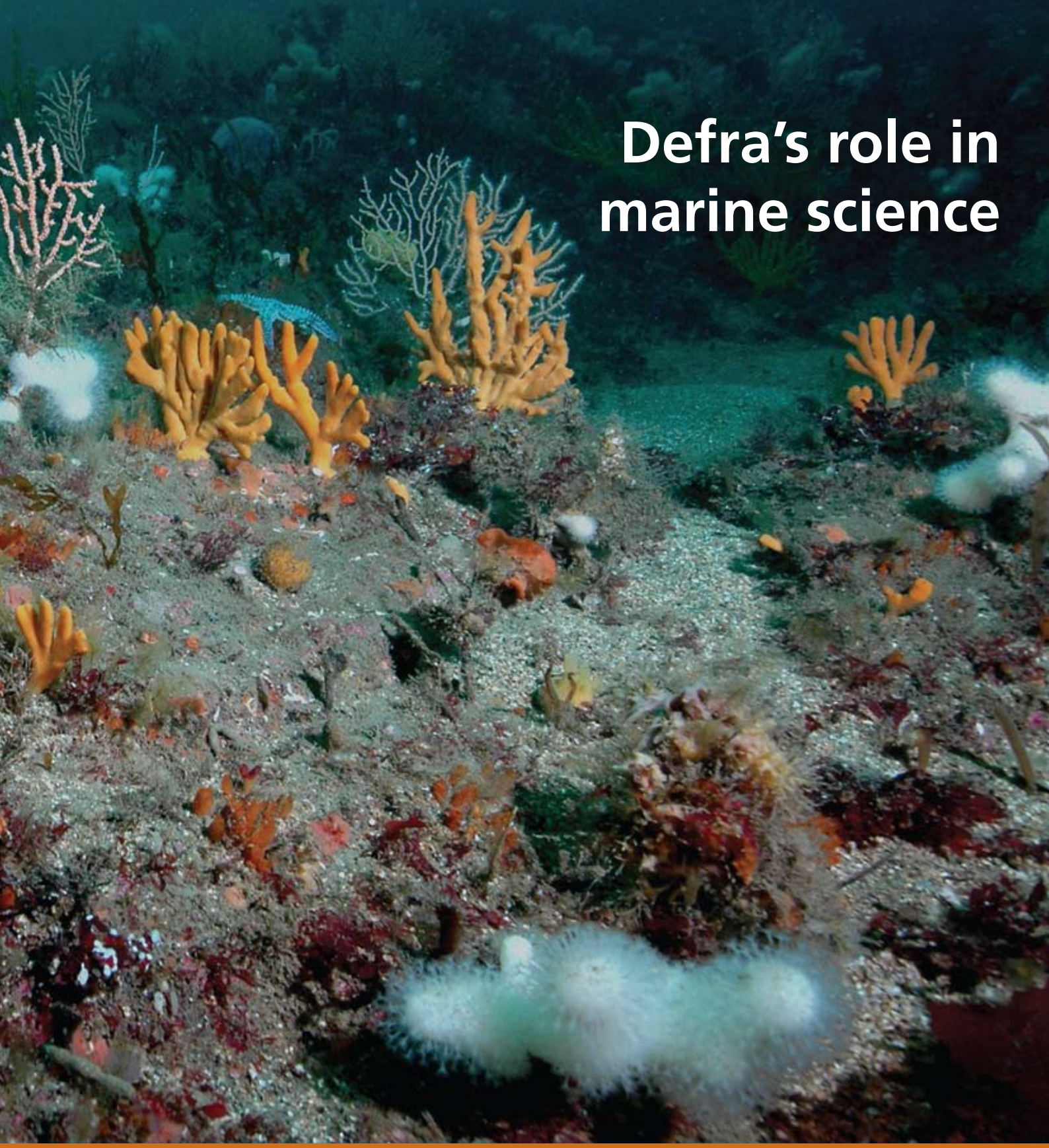


Defra's role in marine science

defra

Department for Environment
Food and Rural Affairs

The Government's vision is for **clean, healthy, safe, productive and biologically diverse oceans and seas**

Kelp forest with sponges

Foreword

Our seas are of immense value. They regulate our climate and provide us with resources, as well as being home to over 8000 species of animals and plants. These range from beautiful corals to commercial fish stocks. The scale and variety of activity in our seas and the complex backdrop of national and international policy drivers for our decision-making require a strong evidence base for us to be sure that we are making the right decisions – not just for now, but for the future. Marine science plays a key part in providing that vital evidence. As we face serious challenges such as climate change, ocean acidification and depletion of some fish stocks, marine science has become even more important to us.

Through our marine science we seek constantly to improve our knowledge of how our seas function, how our activities impact on them and how to manage activities ranging from fishing, to the development of renewable energy, to the storage of carbon dioxide under the seabed. We monitor changes in our seas, investigate causes and effects and ensure that scientific data is available to, and understood by, policy-makers.

Our marine science must be high quality and credible so that Government Departments, international organisations, our stakeholders and the public can have confidence in it. Defra supports Cefas (Centre for Environment, Fisheries and Aquaculture Science), its executive agency, to deliver much of the research evidence needed for policy development, both nationally and internationally. We also work with a wide range of other centres of scientific expertise including universities and national and international organisations. We will be making sure that the Marine Management Organisation, being set up under the Marine and Coastal Access Bill, has access to, and uses, good quality marine science.

We welcome working with everyone with an interest in marine science. If you have research ideas you'd like to explore with us just contact Defra's Marine and Fisheries Science Unit (see page 24).

Huw Irranca-Davies MP
Minister for the Natural and Marine Environment,
Wildlife and Rural Affairs

Why we need marine science

Defra's marine stewardship report, *Safeguarding our Seas*[1], recognised that the UK's marine area is a vast but not a limitless resource. It set out the Government's vision of 'clean, healthy, safe, productive and biologically diverse oceans and seas'. Delivering this vision requires regular updating of our knowledge on how the seas function and how human activities impact on them.

Charting Progress[2], the first UK-wide integrated assessment of the state of the UK seas, published in 2005, outlined our current knowledge on the state of the seas. This was the basis for our understanding on how to deliver the Government's vision for the seas. However, our knowledge on how the seas function and how they are affected by human activities is being regularly updated and improved. Monitoring and assessment play a vital role in providing and evaluating the evidence to demonstrate that the Government's vision is being achieved and to underpin the environmental framework used to manage the seas.

