House of Commons

Science and Technology Committee

Investigating the Oceans

Tenth Report of Session 2006–07

Volume I

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The Science and Technology Committee

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The oceans are fundamental to climate and weather patterns across the world; they provide minerals, foods and chemicals; they are major sources of energy resources, in the form of both hydrocarbons for current needs and renewables for potential development; and they provide services in the form of transport, trade, communications and recreation. They also provide unquantified (or perhaps unquantifiable) services through the maintenance of biological and landscape diversity, the importance of which may only be fully appreciated by future generations. For all these reasons, the oceans need to be explored, monitored, studied and understood more thoroughly than has been the case up to now.

In 1986 the House of Lords Select Committee on Science and Technology examined marine science and technology in the UK and concluded that it was poorly co-ordinated, fragmented and underfunded. We echo those conclusions today. We have been greatly impressed by the research efforts of UK institutions and individual scientists but we have found these to be inadequately supported in terms of co-ordination and overall levels of funding. We have made many recommendations aimed at improving this process.

Our central recommendation is that there should be a new marine science agency, replacing the current inter-agency co-ordinating committee. The responsibilities of this agency should include co-ordination of marine science throughout the UK, promoting marine science education in schools, universities and to the wider public, undertaking a strategy to tackle skills shortages in marine science and technology, engaging with industry and facilitating UK involvement in international organisations. It should also take on the role of co-ordinating ocean monitoring and observations, with direct funding for operational observations where appropriate.

An important task for the new marine co-ordinating body would be ensuring the balance of research effort between the different strands within marine science. Climate change work and policy-related research into marine ecosystems and management are vitally important but this should not crowd out the opportunities for blue-skies, curiosity-driven science. A further area where we see a need for a better balance of research effort is in the crucial polar regions. Here we wish to see more effort expended in the Arctic, albeit not at the expense of the excellent work conducted by the British Antarctic Survey in the Southern Ocean.

We are concerned that there may be insufficient research vessel capacity available to UK scientists provided by NERC, especially for coastal research. Research vessels are not a luxury but a vital necessity in marine science and we recommend that NERC prepare a case for a new coastal vessel.

The Report also examines Defra's plans to establish marine protected areas under the forthcoming marine bill. We have concerns about the place of science within the designation, monitoring and objectives of these sites and about Defra's ability to deliver what is required. We recommend that Defra brings forward the draft Bill without further delay and commit to a timetable which would see the bill enacted by the end of the next parliamentary session.

Finally, and most importantly, we address the need for a new strategy to cover marine science in the UK and to form part of a wider national plan for the oceans. We recommend that the marine science strategy be implemented on a day to day basis by the new marine agency but that overall responsibility for both the strategy and the plan should be invested in a designated minister within Defra.

1 Introduction

The importance of understanding the oceans

1. The United Kingdom is an island nation that has through its history looked to the sea for its food, wealth and security. Even today, 95% of the UK's trade is sea-borne and the maritime sector has been estimated to be worth about £35 billion annually to the economy.[1] Within this overall figure are reflected the many different purposes for which the ocean is used, including transport, fishing, the exploitation of oil and gas reserves and recreation. It is vital that the oceans are studied and understood in order to sustain existing industries and to exploit newly emerging opportunities, for example, in marine biotechnology or renewable energy.

2. The importance of the oceans, however, is much wider than these national or economic interests. Many of the problems faced by the world at this time require greater understanding of ocean processes in order to help predict the future or to identify solutions. The oceans play a key role in climate change and extreme weather events. For example, the major floods of earlier this summer have been attributed to a change in the pattern of ocean currents. The experience of Hurricane Katrina and the Boxing Day 2004 tsunami highlighted the vulnerability of the growing section of the world's population who live in the coastal regions to what happens out in the open ocean. These people may also be increasingly affected by health hazards from the sea which also need much further research. In addition, there is growing awareness of a need for the oceans to be managed in a sustainable fashion.

3. It is clear that in many respects human understanding of the oceans is still in its infancy. Seventy-five per cent of the planet is covered by oceans and therefore affected by the interface between the atmosphere and the ocean; 80% of biodiversity is found in the marine environment. Yet just 10% of the ocean has been explored and only 5% of the estimated total species in the ocean have been identified. Modern technology enables scientists to explore this world in startling new detail, and the urgency of their task to increase our understanding is underscored by the seriousness of the questions which they are trying to address.

4. The UK has long experience and well-established centres of excellence in many disciplines relevant to marine science and technology. To enable the sector to reach its potential and to provide the information policy-makers need to tackle ocean-related issues, marine science in the UK needs to be properly resourced and co-ordinated.

Our inquiry

5. We announced our inquiry into marine science in the polar and non-polar oceans on 27 November 2006. Our terms of reference focussed on:

- organisation and funding of UK marine science in the polar and non-polar regions;

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- the role of the UK internationally, and international collaboration in marine science;
- support for marine science, including provision and development of technology and engineering;
- the state of the UK research and skills base underpinning marine science and provision of skills to maintain and improve the UK's position in marine science; and
- use of marine sites of special scientific interest.
- The inquiry also included study of how marine science is being used to advance knowledge of the impact of climate change on the oceans.[2]

6. We are grateful to all those who gave written and oral evidence during this inquiry. Transcripts of the oral evidence sessions are published alongside this Report, together with written evidence submitted to the inquiry.

7. Our inquiry was also greatly assisted by informal meetings and visits. We launched this investigation with a public seminar hosted by the Plymouth Marine Science Partnership and a visit to the organisations involved in that partnership. Later in the inquiry, we visited two other UK research institutes with specialisms in marine science: British Antarctic Survey in Cambridge and the National Oceanography Centre, Southampton. We also visited relevant institutions in Boston, Cape Cod and Washington DC in the United States. Finally, we visited Lisbon, Portugal to coincide with a port call of the new NERC research vessel, the RRS James Cook, on its second research cruise and met members of the Portuguese Government Task Force responsible for the co-ordination and funding of marine research in that country. Our thanks go to those who arranged and participated in all these highly informative and useful visits.

8. Our special adviser for this inquiry was Professor Laurence Mee, Director of the Marine Institute at the University of Plymouth. We are grateful to him for his advice and expert knowledge.

Relevant reports

House of Lords Report on Marine Science and Technology

9. The House of Lords Science and Technology Committee published a report on *Marine Science and Technology* in January 1986. The report concluded that "UK marine research suffers from fragmentation, together with lack of funds".[3] The Committee identified the main consequences of this as "(i) inadequate levels of funding; (ii) lack of coordination of the national research effort; (iii) absence of a forward-looking strategy as a framework for research; (iv) failure to clarify the roles and responsibilities of bodies in involved".[4] It recommended a substantial increase in funding both from the Science Vote and from

2 Press Notice No 3 of Session 2006-07.

3 Second Report from the House of Lords Select Committee on Science and Technology, *Marine Science and Technology*, HL47, Session 1985-86, para 9.1

4 Ibid

commissioned funding; the establishment of a Marine Board sited with one of the research councils to promote and direct UK marine science and technology; and a national strategy for marine research. It also called for closer civil-military links and closer collaboration between research institutes and universities.

10. In its response, the Government rejected the central recommendation for a Marine Board but accepted the case for more co-ordination between the different bodies with an interest in marine-related research. As a result, in 1988 the Co-ordinating Committee on Marine Science and Technology (CCMST) was established to "provide an essential framework of basic, strategic and applied research priorities strongly linked to technological developments and industrial need". The CCMST reported in 1990, setting out recommendations to create a national strategic framework. These included a new co-ordinating body with representation from the public and private sector, including universities. The CCMST also estimated that there would be a need for increased funding of £20–30 million to meet the objectives which it had identified in its plan. In 1991 the CCMST was wound up and replaced by the Inter-Agency Committee on Marine Science and Technology (IACMST) which excluded businesses and the universities and had a narrower remit than that envisaged by the CCMST (see chapter 4).

European Commission documents

11. In June 2006 the European Commission published a Green Paper entitled *Towards a future Maritime Policy for the Union: A European vision for the oceans and seas*.[5] The aim of the paper was "to launch a debate about a future Maritime Policy for the EU that treats the oceans and seas in a holistic way"[6] and to meet the European Commission strategic objective for 2005–09 to establish an "all-embracing maritime policy aimed at developing a thriving maritime economy, in an environmentally sustainable manner … supported by excellence in marine scientific research, technology and innovation".[7]

12. The Green Paper is a wide-ranging document, as befits the ambition of its holistic vision, covering all aspects of maritime policy. The consultation period closed on 30 June 2007 and it is anticipated that the Commission will present a Communication to the Council and Parliament at the end of 2007, summarising the results of the consultation process and proposing the way forward.[8] On 27 July 2007, the UK Government published its own response. Co-ordinated by the Department for Transport, it expressed the UK's support for "the development of a healthy, sustainable maritime economy that delivers both socio-economic benefits and environmental protection".[9] However, it expressed reservations about several aspects of the Green Paper, particularly as relates to awarding additional powers and responsibilities to the EU itself.

5 COM(2006) 275 final

6 Ibid p 4

7 Ibid p 5

8 Ibid p 48

9 Government Response to the EU Maritime Green Paper: Contribution from the United Kingdom of Great Britain and Northern Ireland on the European Commission Green Paper: Towards a future Maritime Policy for the Union: A European vision for the oceans and seas (COM(2006)275 Final) p 2

13. The Commission is already pressing ahead with the "second pillar" of its approach to maritime policy, which is to maintain and improve the status of the ocean (the first pillar is the Lisbon Strategy agenda of an integrated approach to industrial policy). This is being pursued through the proposal for a directive establishing a Framework for Community Action in the field of Marine Environmental Policy (the Marine Strategy Directive).[10] The main objective of the directive is to achieve "Good Environmental Status" in all EU waters by 2021 through the application of the "Ecosystem-based Approach", a management strategy originally developed for the Convention for Biological Diversity (ratified by the UK in June 1994). The Directive has been supported by the UK, albeit with amendments that have brought accusations of watering down by a number of NGOs. "Good Environmental Status" has been defined in very general terms in the draft Directive approved by the European Council in December 2006 and more precise definitions will be proposed by Member States for their waters (this can be linked to the Marine Bill in the case of the UK). The Directive will have profound implications for marine research and monitoring in the UK and will require greater effort and integration across sectors.

