&D Programme Manager;

The PBHG will be charged with prioritising research concepts against policy needs and establishing a clear coherent statement of policy priorities and requirements. In order for this to be effective each policy lead will need to prepare a Policy Requirement Document (PRD). This document will provide a description and purpose of the policy issues, the type of evidence needed, why it is necessary (i.e. what is the policy question to be answered) and how the results will be used (i,e. who will use the output and what benefits are expected). Where a specific policy is to be addressed this should be highlighted.

7.4 Improving liaison with other Funders.

A new consultation group will be established to improve the current level of integration, coherence and linkages to other research funders in the marine environment. This **Research Liaison Group (RLG)** will consist of a number of interested parties such as;

- Defra - Policy heads in ME, Marine Bill, MFA, other Defra Policy heads in related areas such as Marine Biodiversity, NEG.
- the Devolved Administrations
- Environment Agency
- Research Councils (such as NERC)
- Others (such as Marine Science Coordinating Committee)

The aim will be for Defra to consult with this group during the commissioning process to seek comments on policy priorities, research being considered, and the quality of proposals. The aim of using such a group is to ensure that Defra does not duplicate research funded elsewhere in Defra or in the statutory agencies and that there is a more cohesive programme of marine environmental research.

8. Review Conclusions

This Stage III report is the final delivery of the Review Group. The main output can be summarised as follows:

- The development of a new structure for Marine Environment Research under the programme title “Sustainable Marine Environment Research Programme”, and composed of four themes:
    - Economic and Social Research in the Marine Environment;
    - Human Pressures and Impacts on the Marine Environment;
    - State of the Marine Environment;
    - Science for Integrated Marine Management.
- Development of three ‘tools’ which will strengthen the links between policy needs and research provision, and provide easier access to marine knowledge;
- Improved procedures for the commissioning and management of Marine Environment research.

This report does not mark the end of the review process. Policy’s requirement for evidence continues to evolve, and more work will be needed to develop the detailed content of each of the four new themes.

APPENDIX 1: Executive Summaries of Stage I and Stage II Reports.

Stage I Report

The Stage I Review aimed to clarify drivers for Defra's more policy focussed Marine Environment research themes, summarise relevant research to date and identify future priorities for research.

This summary document presents a record of the discussions that took place on each of six research themes, under the following headings:
key policy drivers, research achievements, status, future needs, climate proofing, potential partners, communication, future considerations, actions, theme summary and suggestions for future research.

ME13: Emergencies. The discussions focussed on the Napoli incident and the need to learn lessons, to look at how our research helped us to respond, and to identify whether there were gaps in our knowledge. Research in this theme tends to occur only after an incident and we miss opportunities for learning from long-term monitoring of incidents, although clear end points to monitoring should be defined. The research is generic to allow us to be prepared for any emergency scenario as it is impossible to predict what response is needed for each incident.

ME11: Deposits. The Marine and Fisheries Agency and Cefas are key to determining the research needs and identifying the tools needed to provide advice for licensing. However Defra needs to be clearer on the policy goals. We have a good body of evidence on the implications of dredged material deposits and so have few research needs in this area. We should instead focus on risk assessment and modelling work. The beneficial use of dredged material can now be pushed forward as policy. We need to know what tools Cefas require to make licensing decisions for wave and tidal power.

ME21: Hazardous Substances. The research in this area is developing as expected but we should look at developing an integrated, more cost effective, approach to research. We should aim to produce more robust risk assessments.

ME22: Eutrophication. We have completed the primary research for this area but we can increase the effectiveness of our monitoring in order to reduce monitoring effort. We will keep promoting the transboundary nutrients work including working with other countries to promote our science and pressing for policies to be changed appropriately.

SM01: Monitoring and Assessment. There are still some large gaps within the monitoring programme which may require research effort, e.g. Marine litter. Generally our monitoring tool kit is appropriate but we need to determine how we assess and integrate the data it provides.

ME14: Integrated Management. We have specialist expertise in a range of research areas, and we now need to bring them together for marine planning. Effort should therefore be focused at the development end of R&D such as risk assessments and tool development.

Overall we require a more holistic approach to research, collaborating more with external organisations, with research outputs designed to have multiple uses. For this holistic approach to be successful, science and policy must work together since individually they may not appreciate the scope for better integration. This links to an overarching message emerging from the Stage I Review, that of communication and the need to improve the dialogue between science and policy.

Stage II Report

Defra's Marine Directorate is currently undertaking a fundamental review of its Marine Environment and Marine Biodiversity Research Programmes. The review is being conducted in three stages. Stage I of the review focussed on research directly related to the impact and management of human activities in the marine environment (see Stage I Review Report). Stage II, which is reported on here, evaluated research undertaken within three closely related programmes, "Ecosystem, structure and function" (ME31), "Environmental processes and pathways" (ME32), and "Marine Biodiversity" (MB). The annual spend by Defra on research included within Stage II of the review is approximately £1.9m.