There are recent and emerging international, European and national marine-related policy drivers which are changing the shape of the marine science programme – all aiming to manage human activities to protect the marine environment (see page 25). Key policy drivers include:

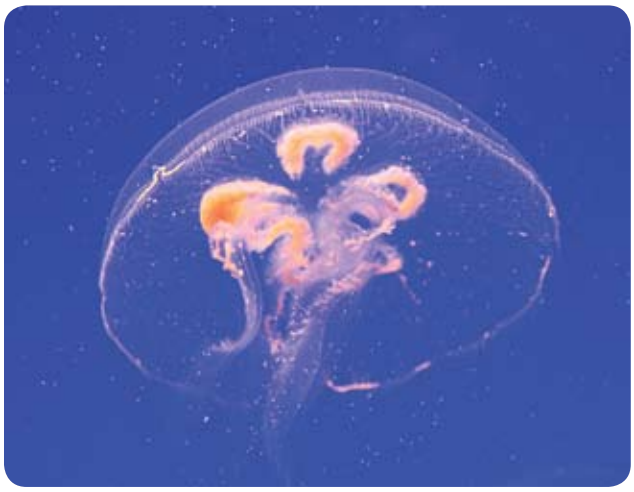
- the commitment by the EU and Member States at the **World Summit on Sustainable Development** (Johannesburg, 2002) to maintain and restore fish stocks to levels that can produce the maximum sustainable yield by no later than 2015, and to establish representative networks of marine protected areas by 2012.

***Brown seaweed (dabberlocks)* with dense anemones and sponge crusts**

1 *Safeguarding our Seas*. A strategy for the conservation and sustainable development of our marine environment, 2002, see: www.defra.gov.uk/marine/environment/stewardship.htm

2 *Charting progress. An integrated assessment of the state of UK seas*, see: www.defra.gov.uk/marine/science/monitoring/stateofsea.htm

- ***Fisheries 2027 – a long-term vision for sustainable fisheries***[3] published in October 2007. The marine fisheries research and development programme was re-structured in 2007 to align it more closely with the current and emerging policy priorities arising from *Fisheries 2027*.
- the high level **Marine Objectives**[4] in *Our seas – a shared resource* published by Defra and the Devolved Administrations in April 2009, following consultation last year. One of the objectives relates to 'using sound science responsibly'.
- the **Marine and Coastal Access Bill**[5], which was introduced into Parliament in December 2008. It will help develop and implement the planning framework and regulation for the sustainable use and protection of our marine environment. It will also help to deliver our Marine Objectives. Research will provide evidence for planning decisions, for example the siting of marine protected areas.
- the European **Marine Strategy Framework Directive**[6], adopted in July 2008. This Directive requires Member States to put in place measures to achieve 'good environmental status' in their marine waters by 2020. It poses significant challenges for marine science, including the need to understand essential characteristics of the marine environment; to analyse pressures and impacts of human activity including physical damage, contamination by hazardous substances, release of substances and nutrient enrichment; and to assess the economic and social use of the marine environment. This understanding is needed for us to develop a set of characteristics and targets that describe 'good environmental status' and to identify measures to help achieve or maintain 'good environmental status'. Marine science will also help us to define precisely what we mean by implementing an ecosystem approach to managing the marine environment.
- meeting **obligations under OSPAR** (Oslo and Paris Convention for the Protection of the Marine Environment of the North-East Atlantic) and the European Water Framework Directive 2010. The marine science directed towards the needs of the Marine Strategy Framework Directive will also help us to demonstrate the extent to which our seas and coasts are achieving good environmental, ecological and chemical status for OSPAR and the Water Framework Directive.



Mark James, FRM Ltd.

Jellyfish *(Aurelia Aurita)*

3 *Fisheries 2027– a long-term vision for sustainable fisheries*, see: www.defra.gov.uk/marine/fisheries/policy.htm

4 *Our Seas – a shared resource. High level marine objectives*, see: www.defra.gov.uk/marine/environment/policy.htm