Defra policy papers

14. The Government department with lead responsibility for marine science is the Department for Environment, Food and Rural Affairs (Defra). In May 2002, Defra published a report, *Safeguarding our Seas*, which set out the Department's vision for "clean, healthy, safe, productive and biologically diverse" seas and described its strategy for the conservation and sustainable development of the marine environment. *Safeguarding our Seas* was followed in 2005 by *Charting Progress: An Integrated Assessment of the State of the Seas* which was intended to provide the scientific basis for policy development and evaluation in this area. Of particular relevance to this inquiry, *Charting Progress* highlighted "a number of gaps both in our knowledge and understanding of the seas and in our arrangements for gathering and co-ordinating information".[11] These two papers led to the formation of the United Kingdom Marine Monitoring and Assessment Strategy (UKMMAS), which aims to "to make most efficient use of UK resources, in terms of all existing obligations and to be prepared for emerging requirements, e.g. the EU Marine Strategy Directive [and to] provide us with the power to answer questions about the state of our marine ecosystem and document ecosystem trends".[12] Most recently, in March 2007, Defra published *A Sea Change: A Marine Bill White Paper* which contained proposals for legislation to provide a strategic approach to the protection and use of the marine area.[13]

Structure of Report

15. In this Report, we look first in Chapter 2 at why the world's oceans are important and need to be studied. In Chapter 3 we then examine how UK marine science is funded and organised, while in Chapter 4 we discuss whether alternative mechanisms for co-ordination are needed. Chapter 5 looks at facilities and government support for research,

10 COM(2006) 275 final, p 6; COM(2005) 505.

11 *Charting Progress*, iii

12 http://www.defra.gov.uk/environment/water/marine/uk/science/ukmas-background.htm

13 Cm 7047

including the provision of research vessels and the role of the Government's Foresight programme. Chapter 6 addresses one of the most commonly cited concerns of the marine community: the availability and sustainability of monitoring and datasets. Chapter 7 asks whether the impressive UK research effort in the Antarctic should be matched by a similar programme in the Arctic. Chapter 8 moves on to look at marine ecosystems and biodiversity, including the provision in the proposed Marine Bill for the designation of marine protected areas. Chapter 9 examines issues specific to the technology and knowledge transfer aspects of marine science. Chapter 10 turns to the health of the research and skills base and considers the place of education and outreach work within marine science. Chapter 11 acknowledges the key importance of international collaboration in investigating the oceans and how the UK contribution could be improved. Chapter 12 returns to co-ordination and whether the UK needs an overall strategy for marine and maritime affairs. Chapter 13 presents our overall conclusions.[14]

14 It is customary to include an annex of acronyms and abbreviations in reports and we have done so in this case (see after the summary of conclusions). This list is very long and includes references to many institutions, organisations and programmes which in many cases are known to the community only by these shortened forms. We have found marine science to be plagued by acronyms. Where programmes in particular are concerned, there has to be a suspicion that the acronym came before the title of the research project, but the names of organisations are also generally unwieldy. We have tried to keep our usage of shortened forms to a minimum but we apologise in advance to the general reader for the proliferation of acronyms and abbreviations in this Report.

2 Marine science

Definitions and characteristics

16. Marine science is the study of the workings of the seas and oceans, including the coastal waters, the continental shelf and the open ocean. Oceanography specialises in the latter area. Tradition has it that marine science in its modern form began with the British Government's sponsorship of the voyage of HMS Challenger in 1872, which surveyed 68,890 nautical miles across the oceans and produced a 50-volume report of the voyage and its findings. In more recent times, three factors have transformed marine science: first, the introduction of new technology, including new computer modelling techniques which have enabled it to move from being an observational discipline to one which can make predictions; second, the availability of remote-sensing data from satellites and aircraft, as well as from autonomous measuring devices that transmit their data to scientists via satellite, which enables scientists to survey vast tracts of the ocean in minutes and has revolutionised knowledge of circulation and biological processes; and third, the radical change in perspective to see the sea as part of the earth's systems, rather than as a separate hostile entity. Nevertheless, the main elements of the marine science conducted on ships—examining the composition of sea water, the movement of water, sea-floor processes and marine biological systems—would be recognisable to the scientists on the Challenger, even if the techniques for studying them and the purposes for which they have studied have changed dramatically.

17. The fundamental characteristics which mark out marine science as different from many other disciplines were usefully set out in evidence to us by the National Oceanography Centre, Southampton (NOCS). Marine science is:

- interdisciplinary in nature but critically dependent on key skills from core science disciplines (mathematics, physics, chemistry, biology and engineering);
- concerned with processes operating over a vast range of space- and time-scales (local to global; milliseconds to millennia);
- heavily reliant on national and international collaborations;
- critically dependent on major infrastructure and logistics support (e.g. ships, satellites) required to operate in the oceans;
- technology dependent (most major advances in marine science have stemmed from new technologies enabling new measurements to be made);
- in possession of a strong imperative (particularly in relation to climate change) to undertake sustained (decadal timescale) observations over ocean-basin and global scales;

- increasingly viewed within a wider Earth System context (consisting of ocean, atmosphere, cryosphere, land surface, deep earth interior), with growing interest in the couplings between the ocean system and other earth system components.[15]

We note that NOCS' list is weighted towards oceanography and that there are other issues which affect coastal seas which should be added. These include the human element, such as economics and sociology which are also core disciplines of marine science. The division of marine science into deep ocean and coastal studies is a long-standing one which needs to be addressed if a holistic approach towards marine, or indeed earth, science is to be successful.

18. The areas of marine research which are being undertaken at present and which will be needed in the future can be broken down under the broad headings of: the role of the oceans in climate systems; biological diversity, including the development of sustainable management systems; human exploitation of the oceans, including the provision of goods and services; and basic or blue skies research.

Climate systems and climate change

Role of the oceans in regulating climate

19. The oceans play a key role in regulating climate systems. The oceans act as a heat reservoir, which slows the rate at which the atmospheric temperature rises and falls. Ocean currents redistribute heat around the planet, a factor of particular importance to Western Europe. The ocean is the main source of water vapour to the atmosphere, determining the pattern of droughts and floods. It also affects cloud formation. Importantly, the ocean also acts as a major sink of natural and man-made carbon dioxide (CO_2).

Climate change

20. Changes in the temperature, salinity and acidity of the sea have occurred throughout history, as shown by core samples taken from beneath the seabed and in polar ice. However, the speed and severity of current changes in the characteristics of the ocean are, to the best of scientific knowledge, unprecedented. There is now near unanimous agreement that human activity is a key factor in these changes, but there are gaps in scientific knowledge of the exact cause-effect relationship, as well as of the processes by which it operates and the baseline against which measurements should be taken. The table below, taken from the climate change annex to EC's maritime Green Paper, sets out current developments linked to climate change and their impacts.

15 Ev 168

Table 1: Developments linked to climate change

Current development linked to Climate Change	Impacts
Increase in sea-surface temperatures	• Shrinking of the sea-ice cover in the Arctic, causing reduced albedo and additional warming of the polar lower atmosphere • Warming of deeper ocean layers, causing risks of destabilisation of methane ice on the sea bed leading to methane emissions • Thermal expansion of the ocean contributing to sea level rise • Shifts in species composition • Less CO_2 intake by oceans • Potential increased rainfall and fresh-water run-off leading to changes in water exchanges between seas areas—i.e. between the North Sea and the Baltic Sea—impacting ecosystems
Global sea-level rise	• Increased vulnerability to storm wave and flood risk and submergence (e.g. the 1 in 100 year flood factor may become a 1 in 10 year factor in the UK by 2100) • Salinisation of surface and ground waters • Morphological changes: changes in wave climate, storm waves and surges leading to greater land erosion, wetland loss, sediment loads to seas, and greater nutrient fluxes to seas. As an illustration, by 2080 estimates suggest that between 13% and 25% of the world's coastal wetlands could be lost due to sea level rise alone.
Ocean acidification	• Worldwide decline of area favourable for coral reef growth • Major changes in marine ecosystems: the base of marine food chains will be affected • The carbon dioxide absorption function of oceans may be undermined. • The impact of pollutants on biota may change as acidity is a crucial factor in influencing chemical processes.
Melting of Arctic ice	• Fresher northern waters weakening the Atlantic conveyer bringing warm waters to Western European from the Caribbean. This now looks unlikely in the foreseeable future but cannot be ruled out (some experts point to a 30% chance of cooling of Western Europe). It would of course have a major impact.