The aims of Stage I and Stage II were broadly to clarify present marine related policy drivers, summarise research outputs to date, and identify Defra's future evidence needs. Stage III of the review will draw together the outcomes of Stage I and II and develop a new structure for the marine research programme to ensure that the research commissioned by Defra is properly aligned with Defra's evidence needs.

The Stage II review was conducted under five session headings: development of tools; measuring state and change; ecosystem function and structure; organisation and co-ordination; and wider marine biodiversity research.

In the course of the review a wide range of marine related policy drivers, including national, European and international obligations and commitments were identified and it was agreed that many of these have shared evidence needs. For example, the Marine Strategy Framework Directive and OSPAR both need an understanding of thresholds and limits and the development of appropriate indicators. The Strategy Directive was identified as a particularly important future driver for research as it raises questions relating to the current state of the marine environment, the key components that we will need to measure (including changes that are occurring) and how to measure these costs effectively.

A small team of independent evaluators attended the Stage II review to help assess progress to date and recommend future direction and focus of the programme. The conclusions reached by the evaluators included:

- Defra's research programme has and continues to contribute to an understanding of marine biodiversity and the ecosystem. For example, there is a strong knowledge base of the effects of stresses, especially contaminants, on

organisms and the effects of climate change on population size, distribution and reproductive cycles;

- Research has contributed to a range of policy areas with some outputs considered "ground breaking" research, for example the development of indicators of diversity. Nevertheless there is a clear need to strengthen policy interaction with the research providers, particularly at the outset and conclusion of the research. Policy requirements for research need to be clear at the outset, and the communication of results needs to be enhanced to ensure the proper flow of information from research to the policy community;
- There is a need for a clear statement of priorities against the identified policy areas to be developed;
- A lack of involvement of social, economic and cultural research was observed. It is essential to link with the natural science to achieve practical and operational ecosystem management; and
- There remains considerable confusion among the research community as to what the term "ecosystem approach" actually means. Because of the scale of the research challenge associated with the "ecosystem approach" it is important that Defra works with other research funders, and that they in turn benefit from Defra's own limited research investment.

Some 30 research questions were identified by attendees during the course of the review. These were brigaded under five broad headings which mirror the policy cycle followed by Defra. The headings cover the fundamental context of research; development of models, methodologies and tools and evidence; monitoring progress towards targets; optimising decisions and implementation; and monitoring progress and evaluation. An important conclusion was that the current research programme focuses on natural science with little research on the social and economic aspects of the marine environment. This will need to be addressed in the future programme.

Many of the research needs identified by the review for marine ecosystem and biodiversity policies are broad in their scope and will need to be defined more tightly and prioritised by Defra. To help this process, prioritisation of drivers will need to occur. The associated evidence needed to support policy delivery will then need to be identified. Ecosystems and biodiversity are acknowledged as challenging areas for science and Defra needs to co-ordinate its research efforts with those of other funders in the UK, particularly with NERC. Coordination with European funders will also be important.

A high priority identified during the course of the review was to improve communication between researchers and policy, as well as the need to communicate outcomes to the wider public.

Recommendations emerging from the review covered three main areas: policy, for example, the need to list and prioritise policy drivers and the need to develop "road maps" to deliver evidence; programme management, such as formulating closer links between Defra and NERC to help maximise opportunities for joint funding; and project management initiatives to ensure clear explanations on how project proposals will deliver evidence, active engagement with policy during the life of a project, and the development of a communications strategy for longer running projects.

The output from Stage II will be considered in detail by Defra and will be used together with the Stage I outputs to define the future shape and content of the new Marine Environment and Marine Biodiversity programme. This will be taken forward in Stage III.

APPENDIX 2: Members of the Defra Review Group

The Review Group had the following membership:

John Lock, MFScU (Chair)
Jo Myers, MFScU
Stephen Malcolm, Cefas
David Garner, MFScU
Caron Montgomery, MFScU
Andrea Leadale, MFScU
Helen Davies, MFScU

The following provided help and advice during Stage III of the Review:

Simon Jennings, Cefas
Stuart Rogers, Cefas
Darius Campbell, Defra Marine
Richard Moxon, Defra Marine
Naomi Matthiessen, Defra Marine
Kirsty Inglis, Defra Economist

Stage I and Stage II attendees are listed in the reports.

Members of the Stage II external evaluation team:

Ed Maltby	University of Liverpool (Chair)
Jean-Claude Dauvin	Université de Sciences et Technologies de Lille
Paul Tett	Napier University
Paul Kingston	Heriot-Watt University
Martin Solan	University of Aberdeen
Mike Burrows	Scottish Association for Marine Science
Mike Kaiser	University of Wales, Bangor
Ian Joint	Plymouth Marine Laboratory