5 Marine and Coastal Access Bill, see: www.defra.gov.uk/marine/legislation/index.htm

6 Marine Strategy Framework Directive, see: www.defra.gov.uk/marine/environment/policy.htm

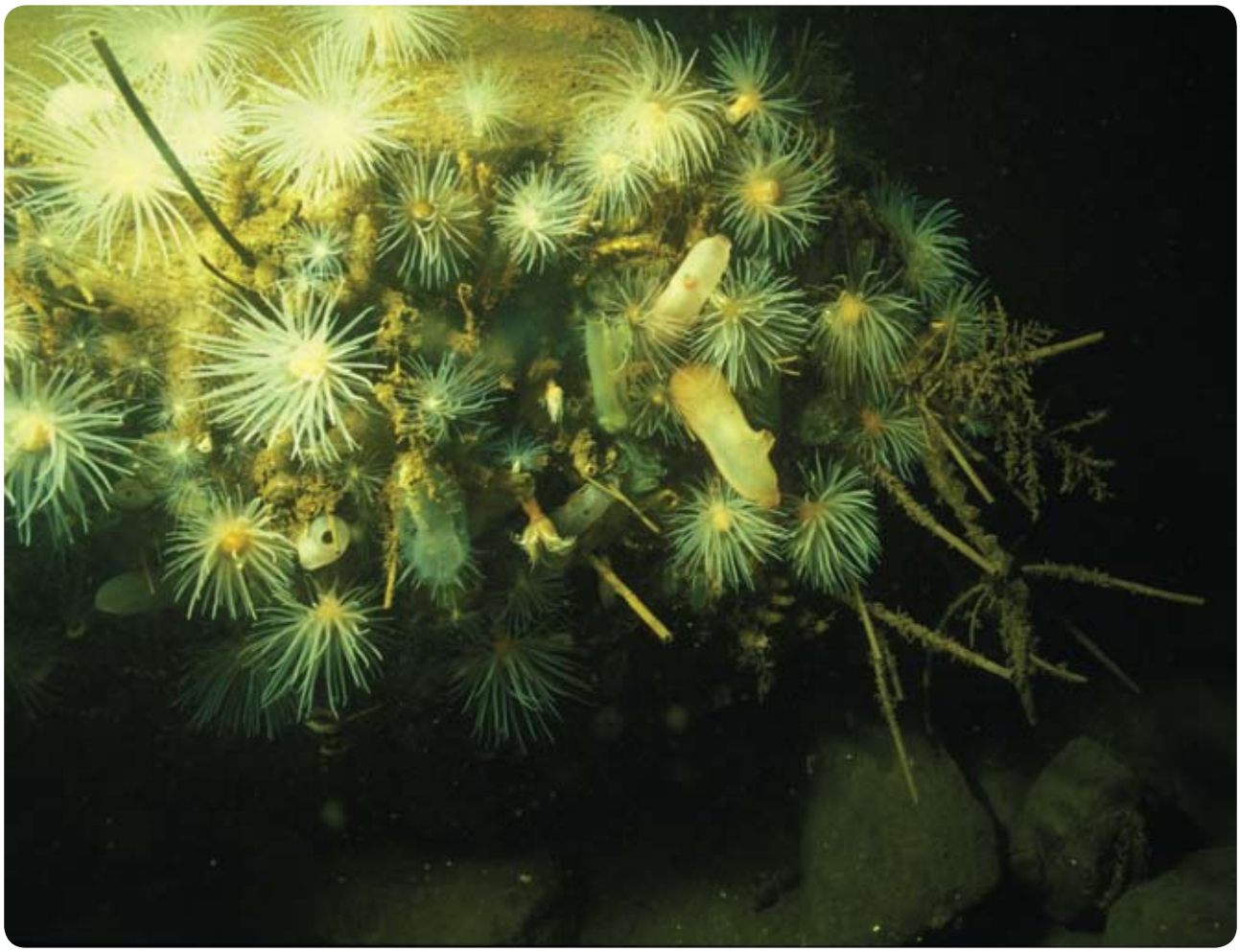
Defra's marine science programme

Defra is a major supporter of marine science, spending approximately £37m in 2008/09, increasing to an estimated £42m in 2009/10.

As a customer for science, Defra has in-house scientists who manage the science programmes and ensure that there is a comprehensive interpretation of the results and uptake into policy. These scientists also use interpretation and communication skills to convey results to other stakeholders and the wider public.

Defra set up a Marine Fisheries Science Stakeholder Advisory Group in 2006 to communicate its science activities to a wide range of stakeholders and seek views on future research. The remit of the Group is now being extended to include marine environment science.

The marine science programme is split between monitoring and advice (non-R&D) and research and development (R&D).



Domonicc Counsell, JNCC

Anemone (*Protanthea simplex*) and Peacock worm (*Sabella pavonina*) on boulders

Monitoring and advice

Defra sponsors a wide range of monitoring programmes which are needed to assess the impact of human activities on marine ecosystems so they can be effectively controlled, and to understand how the broader marine environment functions and how it changes over time. Specific monitoring programmes are also required by various European Commission Directives and international organisations.

Defra spends approximately £26m of its current marine science budget on monitoring and advice which is essential for maintaining an up-to-date assessment of the state of our seas and the effectiveness of our management policies. The main areas are:

Marine environment including the monitoring and assessment of hazardous substances, nutrient enrichment and scientific advice, marine monitoring and *Charting Progress 2*.

Marine and freshwater biodiversity including whaling, cetacean bycatch monitoring, Marine Conservation Zones and salmon and freshwater fisheries.

Marine fisheries including stock assessment surveys, biological sampling, discard monitoring, the Fisheries Science Partnership and management advice.

Marine and Fisheries Agency including scientific advice and monitoring, covering sediment sampling, dredging impact, renewable energy, mineral extraction and FEPA (Food and Environment Protection Act 1985) licences related to construction and disposal, as well as the provision of information technology.

Fishing industry management including aquaculture advice and EU data collection related to aquaculture.

Fish disease specialist at work

Co-ordination of marine monitoring and data handling

Marine monitoring is co-ordinated through the UK Marine Monitoring and Assessment Strategy and *Charting Progress 2*.

UK Marine Monitoring and Assessment Strategy

The UK Marine Monitoring and Assessment Strategy (UKMMAS[7]) was set up in 2005 in response to recommendations in *Charting Progress* that a more co-ordinated and integrated approach to marine monitoring and assessment was needed. UKMMAS publishes regular assessments of the marine environment. It has about 250 stakeholders, including Government agencies and non-departmental public bodies, working at various levels within its structure, and with representatives from the Devolved Administrations being fully engaged at each level.

The high level Marine Assessment and Policy Committee (MAPC) provides policy direction, secures funding and defines monitoring requirements for an implementation group – the Marine Assessment Reporting Group (MARG). A number of evidence groups pull together up-to-date data on all aspects of the sea to understand how clean and safe it is; how healthy and biologically diverse the ecosystem is; the economic and social use of the sea; and the larger ocean processes driving our seas.

Key aims for the UKMMAS groups are to:

- provide long-term documentation of the status and trends of ecosystem quality and understanding and assessment of the role of oceans in the Earth's climate system; and to provide indicators of ecosystem state;
- meet the need for monitoring to provide operational forecasts of the marine and ocean environment;
- improve scientific knowledge across disciplines and at a range of scales to underpin management of the marine environment;
- co-ordinate monitoring activities across the marine community;
- establish a range of marine objectives and indicators, to complement existing management commitments;
- ensure that data sets are properly disseminated, archived and accessible for re-use;
- encourage contributions from all stakeholders (scientific and technical community, non-governmental organisations, industry); and
- ensure that long-term time series are maintained.

UKMMAS is currently involved in preparing *Charting Progress 2*.

7 UKMMAS, see: www.defra.gov.uk/marine/science/monitoring.htm

Charting Progress 2

Charting Progress 2 – the second integrated assessment of the state of UK seas – will provide extensive information on developments since the first report in 2005 and the pressures and impacts on the marine environment. It will place the work within the wider political, social, economical and environmental context. There will be a dedicated chapter on the impact of climate change on our seas, highlighting current gaps in our knowledge and recommendations for mitigation measures.

Over £1m has been invested in the preparation of *Charting Progress 2* and considerably more funding is expected to be committed in the 2009/10 financial year. The report is currently scheduled for publication in May 2010 and will be a key tool to inform policy-makers throughout the UK and highlight priorities for the Marine Management Organisation.

The evidence used to compile *Charting Progress 2*, its findings and the results of the various assessments will form an important building block in the initial assessment of UK waters which must be delivered by 2012 to meet our commitments under the Marine Strategy Framework Directive. Under this wide ranging Directive we will need to work with our European partners to understand the marine environment, and human impacts on it, at the regional scale. The Directive also requires us to develop monitoring programmes to measure progress toward achieving 'good environmental status' and review both our initial assessment and our monitoring programmes every six years. This also enables us to monitor our broader marine environment policies. *Charting Progress 2* will form the backbone of our first initial assessment and will give a provisional indication of the extent to which we are already meeting the aims of the Directive and other marine policies, and as well as flagging up gaps in evidence so that our monitoring programmes can be adjusted to meet the Directive's requirements. UKMMAS is expected to play a key role in delivering the monitoring and assessment needs of the Directive in the future.

The UK Government is also currently preparing its submission for the OSPAR Quality Status Report in 2010. This is a comprehensive report on the status of the north-east Atlantic. To ensure efficient use of limited resources, those assessments produced for the OSPAR for its report will, where possible, be used to inform the preparation of *Charting Progress 2*.