Source: European maritime Green Paper, Background Paper No. 7, pp 4-5

21. The impact and existence of rapid climate change has been recognised in the work of the Intergovernmental Panel on Climate Change (IPCC). In February 2007 it adopted a major assessment of climate change science in the form of a report on the physical science basis for climate change which was produced by around 600 authors from 40 countries, including the UK. Among its other observations, the report concluded that average ocean

temperatures had increased to a depth of at least 3000m, that there had been widespread changes in precipitation amounts, ocean salinity and wind patterns and that the annual average Arctic sea ice extent had shrunk by 2.7% per decade with decreases in summer of 7.4%.[16] [17]

Gaps in knowledge of climate change and the oceans

22. The state of knowledge regarding climate change has improved considerably in recent years as a result of concerted research effort by many nations, but evidence to this inquiry argued that there are still significant gaps in our understanding of the ocean processes as they relate to, and are affected by, climate change and in data on normal and abnormal readings. For example, IMarEST told us that "How the oceans influence natural climate variability and long term anthropogenic change and how these changes impact on the oceans are still not understood".[18] The Challenger Society agreed that there were "great uncertainties in ocean-climate linkage". The society also stressed the two-way relationship between the oceans and the climate: "Future climate change will undoubtedly affect the ocean, altering temperature, circulation patterns, sea level, ocean acidity and the distribution, abundance and productivity of marine life. However, the ocean will also affect the rate and scale of future climate change. Marine research must cover both aspects".[19]

23. The UK Government's Marine Climate Change Impacts Partnership (MCCIP), in its first Annual Report card last November, pointed to insufficient evidence on the impact of changes in, and on, ocean salinity, potential changes to storminess and waves, the effect of climate change on large scale oceanic processes, the impact on fish and marine mammals and changes to seabed ecology. The Head of Science Programmes at BAS told us that in the southern hemisphere, the uncertainties relate to carbon drawdown, how the ocean interacts with ice shelves and the way in which climate change is affecting the eco-system.[20] To this, IMarEST added that "Knowledge of the impact of climate change on [marine] commercial activities is also limited, which means we don't know what the implications of climate change are for shipping, ports, offshore structure design criteria and effects on aquaculture."[21]

16 Working Group 1 of the IPPC 4th Assessment Report, 2007

17 Estimates of the economic cost of climate change vary but all agree that the impact will be considerable. The European Commission listed factors such as increased coastal protection, adjustments in fisheries, considerable losses due to the impact on tourism and the loss of opportunities for marine research and bioprospecting.The Commission quotes figures from the Association of British Insurers which under the most extreme scenario would see the costs of flooding in the UK rise by 15 fold by the 2080s, resulting in losses of over $40 billion. There would also be loss of life due to increased heat and considerable damage to agriculture and forestry. The Munich Re Group estimated that global losses in the 1990s attributable to major weather-related catastrophes amounted to $430 billion. There were four times as many such catastrophes in the 1990s as in the 1960s. In the UK the Stern report, published in October 2006, concluded that based on the most recent scientific evidence, the dangers of unabated climate change could be equivalent to 20% of GDP or more each year. A shift to a low-carbon economy, on the other hand, could bring world-wide benefits of around £2.5 trillion each year.

18 Ev 230

19 Ev 120

20 Q 428

21 Ev 230

Research programmes

24. Our knowledge of climate change with respect to marine science depends upon: long term observations (including paleooceanography) and datasets, research into processes and accurate modelling. Looking at and recording what is there is essential for giving scientists the baselines against which to measure changes in the key climate change indicators. Process-based studies then allow scientists to investigate how ocean systems work and how changes occur. Accurate modelling, validated using data from the past, enables researchers to predict what may happen in the future. The three types of research work together to create deeper understanding of the oceans and climate change. Within this structure, there is also an important role for the study of paleo records of how the oceans coped with and responded to large changes in the past (for example, through the Integrated Ocean Drilling Programme). As UK IMAGES, one such programme, told us, "modern monitoring and modelling studies, which aim to assess potential future climate change, cannot deliver without the context of a sound understanding of past climate variability".[22]

25. There are many UK and international marine science research programmes addressing climate change. At the UK level, NERC is funding related work under all three of its current strategic priorities: earth's life support systems, climate change and sustainable economics. Examples of the questions being asked by NERC-funded researchers were set out in evidence to us.[23] Many of the large-scale programmes of research in this area are international collaborations. These include EU-funded programmes[24] and projects with wider participation[25], as well as international observation systems such as GOOS and Argo, set up to monitor the physical characteristics of the oceans.

Ocean acidification and climate change

26. The rise in atmospheric levels of CO_2 and the possible link to global warming has received much publicity but ocean acidification or the impact of rising CO_2 on the chemical balance of the oceans, has only recently been recognised as "the other half of the anthropogenic CO_2 emission problem".[26] Put at its simplest, the oceans absorb CO_2 from the atmosphere on a large scale: over half of man-made emissions of CO_2 in the last 200 years have been absorbed by the oceans. As CO_2 dissolves, it combines with water to increase slightly the acidity of the sea water. As increasingly large amounts of CO_2 become absorbed, the oceans become less efficient at absorbing the gas and at buffering the acidity. In addition, global warming may lead to less mixing of the water within the water column, with a further detrimental impact on the ocean's ability to absorb CO_2.[27] The resulting

22 Ev 115

23 Ev 179

24 The EU programmes include HERMES (Hotspot Ecosystem Research on the Margins of European Seas), MARBEF (Marine Biodiversity and Ecosystem Functioning Network), Damocles and Carboocean.

25 Examples include the NERC-led RAPID (Rapid Climate Change), WOCE (World Ocean Circulation), the Global Sea Level Observing System (an IOC/UNESCO programme, hosted by the Proudman Oceanographic Laboratory), CLIVAR (Climate Variability programme), IMAGES (International Marine Past Global Change Study) and the IODP (Integrated Ocean Drilling Programme).

26 Ev 169

27 This process is explained in detail in the memorandum submitted by the Royal Society of Chemistry, Ev 104

acidification could potentially have a significant impact on marine biodiversity, particularly on calcifying organisms which take up inorganic carbon, but also on other organisms such as phytoplankton and aquatic mammals, thus affecting the food chain as well as the climate.

27. There is much that is still unknown about the processes and possible impacts of ocean acidification. Even the extent to which it is taking place is not clear: the IACMST pointed out, for example, that "there is little evidence of observed pH changes in coastal waters, partly due to the natural variability of the region".[28] The Royal Society of Chemistry suggested a series of key research questions which have to be addressed.[29] Despite these uncertainties, all witnesses agreed that acidification is a serious problem. The Plymouth Marine Sciences Partnership have attested that "understanding the impacts [of acidification], predicting what future marine ecosystems will look like and determining feedbacks to the functioning of the Earth's life support system will undoubtedly be one of the biggest challenges for marine scientists in future decades".[30]

The oceans and the environment

28. The oceans are now known to be very rich in biodiversity with an estimated 80% of the world's species found in marine ecosystems, but there is a lack of data on many of the species in the sea and on the oceans themselves. The IACMST perceived the sparseness of "data on the biological resources of the seabed and some components of the water column" as "a major constraint on biological resource mapping" and "a major strategic issue for UK marine science".[31] Dr Vincent of the Joint Nature Conservation Council (JNCC) estimated that "in terms of biological data, we have about 10 to 15 per cent of what we actually require to take any practical action to regulate human activities in relation to the UK continental shelf waters".[32] One international project which aims to assess and explain the diversity, distribution and abundance of marine life in the oceans is the Census for Marine Life. The Census is based in Washington DC and involves researchers from more than 70 countries. Its UK partners include NERC, SAMS, SMRU and the National Oceanography Centre in Southampton. The Census aims to "assess and explain the diversity, distribution, and abundance of life in the ocean and explain how it changes over time".[33]

29. There is growing international interest in protecting marine biodiversity and marine environments more generally. The trend is towards the development of sustainable management systems based on an ecosystem approach. This is exemplified by the EU Marine Strategy Directive and by the proposed UK Marine Bill. However, there are acknowledged to be significant gaps in the science needed to underpin the formulation and implementation of policy in this area. A Defra report, *Charting Progress*, compiled "an initial list of science evidence gaps" in "understanding of the marine ecosystem and its

28 Ev 131

29 Ev 106

30 *Living in a high CO_2 world – How increased atmospheric CO_2 is affecting our oceans: What is ocean acidification?*, leaflet by Plymouth Marine Sciences Partnership

31 Ibid

32 Q 374

33 http://www.coml.org/aboutcoml

various components, how it can be defined, how it functions and what indicators are needed to see whether it is in good shape".[34] These "evidence gaps" were in areas fundamental to the ecosystem approach to managing the health and sustainability of the marine environment.[35]

30. We heard concern from several witnesses that the emphasis on the deep oceans was distracting attention from marine biology or work to underpin policy on coastal regions. The JNCC, for example, complained that "Current publicly-funded UK marine research is largely focussed on oceanographic studies", while data on marine biology was sparse.[36] This is despite the fact that, as Gardline Environmental Limited argued, "coastal and territorial waters are the location of both the greatest productivity and the greatest pressure on the marine environment from a wide range of factors including resource removal, global warming, pollution and recreational use."[37] We return to the need for a greater balance within marine research later in this chapter and discuss the application of marine research in the proposal for marine protected areas in the UK in Chapter 8.

Exploitation of the oceans

31. The European Commission has estimated that between 3 and 5% of Europe's GDP is generated by marine-based industries and services, not including the value of raw materials such as oil, gas and fish.[38] Within the UK, the value of marine ecosystem goods and services has recently been estimated to exceed £52 billion.[39] A study for the IACMST in 2002 (the Pugh and Skinner analysis) estimated the contribution of marine-related activities to the UK economy in 1999–2000 to be £39 billion or 4.9% of GDP.[40] The amount of research required to underpin development of the sectors included in this total is variable and is sourced widely: in some cases such as oil and gas exploration, fisheries or offshore renewable energy, the role of research is vital.

32. The most long-standing of all such industries is fisheries. Many communities around the world are still dependent upon fishing for their livelihoods and for food, but there are a

34 *Charting progress*, p 113

35 The gaps included: a set of tools to help demonstrate whether, taken together, the various human uses of the sea are having adverse effects on the marine ecosystem; the effects of contaminant mixtures on marine species and whether such mixtures affect the long-term viability of populations; impacts arising from changing uses of the sea such as new offshore developments of windfarms, extracting aggregates from new areas and new fishing regimes and practices; the degree of human impact that the marine environment can safely tolerate; the lack of a basic habitat map of UK waters hinders the assessment of the current ecosystem 'state' and the effects of impacts on a wider scale; natural variability of ecosystems and distinguishing this from anthropogenic pressures; longer term changes to ecosystems associated with pressures such climate change and what can be done to adapt to such changes; andthe impacts which over-fishing has on the food web and overall ecosystem stability (see http://www.defra.gov.uk/environment/water/marine/uk/stateofsea/chartprogress-chap6.pdf).

36 Ev 133

37 Ev 232

38 COM(2006) 275 final, p 3

39 Defra and PML, *Marine biodiversity: An Economic Evaluation 2006*, cited in the Government response to the EU Maritime Green Paper

40 This figure is derived from official statistics relating to the turnover of sectors as diverse as oil and gas (£20.60bn), leisure and recreation (£19.29bn), the Royal Navy (£6660m), business services such as law and insurance (£4535m), shipping industry operations (£5.2bn), ship building and repairs (£3172m), marine equipment (£2326m), fisheries (£2447m), ports (£1690m), marine environment (£1050m), marine construction (£497m), research and development (£609m), submarine telecommunications (£497m), safety and salvage (£316m), crossings (£155m), aggregates (£69m) and education and training (£48.7m).

large number of fisheries which are now accepted to be fully exploited or overexploited. Use of research within the fisheries sector is vital for management and conservation and for the development of new technologies which exploit fishing areas in a less damaging, more sustainable way. We have heard extensive comment about the destruction of marine habitats by commercial fishing and **we recommend that greater research effort be directed by UK public sector funders towards the understanding and mitigation of the impact of fishing on marine environments, and the coming Marine Bill must address this issue.**

Future exploitation

33. Increasing attention is now being focused on the ocean as a source of renewable energy, from tides, currents or waves, and a background paper to the EC's maritime Green Paper describes the marine environment as representing "a potentially vast reserve of yet under-explored natural resources".[41] However, exploitation should be approached carefully in an environment and medium which is still poorly understood.

34. An emerging area which may be highly significant in future is marine biotechnology or "blue biotech", the global market for which is forecast to grow by over 10% per annum from its current value of $2.4 billion.[42] The EC describes this area as "one of the most exciting emerging technology sectors" which will "contribute to nearly every industry sector, from healthcare to bioremediation and from cosmetics to nutraceuticals".[43] IMarEST described the sea as "a biotechnological frontier waiting to be explored"[44] and saw "potential for marine biotechnological products to be used as anti-cancer agents, for bulk chemicals such as adhesives, for feed additives for aquaculture and for remediation of environmental damage".[45] One group of microbes from hydrothermal vents has already been found to have a compound which inhibits MRSA. 90% of this group of deep-sea microbes that have been collected from deep-sea sediments are newly discovered species. This implies a rich source of biodiversity and of marine biotechnology products and applications.[46]

35. At PML we saw some interesting work involving culturing micro algae through CO_2 absorption in a photobioreactor. As well as potential application to capture carbon at point of emission, the cultured algae can be harvested and processed to produce a biofuel. This science also has potential applications in treating sewage and contaminated water. With emerging concerns about the impact of land-based feedstocks for biofuel on the price of agricultural products and the environment, this area of marine biotechnology is yet another illustration of the potential of the oceans to provide solutions to climate change issues.

41 Background paper No.8 on *Marine related research and the Future European Maritime Policy,* p 5

42 Ibid, p 5

43 Ibid

44 Ev 232

45 Ibid

46 See POSTnote on the *Deep Sea*, No. 288, July 2007

36. Research and development into marine biotechnologies in the UK is funded largely by the BBSRC, which has a special interest in marine organisms. It has also been facilitated in the recent past by the NERC-funded Marine and Freshwater Microbial Biodiversity (M&FMB) programme (2000–2005) and by one of the NERC institutes, SAMS, which has expertise in this area, including a "growing business cluster exploring for novel compounds in marine organisms".[47] SAMS observed that to exploit this field of research, they need collaboration across Europe (for example, the Marine Genomics programme) to address the low level of UK investment in the expensive analytical facilities needed for molecular biology and genetics.[48]

37. Another possible future use of the oceans might be in mitigating the impact of climate change, for example by storing carbon dioxide in geological formations under the ocean floor. Carbon capture and storage was the subject of a report from this Committee two years ago which concluded that there is significant scope for such technology to contribute both to reducing CO_2 emissions in the UK and abroad and to enhancing the security of the UK's future energy supplies.[49]. In the course of this inquiry, we heard that there are still many questions to be answered about carbon capture and storage, such as those listed by the Royal Society of Chemistry.[50] These questions will have to be addressed by scientists before carbon capture and storage can be safely adopted.

38. Finally, a "very significant growth area" identified by the IACMST is operational oceanography (ocean forecasting).[51] This was recognised in the Foresight Panel's report of 1997 which suggested that the development of operational oceanography could lead to the creation of 5000 jobs and an environmental forecasting business with an annual turnover of some £400m.[52] The markets for operational oceanography were identified as (i) the oil and gas industries, (ii) coastal zone management, operations and forecasting services, (iii) global transport, (iv) navies, (v) fisheries, and (iv) science and technology in academia and Government.[53] Dr Bell of the Met Office told us that "operational forecasting has gone up the agenda a lot in the last ten years … because it is only in the last ten years that it has been seen to be feasible."[54] A scoping study for an MSc course in Operational Oceanography has recently been completed by the IACMST, with the aim of increasing the UK skills base in this area.[55]

Blue skies research

39. Blue skies research addresses fundamental, curiosity-driven science. This is particularly important in marine science where knowledge is still at such a relatively early stage of

47 Ev 232

48 Ev 166

49 First Report from the Science and Technology Committee, Session 2005-06, *Meeting UK Energy and Climate Needs: The Role of Carbon Capture and Storage*, HC 578, Summary

50 Ev 107

51 Ev 128

52 *"Progress Through Partnership"*, 16, Office of Science and Technology, Department of Trade and Industry, May 1997

53 Ibid

54 Q 136

55 Ev 131

development. Dr Horwood of Cefas admitted that "There is a very significant list of things that needs to be done at sea. We really do not understand how the sea works at all".[56] Professor Boyd of SAMS agreed that "the deep oceans are largely a mystery to us, for example, and the microbiology in the oceans is something that is only just being unfolded".[57] At the most basic level, scientists and policy-makers need to know what is there and where it is.[58]

40. It is important that blue skies (or more appropriately, blue seas) research can continue to find funding. It is only through curiosity-driven science undertaken in the past that information is now available to measure the impact of climate change on the oceans and therefore on the earth, or to begin to understand the questions involved in studying the earth's processes. As the Marine Environment Information Centre at the UKHO pointed out, "the release of old data is useful in climate change studies but the data has rarely been gathered with that use in mind".[59] It is impossible to predict what questions will need to be answered in the future, but continuing to fund blue seas research now is likely to place scientists in a much better position to address them when they do emerge. We were therefore pleased to hear NERC's assurance that not all research has to be conducted in pursuit of a central strategy: "we need there to be mechanisms just for taking excellent proposals in any area of marine science".[60] This thinking should also apply to the other Research Councils with marine interests (EPSRC, BBSRC and ESRC).

Priorities for marine research

41. Professor Hill of NOCS observed that "there is an interesting convergence" of views on priorities for research, emerging from the EU framework programmes, NERC, the European Science Federation and the NERC marine centres' Oceans 2025 programme (see below), with "the same things cropping up time and time again": "climate, biodiversity, natural resources including bioresources and energy, the issue of environment and health and technologies".[61] The importance of climate has been recognised in the restructuring of research effort to focus on this key theme which cuts across many disciplinary boundaries. For example, NERC has moved towards a thematic approach for funding research, eschewing a marine programme for the integration of marine science within a more holistic examination of key questions. Its new strategy recognises the link between climate change and other environmental work. This is also the approach taken by Cefas, which "recently re-organised our science into thematic areas of work to give more emphasis on developing tools to assess the impact and develop methods to mitigate the effects of climate change."[62] Cefas told us that "the principal research objective of the Climate Group is to understand the effects of climate variation and change on species, communities and

56 Q 157

57 Q 371

58 Ibid

59 Ev 96

60 Q 62

61 Q 210

62 Ev 101

ecosystems and the consequences for humans, in order to improve environmental management".[63]

42. It is important that within this approach the balance is maintained between different aspects of marine science, especially between oceanography and marine biodiversity or with regard to the geographical division between the deep oceans and the coastal shelf. Marine science covers many diverse, cross-disciplinary themes, such as marine biology, marine chemistry, pollution studies, fisheries science, systems science, marine physics, marine technology, and many others. The urgency of the questions which marine science is addressing in the area of climate change, in particular, can make other research seem dispensable in comparison. It is undoubtedly true that climate change concerns have radically transformed the standing of marine science, including oceanography, as the role of the oceans becomes ever more apparent. Nevertheless, there are risks in recasting marine science as "climate change science" or even as seeing it only through the prism of informing policy on economic or environmental sustainability. The Biosciences Federation cautioned that:

> The growing focus on this topical, socially and economically relevant, and increasingly well-funded research area [of climate change] should not be allowed to further distort the UK's marine research base. Vigour and cohesion can be achieved only by maintaining various critical balances—between organismal and molecular, evolutionary and ecological, macroscopic and microscopic, nearshore and deepwater, applied and blue-skies. Imbalances and asymmetries that have developed through the last two decades have helped constrain the speed and impact of the UK's response to climate change.[64]

Natural England too expressed its concern that core research, such as taxonomy, might be "lost in the desire to fund what may appear to be novel, new and more 'exciting' aspects of investigating the oceans."[65]

43. In general, scientists and policy-makers need to understand the oceans as systems coupled to human development and activities. This should not preclude the essential building blocks, such as basic skills in taxonomy or molecular biology, for example, but they should be integrated more closely with overarching aims at various levels. Within the UK, Professor Sir David King spoke for all witnesses to this inquiry when he told us that "we have not, despite being a maritime nation, fully recognised the importance of marine science in the overall picture."[66] He added that "we will have to have a much greater focus of attention on marine science as we move forward".[67] **The world's oceans are fundamental to the continuing ability of human beings to survive comfortably on this planet, and it is vital that efforts to understand them are pursued with clarity, co-ordination and purpose, but also with an open mind as to future areas of importance.**

63 Ev 101

64 Ev 146

65 Ev 210

66 Q 505

67 Ibid

3 Funding and organisation of marine science in the UK

44. The main sources of funding for public sector marine research in the UK are the Research Councils, primarily NERC but also to some extent the Biotechnology and Biological Sciences Research Council (BBSRC) and the Engineering and Physical Sciences Research Council (EPSRC), with some relevant social science research funded by the Economic and Social Research Council (ESRC). Other funding comes direct from Government departments and non-departmental public bodies, and via private sources, such as charities or the oil and gas industry.