Water sampling on *Cefas Endeavour*

Marine data

The Marine Environment Data Information Network

The Marine Environment Data Information Network (MEDIN) was set up in 2007 to improve access to and management of UK marine environmental data and information. This is to ensure that all marine stakeholders can have an understanding of what data is available from various organisations holding marine data.

The work of MEDIN continues the earlier activities of the Marine Environmental Data Action Group (MEDAG) and Marine Data and Information Partnership (MDIP[8]).

The MEDIN programme has several work streams. These still are being developed and will include:

- providing a network of marine data archive centres for secure long-term storage of marine data. The network will provide the capability to upload data into, and to retrieve data from, the data archive centres. Data contributors will have free access to their data managed within the framework;
- establishing, promoting, documenting and providing guidance for standards for data and metadata to cover an expanding range of data types;
- developing and maintaining a universally recognised marine portal to provide a search, evaluation and retrieval capability across current marine data and information;
- co-ordinating the UK input to the development of international data commitments and drivers that may influence marine data management in the UK (e.g. the EC Directive on an Infrastructure for Spatial Information in the Community, the Water Information System for Europe (WISE), the Intergovernmental Oceanographic Commission (IOC) of UNESCO and the International Council for the Exploration of the Sea (ICES) data policies); and
- developing research and application development, communications and improving co-ordination.

The implementation of the MEDIN framework is carried out by partners in working groups. Sponsors supporting the programme, which costs more than £700k a year, include Defra, the Scottish Government, the Department of Agriculture and Rural Development, Northern Ireland, the Natural Environment Research Council, the Meteorological Office, the Environment Agency, the Countryside Council for Wales, the Maritime and Coastguard Agency, the UK Hydrographic Office, the Crown Estate, the Ministry of Defence, Seazone, the Joint Nature Conservation Committee, the Northern Ireland Environment Agency and HR Wallingford.

Current work on exchange of data within Government Departments

Defra approached the Maritime and Coastguard Agency last year offering to participate in a more formal agreement for co-operative working. Since then both organisations have worked

8 Marine Data and Information Partnership, see: www.oceannet.org/mdip/index.html

together to draw up a Memorandum of Understanding covering bathymetric survey data and data gathering. The two main aims of the Memorandum are to:

- exchange existing (from 2003) and future multibeam echosounder data and backscatter data between the participating organisations at no cost; and
- ensure that participating organisations' future surveys are programmed to avoid duplication wherever possible, by setting up a forum to exchange information on future survey plans.

The Memorandum represents a significant step in increasing offshore survey efficiency for Government organisations. It is in circulation for signature by Defra, the Maritime and Coastguard Agency, Cefas, JNCC (Joint Nature Conservation Committee), Natural England, the British Geological Survey and the United Kingdom Hydrographic Office.

The Memorandum encourages the 'collect once, use many times' view and the sharing of plans and marine survey data at no charge. It demonstrates that partnerships can be developed to promote data exchange. Outside this Memorandum, United Kingdom Hydrographic Office data (excluding third party data) is accessible under the Freedom of Information Act 2000 and the Environmental Information Regulations 2004 and is made available for re-use by licensing.

Deploying camera sledge from *Cefas Endeavour*

Research and development

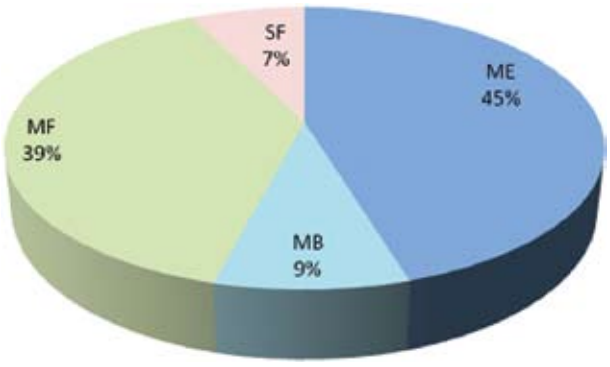
Apart from monitoring and advice, Defra spends approximately £11m on research and development (R&D) which helps interpret the results of the monitoring programmes and assists us in adopting and developing appropriate management measures. In addition to funding the more specific policy-related research, we also commission strategic research which helps us, for example, to understand long-term variability in the marine environment, climate change and ecosystem structure and function.

The marine science R&D programme has four separate but linked research areas:

- sustainable marine environment (ME)
- sustainable marine fisheries (MF)
- marine biodiversity (MB)
- conservation of salmon and freshwater fish stocks and whales (SF).

A database of current projects in these four areas is on the Defra website[9].

Figure 1: The split of the budget between the four research areas



9 Defra's Research Projects, see: www.randd.defra.gov.uk/

Programme development and quality assurance

Defra commissions marine science primarily to provide evidence for policy development. We ensure that the science programme is fit for purpose, robust, good quality, and delivers the necessary evidence through measures including:

- individual research programmes usually being reviewed every three to five years, a process involving external experts to help us assess programme progress and set future priorities; and