45. The most recent published synthesis of marine science and technology investment across the piece was contained in the Pugh and Skinner report for IACMST, prepared in 2002. This showed that in 1999-2000, the UK spent £609m on marine-related research and development. Of this, £273m (45%) was spent by Government departments and agencies, £118m (19%) in university departments and the rest, almost £220m (36%), in the commercial sector. The table below sets out the expenditure by the public sector, with figures for 1994–5 for comparison. We note that when the 1994–95 figures are adjusted for inflation, the expenditure was £303m at 1999 prices; in other words, in real terms, funding decreased by £30m over this period.

Table 2: Summary of R&D Expenditure by Public Sector 1999–2000 (£m)

	1999–2000		1994–95
Ministry of Agriculture, Fisheries and Food	10.2	Ministry of Agriculture, Fisheries and Food	8.9
Scottish Executive	4.4	Scottish Office Agriculture, Environment and Fisheries	5.2
Department of Environment, Transport and the Regions—Env	2.5	Department of Environment	2.8
Marine Safety Agency	1.4	Department of Transport	1
Environment Agency	0.6	National Rivers Authority	1.1
Northern Ireland Office	0.9	Northern Ireland Office	2.2
Ministry of Defence:		Ministry of Defence:	
Defence Evaluation and Research Agency	190	Defence Evaluation and Research Agency	168
Met Office	2.2	Met Office	3

Department of Trade and Industry	1.9	Department of Trade and Industry	10.5
NERC	51.2	NERC	52.2
Department for International Development	2.1	Overseas Development Agency	1.8
Health and Safety Executive	5.4	Health and Safety Executive	7.5
	272.8		264.2

Source: A New Analysis of Marine-Related Activities in the UK Economy with Supporting Science and Technology, David Pugh and Leonard Skinner, IACMST Information Document No. 10, August 2002 (Pugh and Skinner)

The top spending Government department in each of these years was the Ministry of Defence, followed a long way behind by MAFF (now Defra). The NERC expenditure includes funding for its own institutes but not grants to universities.

46. The Pugh and Skinner study updated work originally undertaken in 1994–5. It was intended to be "an interim update, perhaps in anticipation of a full revision after ten years" and therefore was not so full a survey as the original work had been.[68] No further work has since been undertaken. We understand that the Crown Estate is currently conducting a study of the socio-economic indicators of marine-related activities in the UK economy, which includes research and education and training, incorporating information and techniques used previously by Pugh and Skinner. This study is expected to be available in October 2007. We regret the failure of the IACMST to follow up the Pugh and Skinner study as anticipated in the 2002 report. Up to date figures and analysis are needed to ensure that trends in expenditure on research in this important area can be monitored. **We recommend that funding be identified by the sponsoring Government department for a regular survey of marine-related research and development in the UK by the IACMST or any successor body with responsibility for co-ordination in this area.**

Research Councils: NERC

47. NERC is responsible for funding and carrying out scientific research in the environmental sciences, including marine science. It operates through three funding streams: responsive mode, directed programmes and centre programmes. It also provides central facilities such as research vessels and equipment, which we discuss in a later chapter.

Responsive mode funding

48. Responsive mode funding is awarded to scientists on the basis of proposals for projects made outwith a NERC call for applications covering a particular area of research. From 2000 to 2004, NERC spent approximately £6.8m a year on marine research through responsive grant schemes, which equates to 16 to 22% of NERC's total responsive mode

68 Pugh & Skinner, p 5

budget.[69] This has varied between a low point of £4.7m in 2001/02 and a high of £7m in 2006/07.[70]

Directed programmes

49. Funding is also available through directed programmes which address specific themes within NERC's strategic priorities. These often result in collaborative bids which bring together NERC's centres and the universities. On average such programmes receive approximately £5–10m per programme, generally over five years, and NERC has run up to twelve programmes with a marine component since 2000. Some of these programmes have attracted international partners. Examples include RAPID, a seven-year £20m investment that aims to improve prediction of the impact of climate change which is operating in collaboration with the US, and the UK Surface-Ocean Lower-Atmosphere Study (SOLAS) programme, which has support from Germany and which has a substantial marine science element.[71]

50. The table below shows the figures for NERC spending on directed programmes in marine science from 1999/00 to 2006/07. It indicates that funding for directed programmes peaked in 2003/04 and has been declining in each year since.

Table 3: Expenditure on NERC marine-related directed programmes

Programme	£m 1999/00	£m 2000/01	£m 2001/02	£m 2002/03	£m 2003/04	£m 2004/05	£m 2005/06	£m 2006/07	£m Total
Autosub Science missions	0.900	0.300							1,200
Autosub Under Ice			1.100	1.284	1.154	0.784	0.549	0.449	5.320
Developmental Ecology of Marine Animals (DEMA)	0.900	0.500	0.200	0.023					1.623
Ocean drilling Programme (ODP)	0.500	0.500	0.500	0.404	0.591	0.189	0.090	0.042	2.816
Ocean drilling programme subscription	1.800	1.900	2.100	2.014					7.814
Integrated Ocean drilling Programme (IODP) (inc subscription)					1.796	2.458	2.606	2.506	9.366
Marine Productivity	0.100	0.900	1.300	1.696	1.025	0.616	0.083	-0.040	5.680

69 Ev 180

70 Ibid

71 Ev 180

Programme	£m 1999/00	£m 2000/01	£m 2001/02	£m 2002/03	£m 2003/04	£m 2004/05	£m 2005/06	£m 2006/07	£m Total
Ocean margins LINK		0.200	0.200	0.918	1.068	0.840	0.595	0.478	4.299
Rapid Climate Change (RAPID)			0.100	0.180	3.950	3.609	4.325	3.197	15.361
LINK Aquaculture	0.300	0.400	0.300	0.165	0.083				1.248
LINK SEASENSE	0.200	0.200	0.200		0.048				0.648
Plankton Reactivity in the Marine Environment (PRIME)	0.100								0.100
The Deep Ocean Benthic Boundary Layer (BENBO)	0.500	0.200							0.700
Marine Biofouling	0.100								0.100
Total	**5.400**	**5.100**	**6.000**	**6.684**	**9.715**	**8.496**	**8.248**	**6.632**	**56.275**

Source: Ev 270

NERC's centres

51. NERC has seven research and collaborative centres dedicated to marine research. These are as shown in the table below:

Table 4: Current organisational status of the NERC Marine Centres

The Marine Research and Collaborative Centres contributing to *Oceans 2025*				
Institution	**Acronym**	**Type of Centre**	**Owning Body**	**Current Relationship with NERC since**
National Oceanography Centre, Southampton(formerly Southampton Oceanography Centre)	NOC (formerly SOC)	Collaborative Centre	Jointly owned between NERC and the University of Southampton	1994
Plymouth Marine Laboratory	PML	Collaborative Centre	PML (Company Limited by Guarantee with Charitable Status)	2002
Marine Biological Association of the UK, Plymouth	MBA	Grant in Aidfunded Body	MBA (Company Limited by Guarantee with Charitable Status)	1965 (modified 1987 & 2001)
Proudman Oceanographic Laboratory, Liverpool	POL	Research Centre	NERC	1969
Scottish Association for Marine Sciences (Dunstaffnage, Scotland)	SAMS	Collaborative Centre	SAMS Group (Company Limited by Guarantee with Charitable Status)	1967 (updated 1994 and 2002)
Sea Mammal Research Unit, St Andrews (Scotland)	SMRU	Collaborative Centre	University ofSt Andrews	1996
Sir Alister Hardy Foundation for Ocean Science	SAHFOS	Grant in Aid funded body	SAHFOS (Company Limited by Guarantee with charitable status)	1990

Source: Ev 206

52. Recent trends in funding for these centres are shown in the table below:

Table 5: NERC funding for marine centres

	£m 1999/00	**£m 2000/01**	**£m 2001/02**	**£m 2002/03**	**£m 2003/04**	**£m 2004/05**	**£m 2005/06**	**£m 2006/07**	**£m Total**
Centre for Coastal and Marine Sciences (CCMS) (excl SAMS and MBL)	9.200	9.300							18.500
Proudman Oceanographic Laboratory (incl PSMSL and BODC)			2.900	5.602	8.170	4.352	4.811	4.940	30.775

	£m 1999/00	£m 2000/01	£m 2001/02	£m 2002/03	£m 2003/04	£m 2004/05	£m 2005/06	£m 2006/07	£m Total
NOCS (excl marine facilities of NMFD, UKORS, RSU, RVS)	6.200	7.100	6.200	6.624	8.635	7.039	8.398	7.020	57.216
Plymouth Marine Laboratory (PML)			4.900	5.980	4.311	4.262	4.487	4.565	28.505
Sea Mammal research Unit (SMRU)	0.500	0.500	0.600	0.628	0.640	0.630	0.640	0.940	5.078
SAHFOS	0.200	0.200	0.200	0.155	0.155	0.375	0.000	0.196	1.481
SAMS (inc CCAP)	0.300	0.300	2.400	2.237	2.311	2.323	2.534	2.642	15.047
MBA	0.400	0.400	1.000	1.040	1.175	1.184	1.179	1.194	7.572
Total	**16.800**	**17.800**	**18.200**	**22.266**	**25.397**	**20.165**	**22.049**	**21.497**	**164.174**

Source: Ev 269

In addition, NERC funds the British Antarctic Survey (BAS) in Cambridge which conducts marine-related research in the Southern Ocean, and the Centre for Ecology and Hydrology and the British Geological Survey (BGS) which both conduct some marine-related research.

53. The history of these centres is a long one, with some of them dating back to the 19th century. During that time, there have been several major reconfigurations, with amalgamations and break ups, but under the current arrangements, put in place in 2001, the centres are dispersed across the country and are mainly closely linked with universities. The three Plymouth-based centres, for example, are part of the Plymouth Marine Science Partnership in which the University of Plymouth is also a partner, while POL works with the University of Liverpool and NOCS with Southampton University. NERC described these moves as part of NERC's strategy "to encourage engagement between its researchers and the university sector to try to stimulate the younger students to come through to fill some of [the skills] gaps."[72] The centres retain "a diverse set of ownership and governance arrangements".[73] NOCS claimed that "there is strength in this diversity and the Centres work together cooperatively and in a coordinated way at the strategic level".[74] Each centre has its own area of expertise, and their directors jointly told us that "The Science Management Audits for each of the centres undertaken in 2004/5 found high quality science in all of the Centres with a high degree of differentiation between them and little or no evidence of duplication."[75] However, a review by NERC Council in 2005 found that the UK marine centres' separate research programmes were discouraging a co-ordinated

72 Q 79

73 Ev 168

74 Ibid

75 Ev 201

research approach and jeopardising the future of long-term ocean monitoring programmes. In response, the seven marine centres designed what has become known as Oceans 2025.

The Oceans 2025 proposal

54. Oceans 2025 is a NERC-funded research programme proposed, and to be implemented, by the marine centres. It aims to deliver key strategic scientific goals in marine research and to offer improved support for long-term monitoring. It is intended to

- increase the understanding of the size, nature and impacts of changes in the marine environment and address some of the most fundamental issues in marine science;
- integrate a co-ordinated approach from the marine centres, with co-operation and input from Government agencies and departments, to improve the knowledge of how the seas behave and how they are changing, and the consequences for the oceans and for society: and
- address the development of sustainable solutions for the management of marine resources for future generations.

55. Oceans 2025 will receive approximately £120m from NERC over five years, just under half of NERC's total spend on marine science,[76] although the funding for the final three years of the programme depends on the outcome of the 2007 Spending Review. Most of this funding will be spent within the NERC centres but Oceans 2025 also includes a new Strategic Ocean Funding Initiative (SOFI), which offers funding for projects where the skills required are not available within the marine centres. This opens up some of the money for universities and other partners, although it is not quite accurate to describe this, as one witness did, as "money in Oceans 2025 to work specifically with the universities"[77] since the SOFI pot of £5m (around £1m a year) is not limited to work with the higher education sector (see paragraph 71 below).

56. Oceans 2025 has been well received by the majority of the UK marine science community as a positive development for UK marine science. One of its participants, POL, described it as "a significant step forward in funding marine technology", which would enable them "to further develop the Liverpool Bay Observatory and to develop state-of-the-art telemetry systems for sea level data".[78] From outside the centres, Professor Sir Howard Dalton, speaking in his capacity as Chair of the IACMST, told us that "Oceans 2025 has made quite a big difference to the way in which we are trying to get together to try to co-ordinate activities."[79] The RSPB also welcomed Oceans 2025 as "a huge step forward in addressing the need for coherence between disciplines", although it lamented "the role of seabirds in the ecosystem" was "a glaring omission from this new integrated structure".[80]

76 Oceans 2025 information leaflet

77 Q 433

78 Ev 103

79 Q 2

80 Ev 111

57. Initial confusion by some in the university sector over the process by which Oceans 2025 was proposed, consulted on and ratified by NERC was resolved through our evidence sessions and a further submission from NERC.[81] In essence, Oceans 2025 is a scientific proposal similar to any other and therefore it was not appropriate to have full-scale public consultation on the details. Professor Thorpe was clear that "Oceans 2025 is the name given for our core strategic investments in marine science. It maintains the national capability to do marine science; it does not represent the totality of the funding that we devote to marine science, nor does it represent a holistic marine strategy."[82] We welcome the development of Oceans 2025 as a strategy for NERC's marine centres, particularly as a centre-driven proposal for self-organisation and better peer-group co-ordination. We accept that the universities were properly consulted. However, the apparent resentment in some quarters of the Oceans 2025 process in its early stages indicates the desire of many working in marine science for a similar strategy embracing all parts of the marine research community. We discuss this further below.

Universities

58. The major UK universities engaged in marine science (based on the number of researchers) are Southampton, Bangor, Stirling, Plymouth, Aberdeen and St Andrews. Centres of excellence in marine engineering are mainly located at former sites of shipbuilding activities (including the University of Strathclyde, the University of Edinburgh, Southampton University, the University of Newcastle and Imperial College London), although there are other institutions with an interest in this area. These universities now have expertise in marine energy-generation research. Pugh and Skinner listed 17 schools or departments with more than 40 research workers in 1999–2000.[83]

59. Professor Gideon Henderson from the University of Oxford told us that there were some areas of particular excellence in the university sector, especially in ocean chemistry, but that it was focussed in relatively few universities.[84] He described opportunities for funding marine research apart from the Research Councils as "quite small".[85] This is supported by the Pugh and Skinner analysis that in 1999–2000 68% of research funding for higher education institutions came from the public sector (government, Research Councils and the EU), 25% from the private sector (industry, industrial consortia and trade associations) and 7% from endowments, trusts and charities.[86] Of the public sector funding, the Research Councils were the single largest source, giving 35% of the total funding.[87]

60. Professor Henderson pointed out that universities were only allowed to bid for blue skies research funding from NERC and not for strategic (directed) grants.[88] He told us that

81 Ev 237, 244

82 Q 570

83 Pugh & Skinner, p 31

84 Q 89

85 Q 94

86 Pugh & Skinner, p 31

87 Ibid

88 Ev 163

"Many people in my direct field and similar fields feel that we are doing strategically important work for the country but we are not able to tap into funding for that work".[89] He also felt that the process for setting the agenda for UK marine research excluded the universities and that the sector should be involved in determining marine science strategy in the future.[90] Professor Henderson's view was supported by the President of the Challenger Society, a leading marine science learned society, who argued that "In the universities, where much of the cutting edge marine research is being done, there is an almost complete lack of national coordination or overall marine science strategy, made worse by NERC's abolition of its marine research grant committee some years ago (noting that NERC is the major funder of university research in this area)".[91]

Funding issues

61. There are a number of issues which were raised with us about NERC funding. These include the level of available funding, types of funding and NERC's attitude towards interdisciplinary applications. Finally, there were concerns about funding for Oceans 2025.

Levels of funding

62. The overall trend in NERC funding for marine science is shown in the table below:

Table 6: NERC funding for marine science

Expenditure heading	£m 1999/00	£m 2000/01	£m 2001/02	£m 2002/03	£m 2003/04	£m 2004/05	£m 2005/06	£m 2006/07	£m Total
Ship operations	7.000	4.600	7.000	9.096	10.643	8.934	10.149	12.226	69.648
Marine centre expenditure	16.800	17.800	18.200	22.266	25.397	20.165	22.049	21.497	164.174
Directed programmes	5.400	5.100	6.000	6.684	9.715	8.496	8.248	6.632	56.275
Total	**29.200**	**27.500**	**31.200**	**28.046**	**45.755**	**37.595**	**40.446**	**40.355**	**290.097**
Other directed programmes	1.200	2.300	2.900	5.794	7.725	7.676	7.569	9.871	45.035

Source: Ev 270

Looking back to 1985, NERC funding for marine science and technology rose in real terms from c£10m in 1985/86 to £30m in 1995/96, but then fell in real terms every year until at least 2003/04 as a result of the rebalancing of NERC's priorities in the later 1990s.[92] It has continued to fall since, with overall expenditure, excluding response mode grants, some £5.4m less in cash terms in 2006/07 than in 2003/04. This is reflected in evidence from one centre, SAMS, which told us that its core strategic funding from NERC "had decreased in

89 Q 123

90 Ev 163

91 Ev 121

92 POST Report 128, July 1999, p 10

real terms year on year for the past 10 years".[93] We note that other funds have also been available through responsive mode grants but **the declining trend in NERC funding for marine science is a worrying one and we seek an explanation from NERC as to why marine science has apparently been less of a priority than other areas within the NERC remit.**

Types of funding

63. In June 2006 NERC's Council announced that it would be changing the way in which it makes awards. The Funding Allocation and Budgeting (FAB) project reviewed NERC's strategic planning, funding and management processes, with the aim of improving collaborations, flexibility and performance management whilst linking scientific investment more closely with priority areas and Government spending review cycles. There will be two funding streams under FAB:

a) National Capability Funding: research infrastructure, services and facilities, survey and monitoring, and scientific advice over long timescales. Established NERC research and collaborative centres will be allocated National Capability funding for long periods, with known levels of funding and agreed margins for flexibility so they can respond to new issues as they arise.

b) Research Programme Funding: to support time-limited research programmes that address the science priorities defined by NERC's strategy. Most programmes will be collaborative and will build on the capability and capacity provided by research and collaborative centres and universities.[94]

Under the new arrangements, NERC intends that funding bids will be open to a wide range of research providers and that new research programme can be developed quickly where needs arise. It sees this approach as very similar to the way centres already bid into directed programmes, blue skies, and contract research opportunities.[95]

64. FAB has been welcomed by some in the community as promising "to create a funding environment that enables centres/surveys to collaborate".[96] The Oceans 2025 initiative, which aims to do precisely this, was explicitly designed to fit within the new FAB structure. POL also welcomed the proposal under FAB that "'national capability' within NERC centres and surveys (such as marine technology) be funded on a longer time-scale, such as 10 years".[97] There is a larger question as to whether NERC is the most appropriate agency to fund operational observations which we discuss later (see Chapter 6).