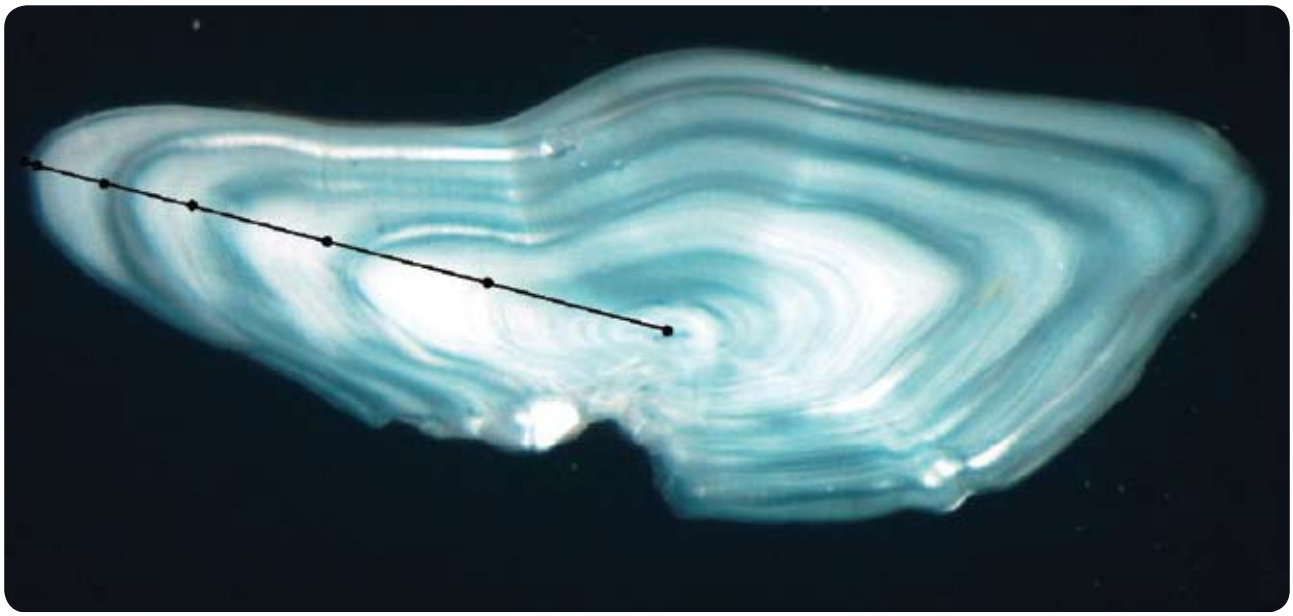
Parasitologist at work

- a vigorous process of peer review, including evaluation of project proposals and final reports. Open competition in some research areas helps widen our contractor base.

We have recently completed a comprehensive review of Defra's marine biodiversity and marine environment research programmes to ensure our research is properly aligned to the Marine Objectives and the Marine Policy Statement which will articulate the Government's shared vision, objectives and policies for the marine environment. Following consultation with the scientific community, a new programme structure is being created for research in the sustainable marine environment area, developed around four key themes:

- economic and social research in the marine environment;
- human pressures and impacts on the marine environment;
- state of the marine environment; and
- science for integrated management.

The programme structure is designed to link directly with the Marine Objectives, and the research evidence emerging from the four themes will help answer the key challenges set by the Marine Strategy Framework Directive.



Cod otolith (earstone) showing annual growth zones

National and international collaboration

Since budgets are finite and the seas are vast, collaboration with other funders of marine science within the UK and internationally is essential. There are wide and diverse mechanisms in place to ensure that there are good links between Defra's marine research programme and other funding bodies' programmes. Examples of significant collaboration include:

- ***Charting Progress*** (see page 4), co-ordinated by Defra, which drew on scientific evidence from nearly 60 organisations across the UK. Following this, Defra has taken a leading role on three UK-wide collaborative partnerships on marine data: UKMMAS (see page 8); the Marine Data and Information Network and UK Marine Climate Change Impacts Partnership (MCCIP[10]).
- the **Marine Climate Change Impacts Partnership** (MCCIP) which promotes adaptation to marine climate change impacts. Defra has taken the lead on understanding the impacts of climate change on the marine environment. The Partnership aims to provide a co-ordination framework for the UK. It will enable the transfer of high quality evidence on marine climate change impacts, and related advice, to policy advisers and decision-makers. MCCIP draws on the output from a vast array of R&D and modeling for its impact assessment. It acts as a focal point for evidence and enables the UK to plan for the challenges and opportunities presented by the impacts of climate change in the marine environment. The first example of this is the Annual Report Card launched in November 2006. This is a high level assimilation of related UK marine science knowledge in an accessible format for policy advisers and decision-makers.
- the **European Global Monitoring for Environment and Security** (GMES)[11] programme for which Defra acts as UK co-ordinator. A significant part of this programme involves remote sensing of our seas using satellites.
- Defra working with **Research Councils**, including the Natural Environment Research Council (NERC) and the Economic and Social Research Council (ESRC), which support high quality, strategic research potentially of use to Defra. We are seeking to develop our links further with Research Councils to increase the value of their programmes for policy. For example as part of NERC's Oceans 2025 programme Defra, NERC, Fisheries Research Services (part of Marine Scotland, which is a Directorate of the Scottish Government) and the Agri, Food and Biosciences Institute developed a collaboratively funded research programme: 'Sustainable Marine Bio-resources'.

10 Marine Climate Change Impacts Partnership, see: www.mccip.org.uk/default.htm

11 European Global Monitoring for Environment and Security, see www.GMES.INFO/

- funding **ocean observations**, which are important for the detection, monitoring and attribution of climate change and the validation and further development of models. Observations funded by Defra include instruments on the satellite ENVISAT[12] (for measuring sea surface temperatures with the accuracy necessary to detect climate change) and ARGO[13] (Array for Real-Time Geostrophic Observations), a global network of profiling floats funded by over 20 nations worldwide. The UK component of ARGO is provided by Defra and other UK partners.
- internationally, the European Commission funded the **ERA-NET** (European Research Area Network) scheme, in which Defra is an active participant. For example, we co-ordinate the MariFish ERA-NET[14] which brings together funders from 16 different European countries. **MariFish** aims to exchange information on current R&D programmes, enhance co-ordination between fisheries research and other disciplines, and develop and commission shared research programmes. The total annual fisheries science budgets for all the partners is about €190m, and there are clear advantages for partners working together on common research areas. MariFish is now developing five collaborative programmes which bring together existing research to achieve added value and avoid duplication. Defra is leading on a programme of discards and gear research, involving 14 other European partners. Also, MariFish partners have provided funding (€4.1m in total from nine partners) for a joint call for research to develop fisheries management indicators that will help to develop long-term management plans for sustainable fisheries.
- other relevant ERA-NETs, in which Defra is involved, include **AMPERA** on accidental marine pollution which brings together funders from eight different European countries. AMPERA's aims include: setting research priorities, linking research with mitigation, and improved co-ordination of national/regional research programmes. We will also be working closely with European partners in the development of the new **SEAS** ERA-NET which will provide a framework for closer collaboration at both a national and a regional scale. Researchers will be able to work across national boundaries to tackle key fishery issues at an ecosystem level, sharing data and providing a wider picture than any single national project could achieve. Through these ERA-NETs Defra is able to access results emerging from research funded across Europe, and to participate with our European partners in jointly funded projects.

12 ENVISAT, see: www.esa.int/esaEO/SEMWYN2VQUD_index_0_m.html

13 ARGO, see: www.argo.net/

14 MariFish ERA-NET, see: www.marifish.net/

- **European Commission funded research** programmes, in which Defra encourages its contractors to participate. For example, in 2006 Cefas was involved in over 30 Framework Programme projects, all of which received matched funds from Defra. Projects involve collaboration with many other research institutes. For example, a project evaluating management tools involved 28 partners from more than 10 countries.
- **key international bodies**, in which Defra is an active participant and supporter, such as the International Council for the Exploration of the Sea (ICES) and OSPAR. Output from our science programmes provides evidence to these organisations, helping, for example, with the adoption of new detection and analysis techniques for pollutants and production of the overall Quality Status Reports. Cefas scientists work jointly with scientists from other Member States to assess fish stocks, leading to the setting of annual fishing quotas by the European Commission.

Devolved Administrations and other Government Organisations

Within the UK other Government Departments, Devolved Administrations and agencies also have an important role in developing marine policy. They too require scientific evidence and Defra collaborates closely with these science funders, including the Department for Business Enterprise and Regulatory Reform, the Department of Energy and Climate Change, the Environment Agency, the Maritime and Coastguard Agency, Natural England, and JNCC (the Joint Nature Conservation Committee).

Some specific examples of collaboration are:

- the **UK Management Group of Directors (MGD)**, which is a forum of the directors of the UK Government-funded fisheries science laboratories (Fisheries Research Services, Cefas and the Agri-Food and Biosciences Institute), has the objective of enhancing and collaborating on marine and fisheries science matters.
- the **Aggregate Levy Fund**, for which Defra participates in the management of the marine component. The Fund comes from a levy on the extraction of sand and gravel aggregates; and in the marine environment its objective is to promote environmentally friendly aggregates extraction. Government agencies, the aggregate industry and Natural England form the steering group for the Fund.

Keith Hiscock (published on *MarLin* website)

Surveying an underboulder community

- **Department for International Development (DfID)** research funds, to which Defra has in the past had access for work on marine ecosystem services. The two Departments are working closely to tackle the international problems associated with illegal, unreported and unregulated (IUU) fishing.
- Defra's sponsorship of **Natural England and JNCC,** who are responsible for promoting nature conservation, for providing advice on marine biodiversity policy and for delivering many of the Department's policy objectives. These organisations have their own research programmes to support this work. There is no precise dividing line between what is required by the Department for developing policy and the organisations sponsored by the Department responsible for delivery. Therefore close liaison is required to ensure there are no gaps or overlaps.

Co-ordination of marine science in the UK

As part of its response to the House of Commons Science and Technology Committee's report *Investigating the Oceans*[15], the Government established the Marine Science Co-ordination Committee in 2008. The Committee is composed of senior representatives of the Departments funding marine science and the key research providing bodies – with three non-executive members to be appointed later in the year. The Committee is co-chaired by Defra's Marine Programme Director and his Scottish counterpart. The Committee will be reporting to a group of Ministers (represented on the Committee) chaired by Defra's Minister for the Natural and Marine Environment, Wildlife and Rural Affairs in the role of 'UK Minister for Marine Science'.

UK Marine Science Strategy

The main focus of the Marine Science Co-ordination Committee's work during 2009 will be the development of a UK Marine Science Strategy. The Strategy will help deliver the evidence needed to fulfil the UK's Marine Objectives and other policy drivers. The UK Government's interest in marine science is very broad, ranging from 'Blue Skies' research by NERC and university teams, through to applied research and monitoring which provides the evidence used by Defra and other Government Departments to support policy development. The Strategy is expected to include proposals for working more closely with others in Europe, to help provide the necessary evidence at the regional scale.

Ken Collins (published on the *MarLin* website)

Diver surveying mounds of *Sabellaria*

15 *Investigating the Oceans*, see: www.publications.parliament.uk/pa/cm200607/cmselect/cmsctech/470/470i.pdf

UK key players in marine science

The Pugh and Skinner analysis (2002)[16] provided a useful snapshot of what was being spent on marine science, covering oil and gas production, tourism revenue and shipping.

At present there is no high level summary of the overall expenditure on marine science by Government Departments and such figures are often complicated by the way different Departments present their information. For example, research costs do not always include the full cost of depreciation, capital costs or land and building costs.

The Marine Science Co-ordination Committee will be considering whether an annual summary of marine science spend is a priority or whether current more targeted compilations, such as those prepared by Defra, the Scottish Government, the Agri-Food and Biosciences Institute, and the Environment Research Funders Forum Research Database, are sufficient for specific sectors. The Committee's secretariat is currently drawing together the general spend on marine science by each of its members.

Cefas

Cefas (Centre for Environment, Fisheries and Aquaculture Science) bridges the interface between science, policy and delivery. It provides evidence-based scientific advice, manages related data and information, conducts scientific research, and facilitates collaborative action through wide-ranging partnerships. These span the EU, Government and its agencies, international fora, scientific institutions and research centres, universities, non-governmental organisations and industry. Through its alliances and partnerships it is able to draw in wider scientific, socio-economic and industry perspectives.

With over 500 staff, two UK laboratories (in Lowestoft and Weymouth), its own 72 metre ocean-going research vessel (*Cefas Endeavour*), and over 100 years of experience, Cefas is the UK's largest and most diverse applied marine science laboratory providing leadership in many areas. Its applied marine and freshwater science takes in freshwater environments to the open ocean, and includes both wild and farmed fish. It has leading-edge capabilities to collect, manage and interpret a breadth of environmental, biodiversity and fisheries data to address complex issues.

Cefas Endeavour

16 A New Analysis of Marine-Related Activities in the UK Economy with Supporting Science and Technology. D Pugh and L Skinner. IACMST Information Document No 10, August 2002

As an executive agency of Defra, Cefas' work directly supports the delivery of the Department's Public Service Agreement targets and maps closely to Departmental strategic objectives. For example:

- Cefas helps **conserve and enhance the environment** as the lead adviser on the breadth of marine licensing issues ranging from aggregate extraction to offshore renewables. It also provides the evidence base to comply with international and national obligations.
- Cefas supports the **sustainable use of natural resources**. Annual surveys and assessment of marine fish stocks underpin its advice on fish quotas and stock recovery plans. Its research has shown that discards (non-targeted fish tipped back dead into the sea) can be reduced by 60-90% through use of selective fishing gears.
- Cefas **collects, interprets and manages data** to support decisions and strategic marine planning. It uses the *Cefas Endeavour* to study seabed ecology, assess biodiversity, and deploy acoustic mapping devices to create seabed maps.
- Cefas provides the base for the **Fish Health Inspectorate** (FHI) which undertakes statutory duties resulting from EU and national fish health legislation. The Inspectorate helps to protect society from the effects of aquatic contaminants and fish disease through licensing, monitoring and an enforcement programme aimed at fish and shellfish imports. Cefas also provides diagnostic functions, and disease, microbiological and toxins research, which in turn help to ensure food safety.
- Cefas provides the secretariat and produces the Annual Report Card for the **Marine Climate Change Impacts Partnership** (MCCIP) (see page 14).
- Cefas operates the **Fisheries Science Partnership** for Defra. This encourages fishermen and Cefas scientists to work together. Established in 2003, the programme provides information from commercial fishing operations on key stocks, to supplement the data used in ICES assessments; addresses issues raised by fishermen on scientific assessments or on stocks not currently assessed; and investigates new scientific methods and more environmentally friendly or selective fishing methods. Fishermen help to plan and commission specific Fisheries Science Partnership studies. Cefas provides the secretariat for the Partnership and regularly produces scientific outputs[17].
- Cefas' **scientists work jointly** with scientists from other Member States to assess fish stocks, leading to the setting of annual fishing quotas by the European Commission. Many of Cefas' fisheries research projects are linked to projects supported by the Commission.