65. PML was more cautious about FAB, concerned that opening up funding to competition "could be damaging if taken to its logical limits".[98] We also heard concerns that the move to FAB, where budgets are restricted to shorter timescales, will mean that the

93 Ev 164

94 http://www.nerc.ac.uk/funding/allocation/statementfaqs0906.asp

95 Ibid

96 Ev 103

97 Ev 104

98 Ev 117

annual review of science projects will be too onerous and will disadvantage UK scientists compared to those competing for funding overseas. This would mean that research cruise proposals, which often take the scientific team behind them three or more years to bring to fruition, are disadvantaged. One effect of this may be that people may prefer to leave the UK to work in other countries where it is less cumbersome to obtain funding for such projects, or where funding is secure over a longer term.

66. We also heard the perception voiced that bids for responsive mode funding from within the marine science community are proportionally less successful than those from other areas within NERC's remit. Statistics from NERC bear this out. The table below shows funding for all NERC's highly graded standard grant research proposals and for marine science standard grant proposals, from 2001 to 2006. These figures indicate that, consistently, a lower proportion of highly graded marine science proposals receive funding than the average, with the sole exception of 2003 when the two were more equally balanced. **We accept that NERC acts in good faith to support the best science in awarding funding under the responsive mode and that the number of applications is small, but we believe that the apparent bias against funding for marine science applications requires investigation and explanation from NERC.**

Table 7: Success rates for highly graded proposals for NERC-funding

Year	Total number of funded α4/α5 graded research proposals	Total number of funded α4/α5 graded MS research proposals	Total number of unfunded α4 graded research proposals	Percentage of unfunded α4 graded research proposals	Total number of unfunded α4 graded MS research proposals	Percentage of unfunded α4 graded MS research proposals
2001	105	18	70	40	16	47
2002	53	9	24	31	9	50
2003	122	25	44	27	9	26
2004	112	10	63	36	13	57
2005	103	19	76	42	18	49
2006	102	19	25	20	7	27

Source: Ev 271

Interdisciplinary bids

67. Throughout the inquiry, the fundamental role of the oceans as one part of an integrated earth system has been highlighted by many witnesses. Increasingly, scientists from different disciplines are coming together to work on research problems, for example the interaction between oceans and the atmosphere, of which current understanding is poor. It is a matter of concern, therefore, that several witnesses considered that NERC's procedures for assessing multi- or interdisciplinary applications were inadequate. Natural England, for example, argued that some of the current practices in NERC's peer review procedures for

funding UK marine science are inconsistent and favour mainstream disciplines at the expense of inter-disciplinary research:

> The perception that we are given is that in part this seems to be driven by a mismatch in peer review background (dominated by oceanography and earth science interests) set against the biological marine science focus of projects and programmes under consideration. The consequence may be to make it difficult to fund ongoing innovation or novel research in some areas of marine science.[99]

68. The NERC centre directors also reported "an ongoing perception within the community that NERC's peer review system is systematically biased against grant proposals that involve industry."[100] PML raised the specific difficulty of obtaining funding for joint NERC/MoD bids where strategic projects were being assessed as "blue skies projects" and therefore were not scoring sufficiently highly.[101] PML called for a review of such schemes.[102] One practical problem reported to us was that bids to NERC were foundering because multi-disciplinary grants required the same forms as very detailed specific bids and scientists could not properly express their intentions in the space available, so were dismissed as too vague. Research cruises are often multi-disciplinary since it is not practical for vessels to go out and examine just one research area. To solve this problem, the scientists were moving towards applying for consortia bids which permitted longer explanatory supporting submissions.

69. The marine centre directors argued that "this is an area where NERC might take a more positive and proactive approach through guidance to applicants and members of its Peer Review College as well as fostering a greater understanding of the needs of interdisciplinary research."[103] The Deputy Director, Science and Innovation, NERC, assured us that this was in hand and that "every year there are training exercises [for the peer review college], and the need to be able to be aware of and how to deal with interdisciplinary proposals is part of that training".[104] He expected that this would "be one of the aspects we would look at" in the forthcoming review of the peer review college.[105]

Oceans 2025 funding

70. NERC has only committed funding for the first two years of the Oceans 2025 programme, pending decisions on the Council's share of the Science Budget for the next five years. This has caused some uncertainty in the community, with POL warning that "A real-term cut in years 3 to 5 of the programme would seriously undermine basic research aimed at improving the predictability of climate models and assessing the impact of climate change on the UK".[106] This, they argued, would have "a disproportionately large adverse

99 Ev 210

100 Ev 201

101 Ev 117

102 Ibid

103 Ev 201

104 Q 44

105 Ibid

106 Ev 102

impact on the technology theme" since technology development is "long-term and costly".[107] Oceans 2025 is an important development and one which NERC should support. **We recommend that NERC commit funding to the full five years of the Oceans 2025 programme in order to enable proper planning and effective organsiation. In doing so, it needs to ensure that the longer term programmes and facilities are not packaged together with the short term projects in the same project cycle so that each can be assessed against their natural lifespan.**

71. There were also undercurrents of complaint in the evidence that the funding given to Oceans 2025 represented only "a modest uplift overall".[108] There are also projects and themes which were squeezed out of Oceans 2025 but which might be reintroduced under the programme's Strategic Ocean Funding Initiative (SOFI). For example, the PML proposed a new laboratory to investigate marine environment and human health which did not score well in the peer review process.[109] NERC told us that it expected to use SOFI to fund work such as this, "which Oceans 2025 should be doing but it does not have the capability to do itself, for whatever reason".[110] This pot of funds totals only £5m or 7.5% of the budget for the whole five years, and is already partially allocated to a cross-partner research effort with Defra, SEERAD and the Northern Ireland Office on sustainable marine bio-resources, "another area of Oceans 2025 which did not do particularly well during the funding process".[111] Given that SOFI is expected to foster collaboration with the universities as well, it is worrying that two such important areas are having to be funded out of such a small funding pot. **We recommend that NERC review the use of the Strategic Ocean Funding Initiative, with a view to increasing the amount allocated to it within the Oceans 2025 programme and encouraging participation from universities in Oceans 2025.**

NERC's strategy and organisation

72. Marine research fits into each of the three headings within NERC's current strategic priorities of earth's life-support systems, climate change and sustainable economies. NERC is currently finalising a new strategy with seven cross-cutting themes, and a strong focus on "providing the scientific evidence to address the environmental issues that society and the economy face."[112] There is also a separate funding stream for national capabilities, such as research vessels and maintaining long-term data sets.[113] Professor Thorpe told us that "We will be looking at both maintaining the marine science and technology capability overall, and that obviously is largely but not exclusively delivered by the marine centres via the Ocean 2025 Programme; but marine science appears in the thematic research programmes that cut across".[114]

107 Ev 104

108 Ev 200

109 Q 51

110 Ibid

111 Ibid

112 Q 564

113 Q 568

114 Q 563

73. NERC does not have a strategy specifically for marine science, instead seeing marine science as part of the whole NERC picture. This has been the position since 1994 when NERC abolished its Directorship of Science for Marine and Atmospheric Sciences, established only eight years previously, to develop a coherent strategy for research in NERC's laboratories and in the universities. This left the Directors of the NERC Centres as the main source of marine expertise within the NERC community, with no official source of expertise at NERC headquarters.

74. There is longstanding concern at the implications of these arrangements for NERC's marine science portfolio. Oceans 2025 has attempted to remove the competition between the centres but that between the centres and the universities remains, leading one academic from the university sector to comment to us that "historically I would say NERC has not done a great job of co-ordination … NERC is very focused on its own institutes and it does not necessarily know what is happening in the community as a whole which is quite a lot larger than the institutes."[115] Professor Thorpe told us that "NERC investments in marine science are coherent and fit into NERC's overall strategy".[116] There are undoubted advantages in a thematic approach that goes beyond marine sciences but it is clear that a greater sense of direction and leadership on the part of NERC is desired by the marine science community. **We recommend that NERC review the need for a director of science for marine and atmospheric science.**

Other Research Councils

Biotechnology and Biological Sciences Research Council (BBSRC)

75. The BBSRC funds basic and strategic research in the non-clinical life sciences at universities and research centres. It told us that "marine biology is at the periphery of BBSRC's major interests", although it has "some interest in supporting research into marine organisms where this will allow study of interesting biological processes".[117] The BBSRC covers study of the marine environment only in its interactions with marine organisms. The BBSRC lists three areas of interest in marine biology:

- Biotechnological exploitation of novel processes in the marine environment (e.g. novel chemistries for bioprocessing and novel enzymes from hyperthermophiles and hyperbarophiles from deep-sea vents). Access to marine organisms and the necessary equipment for their subsequent exploitation.
- Maintaining health of farmed fish against bacterial, viral and parasitic infections.
- Understanding the effects and the mechanisms of control of agricultural run-off into catchments and the marine environment.[118]

115 Q 458

116 Q 573

117 Ev 167

118 Ibid

The amount of funding made available is small compared to NERC, as the following table shows. Nevertheless, the BBSRC is important in certain aspects of marine research such as biotechnology.