17 See: www.cefas.co.uk/data/fisheries-science-partnership-(fsp).aspx

- Cefas enables **emergency response**, for example, when it provided advice and a monitoring programme following the grounding of the *MSC Napoli*. Cefas also confirmed the first known outbreak of the notifiable fish disease, Viral Haemorrhagic Septicaemia (VHS), in the UK. It co-ordinated the emergency response and effectively eradicated the outbreak.
- Cefas aims to promote **wider collaboration** between agencies monitoring the marine environment. For example, a new project using passive sampling for contaminants will involve a multi-disciplinary, multi-agency approach – including the Devolved Administrations and UKMMAS evidence groups – to make best use of resources and expertise, and to encourage joined-up working across previously separated monitoring communities. This project will provide evidence that demonstrates that the UK will meet the descriptors of 'good environmental status' relating to hazardous substances. It will also consider what additional measures are likely to be needed to address the risks posed by hazardous substances entering the marine environment.

Recognising the special role that Cefas has in the provision of science, Defra signed a High Level Agreement with Cefas in April 2007. This secures Cefas' long-term future. Under this agreement to support UK Government Departments, Cefas receives Defra funds over a ten-year period – approximately £30 million annually, in absolute terms. Although reducing in relative terms, this will account for over 60% of Cefas income for the foreseeable future.

As a net-running-cost executive agency, all of Cefas' work is delivered through contracts. By being commercially strong, with a clear business orientation in its delivery and a remit to exploit growing wider market opportunities alongside its work for Government, Cefas is able to build the skills that underpin its sustainable future. The margins generated from contracts allow it to reinvest in its business and science, and so maximise the value of its unique knowledge and facilities to the taxpayer.

Cefas Fish Health Inspector at work

Commitments agreed in Defra's Laboratory Strategy Programme include the development of a new fit-for-purpose office and laboratory facility.[18] We expect that staff in the current Lowestoft laboratory will move to these new premises in 2011–12.

Through the High Level Agreement and the commitments made via the Laboratory Strategy Programme, Defra benefits from continued access to high quality scientific services to support Government policy development, the maintenance of science skills and support for emergency response.

Research communities

There are several key players co-operating with Government and supplying research inputs on marine science. Some of these include:

- The **Natural Environment Research Council** (NERC)'s marine science programme tends to focus more on the 'big science' and 'Blue Skies' end of the science spectrum, compared with the more applied, evidence to policy-related science funded by Defra. NERC and Defra have recognised that there is scope for closer collaboration and are developing a joint ocean acidification research programme which will be launched in May 2009.
- The **Plymouth Marine Sciences Partnership** represents one of the largest regional clusters of expertise in marine science and technology in Europe. The Partnership is seven leading marine science and technology organisations that work closely together to optimise their knowledge and strengths to benefit the region, the UK and international communities. They are the Plymouth Marine Laboratory, the University of Plymouth, the Marine Biological Association of the UK, the National Marine Aquarium, the Sir Alister Hardy Foundation for Ocean Science (SAHFOS), the Diving Diseases Research Centre and, as an Associate Member, the Flag Officer Sea Training, Hydrography, Meteorology, Oceanography (FOST HM).
- The **National Oceanography Centre**, Southampton is a collaboration between the Natural Environment Research Council and the University of Southampton. It is one of the world's top five oceanographic research institutions.
- The **Proudman Oceanographic Laboratory** in Liverpool, which is also a part of the Natural Environment Research Council, conducts world-class research in a variety of marine areas.
- **Newcastle University's School of Marine Science and Technology**, which is the largest and broadest-based marine school in the UK, with the Dove Marine Laboratory providing 100 years of marine science and the School containing the largest and widest ranging marine academic unit in Europe. The Marine Management Organisation will be based nearby on Tyneside adding to the regional marine science base.

18 See: http://nds.coi.gov.uk/content/detail.asp?ReleaseID=208792&NewsAreaID=2&NavigatedFromSearch=True

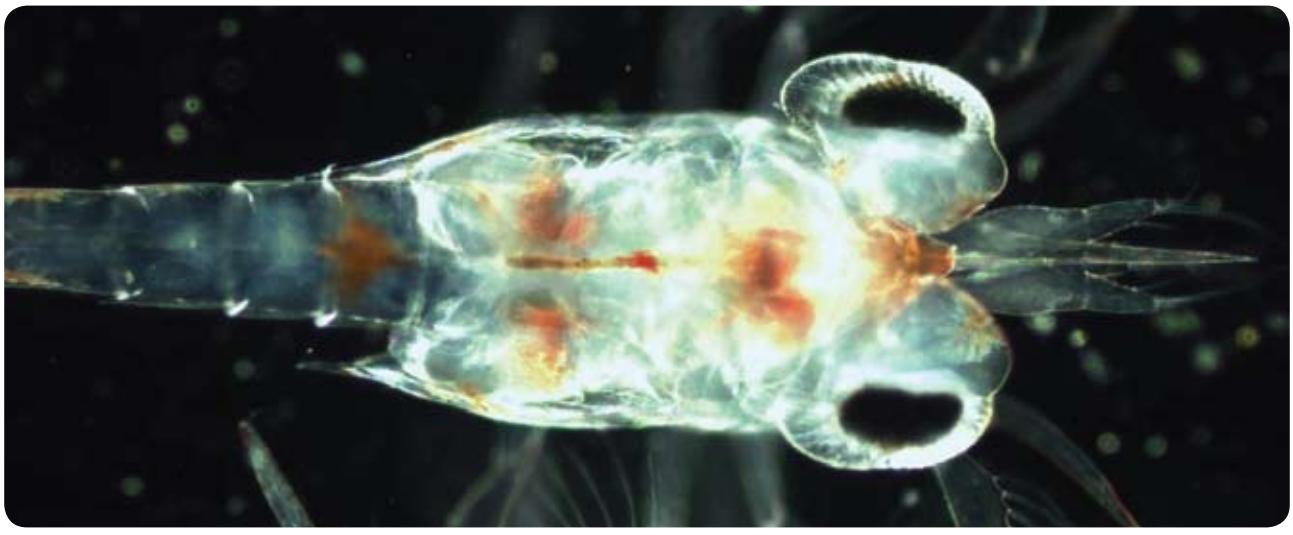
- **The Hadley Centre** models climate change, including marine scenarios.
- The **University of Aberdeen** undertakes a wide range of marine research in the Atlantic Ocean, Mediterranean Sea and Indian Ocean, as well as local work in the North Sea.
- **University of Bangor School of Ocean Sciences** is one of the largest university marine science departments in Europe.
- **University of East Anglia School of Environmental Sciences** is one of the longest and most experienced schools of environmental science in Europe and undertakes research into the biogeochemical interactions between the ocean and the atmosphere.

Support for the marine science skills base, including technology

Defra's support for the marine science skills base arises from commissioning science, rather than through the direct funding of training schemes. We draw on a wide contractor base for evidence, including Cefas, NERC's Marine Centres, universities with marine-related science teams, and consultancy companies.

Scientific skills accessed to provide the necessary scientific evidence

Defra accesses a wide range of science skills to provide the necessary scientific evidence for policy purposes. For example our assessment of ecosystem change arising from natural or human disturbance involves biologists, chemists, physicists, statisticians, geologists, engineers and socio-economic specialists. Skills in geographic information systems, ecosystem analysis, acoustic habitat mapping and stable isotope analysis all contribute to a more comprehensive understanding of ecosystem functioning. Climate change modelling provides prediction of future change, both globally and regionally and information on the future changes we can expect in the marine environment.



Karl Embleton 1999,2000 (www.Sahfos.ac.uk)

Zooplankton *(Anomura Galathea zoea)*

Future marine science challenges

Defra's Evidence and Innovation Strategy[19] identified a number of key science requirements and challenges that Defra needs to address in the coming years. Our knowledge of the marine environment as a whole is still far from complete. For example, we need to increase our understanding of ecosystem structure and functioning and its vulnerability to human impacts and climate change.

Priorities for further science are wide ranging covering biology, ocean processes, socio-economic impacts, new technologies and data management. We need to develop appropriate marine ecosystem indicators, map marine habitats, develop risk analysis frameworks, extrapolate impact from the individual to the population level, and assess social and economic costs and benefits of alternative policy options.

Budgets are finite and to meet new demands for marine science we aim to increase our collaboration with others and to seek efficiencies through the adoption of new technologies, for example where appropriate using satellite remote sensing to monitor the marine environment.

The changes we have made to the marine science programmes, the Marine Science Strategy being prepared by the Marine Science Co-ordination Committee and collaborative work with marine scientists both nationally and internationally will help Defra to meet future marine science challenges.

David Johns SAHFOS

SAHFOS' Continuous Plankton Recorder being deployed from the P&O Ferries' *Pride of Bilbao*

19 Evidence and Innovation Strategy 2005-08, see: www.defra.gov.uk/science/how/documents/Evidence-V4%20BOOKMARKED.pdf

Where to find more information

To find out more about the marine science Defra commissions see: www.defra.gov.uk/science/default.htm and www.defra.gov.uk/marine/science/index.htm
To explore research ideas with Defra's Marine and Fisheries Science Unit email: fisheriesscience@defra.gsi.gov.uk

You can find more information on the Devolved Administration's marine science programmes as follows:

For Northern Ireland see: www.afbini.gov.uk
This website has details of the Agri-Food and Bio Sciences Institute (AFBI) marine science programme, including information on its research vessel (including real-time position plotting) and information on the network of environmental sensors deployed on moorings around the Northern Irish sea loughs (this work is funded by Department of the Environment/Department of Agriculture and Rural Development/Loughs Agency).

For Scotland see: www.marlab.ac.uk
Fisheries Research Services is part of Marine Scotland, which is a Directorate of Scottish Government. It provides expert scientific and technical advice to Government on marine and freshwater fisheries, aquaculture and the protection of the aquatic environment.

For Wales: see: www.wales.gov.uk/topics/environmentcountryside/consmanagement/marinefisheries/?lang=en

For information on Cefas' marine research see: www.cefas.co.uk

For more information on marine data handling and management: see Marine Data and Information Partnership (MDIP) at: www.oceannet.org/mdip/index.html and Marine Climate Change Impacts Partnership www.mccip.org.uk

The British Oceanographic Data Centre website (www.bodc.ac.uk) is a national facility for storing and distributing data on the marine environment. It includes biological, chemical, physical and geophysical data and has measurements of nearly 10,000 different variables.

Annex 1

Key marine policy drivers of interest to Defra and/or other Government Departments

International conventions and organisations

- Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic Area (ACCOBMAS)
- Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS)
- Council of the Baltic Sea States Bergen Declaration
- Convention on Biological Diversity (CBD)
- Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention)
- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
- Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (The London Convention)
- Convention on Wetlands of International Importance, especially as Waterfowl Habitat (Ramsar Convention)
- Infrastructure for Spatial Information in the European Community (INSPIRE)
- Intergovernmental Oceanographic Commission (IOC)
- International Council for the Exploration of the Sea (ICES)
- International Convention for the Prevention of Pollution From Ships
- International Convention for the Safety of Life at Sea (SOLAS)
- International Maritime Organisation (IMO)
- International Whaling Commission (IWC)
- Intergovernmental Oceanographic Commission-Global Ocean Observing System (IOC-GOOS)
- Oslo/Paris Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR)
- The North Atlantic Salmon Conservation Organization (NASCO)
- United Nations Convention on the Law of the Sea (UNCLOS)
- United Nations Framework Convention on Climate Change/Global Climate Observing System (UNFCCC/GCOS)
- Water Information System for Europe (WISE)
- World Summit on Sustainable Development (WSSD)

European Directives

- Dangerous Substances Directive (1967 amended up to 2009)
- European Marine Strategy Directive (2008)
- European Maritime Green Paper (2006)
- Habitats Directive (1992)
- Infrastructure for Spatial Information in the Community Directive (2007)
- Nitrates Directive (1991)
- Sea Directive (2001)
- Shellfish Harvesting Directive (1979)
- Titanium Dioxide Directive (1978 – 2007)
- Urban Waste Water Treatment Directive (1991)
- Water Framework Directive (2000)
- Wild Birds Directive (1979)

National legislation

- Climate Change Act 2008
- Coast Protection Act 1949
- Conservation of Seals Act 1970
- Control of Pollution Act 1974
- Countryside and Rights of Way Act 2000
- Environment Act 1995
- Marine and Coastal Access Bill 2008
- Wildlife and Countryside Act 1981

Shooting a GOV trawl from the Cef*as Endeavour*

Cover image: JNCC (Keith Hiscock)

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