Table 8: Total Marine Science Spend for the Period 2002/03–2006/07

Table 1	Estimated Spend (£K)				Forecast spend 2006/07 (£K)
	2002/03	**2003/04**	**2004/05**	**2005/06**	
Total	2,342	2,887	2,839	3,585	3,111

Source: Ev 248

Table 9: Marine Science Spend by Research Committee

Table 2	**Estimated Spend (£K)**				**Forecast spend 2006/07 (£K)**
Committee area	2002/03	2003/04	2004/05	2005/06	
Agri-Food	401	376	545	848	702
Animal Sciences	821	877	652	917	1,197
Biochemistry and Cell Biology	275	362	366	377	207
Biomolecular Sciences	43	81	74	67	50
Engineering and Biological Systems	7	14	22	24	17
Genes and Developmental Biology	667	1,008	1,056	1,144	775
Plant and Microbial Sciences	130	168	126	210	162
Total	2,342	2,887	2,839	3,585	3,111

Source: Ev 248

Table 10: Marine Science Spend by cross-Committee Priority Area

Name of cross-Committee priority area	**Awarding Committee**	**Estimated Spend (£K)**				**Forecast spend 2006/07 (£K)**
		2002/03	2003/04	2004/05	2005/06	
Bioscience Engineering	PMS	0	0	0	0	2,409
Theoretical Biology	GDB	0	0	0	71,428	77,922
Total		0	0	0	71,428	80,331

Source: Ev 248

Engineering and Physical Sciences Research Council (EPSRC)

76. The EPSRC is the main agency for funding research and training in engineering and the physical sciences, investing around £650 million a year in a broad range of subjects from mathematics to materials science, and from information technology to structural engineering. It supports marine science (including coastal research) where there is a strong engineering or physical science element, as shown by the areas in which they are currently funding projects:

- Coastal and waterway engineering: research on coastal and waterway structures, coastal and waterway management, coastal defences, beach replenishment, estuarine engineering, reservoir and dam engineering and hydrodynamics.
- Fluid dynamics: involves the study of fluids moving around structures. It includes techniques covering computational fluid dynamics and finite element analysis relevant for the study of water flow around marine structures.
- Marine engineering: involves the interaction between the oceans and marine structures, both mechanical effects and hydrodynamic interactions, including the design of marine craft and structures.
- Marine energy: involves the research of wave and tidal energy systems with most work in this area undertaken by the SUPERGEN Marine Energy Consortium.[119]

Some of the EPSRC support for marine research is cross-cutting with other Research Councils, notably the Tyndall Centre for Climate Change Research (co-funded by NERC and ESRC) and the UK Energy Research Centre (co-funded by NERC and ESRC); programmes at these centres focus on broader environmental issues, rather than pure marine science.

77. EPSRC funding for marine-related research is mainly through the responsive mode, although some marine research is funded through managed activities specific to key themes, such as the Sustainable Power Generation and Supply Programme and the Flood Risk Management Research Consortium. The total current project commitment for marine science from the EPSRC is £12.6m (£3.3m for coastal engineering, £9.3m for marine engineering). £2.6m of this total is directed through the Supergen Marine Energy Consortium (part of a directed call for renewable energy generation research). EPSRC has also proposed that marine renewable energy be nominated as a subject for a Science and Innovation Award which is a large, long-term grant (typically £3-5 million over five years), with a commitment from the host institution to continue to support the research group once the grant has ended.[120] Further work is also supported through the recent expansion of the Marine Energy Consortium which will see increased funding of £5.5m for 2007 to 2011.[121] However, EPSRC spend on marine science is a modest fraction of its overall budget of £650m per year, as shown in the table below, with little evidence of real growth.

119 Ev 195

120 Ev 196

121 Ev 197

Table 11: EPSRC expenditure on marine science

Financial Year	Total Annual Marine Science Spend
2006/07	£3,138,849
2007/08	£3,519,717
2008/09	£2,966,241

Current EPSRC marine science research spend for financial years 2006/07, 2007/08 and 2008/09. Annual EPSRC Budget is £650m. Grants to be announced and planned future activities are not included in these figures.[122]
Source: Ev 196

Economic and Social Research Council (ESRC)

78. The ESRC also funds some work in the marine area, although naturally on a much smaller scale than NERC. It has a scheme for funding interdisciplinary PhD awards and a transdisciplinary research seminar competition, both run jointly with NERC, which have seen funding awarded to marine science projects. In addition, one of ESRC's Research Centres (the Centre for Social and Economic Research on the Global Environment) and two of its collaborative centres (the Tyndall Centre for Climate Change Research and the UK Energy Research Centre) also have strong marine research interests. Finally, the ESRC provided us with examples of marine-related research funded under its responsive mode in the last five years which total some £582,000.

Cross-Research Council issues

79. Concerns were raised in evidence about several aspects of cross-council funding applications. First, POL told us that there were "unhelpful barriers for funding marine science between research councils"; they cited the example of offshore engineering which is mainly funded by EPSRC, to whom POL is prevented from bidding.[123] The same difficulty with the "apparently arbitrary way in which organisations are eligible for funding" affected PML, which is also "unable to bid for responsive mode funding from the Engineering and Physical Sciences Research Council" and "has found it extraordinarily difficult to obtain funding from the Biotechnology and Biological Sciences Research Council, although there are signs that this route is opening up somewhat."[124] This also applied to the Met Office, which as a trading fund, cannot apply for money from Research Councils at all.[125] This position is even more stringent than the past regime where it was "a bit less clear whether the Met Office could take part in, say, NERC-funded projects".[126] Dr Bell of the Met Office told us that there had been projects "where collaboration between the Met Office and NERC was obviously very desirable" and where funding eventually had to come from the MoD, because of the attitude of the Research Council.[127]

122 Ev 196

123 Ev 103

124 Ev 117

125 Q 158

126 Ibid

127 Q 158. This issue also affects the fisheries laboratories (see paragraph 89 below).

80. Secondly, evidence highlighted concerns over the success of marine-related research proposals that are relevant to two or more Research Councils, in most cases jointly between NERC and BBSRC or NERC and EPSRC. We were particularly struck by BBSRC's admission that they "did not co-fund any marine science research jointly with other Research Councils in the period 2002/03–2006/07."[128] PML found this issue a "particular frustration" and argued that "a review of how to deal with interdisciplinary science is long overdue".[129]

81. Thirdly, there are areas of science which may fall into the gaps between Research Councils. The MBA highlighted "a risk that important developments in the use of products and genes from the great diversity of marine organisms is being neglected as it is an interface area between NERC and BBSRC."[130] The same could apply to aquaculture research and development.[131]

82. The umbrella body, Research Councils UK (RCUK), is working to address some of these difficulties. NERC Deputy Director, Science and Innovation, told us that changes had been made very recently but "they will not have filtered back to the community yet".[132] He explained that "There is a system now which decides not only which council would handle the proposal but also, based on the fraction in different remits of the different councils, whether it would be co-funded or funded by one council."[133] The EPSRC Research and Innovation Director agreed that "one of the problems we suffer is people remember past experiences much more strongly than the current situation".[134] She told us that "I think the situation has got much better but clearly we have to be ever vigilant".[135] We were also told by the then OSI that EPSRC and NERC collaborate on multidisciplinary research in marine science where it crosses the remit of both Research Councils, and there is a Concordat in place on responsive mode funding to support research that crosses remits.[136] We are pleased to hear of changes to ease applications across two or more councils or where it is unclear which council is responsible for a particular area. **We recommend that RCUK monitor applications and inquiries to ascertain whether there has been improvement in funding interdisciplinary work in marine science areas as a result of recent changes.**

83. These changes, however, do not affect the eligibility of scientists from certain bodies to apply for responsive mode grants. We have previously recommended that these should be opened to all scientists whether working in universities or Research Council Institutes.[137] We have also recommended that all scientists in RCIs should be able to apply to any

128 Ev 248

129 Ev 117

130 Ev 161

131 Ibid

132 Q 43

133 Ibid

134 Q 326

135 Q 327

136 Ev 237

137 Science and Technology Committee, Fourth Report of Session 2006–07, *Research Council Institutes,* HC 68–I, para 37

Council.[138] In the specific case of marine science, **we recommend that scientists working in marine research in the UK be eligible to apply for funding to any of the Research Councils, regardless of their place of employment.**

Government departments

84. The MBA told us that "considerable funding is available from Government departments and agencies for policy-driven science".[139] The funding for civil purposes is mainly from Defra but several other departments are involved, including the MoD, Department of Transport, DfID and the FCO. We here concentrate on Defra and the MoD.

Defra

85. Defra is the lead Government department for marine science and policy since it has responsibility for environmental stewardship of UK waters. These policy commitments are supported by a science programme covering both monitoring and research at an annual cost of around £26 million, broken down as shown in the table below.

Table 12: Defra's Marine Science Programme

Programme Title	Summary of programme scope	Indicative budget 06/07
Sustainable Marine Fisheries R&D	Impact of fishing on the marine ecosystem and appropriate mitigating measures. Environmental variability and climate change affects on fisheries productivity. Modelling tools to support strategic and tactical fisheries management decisions.	£3.0 m
Fish and Shellfish Stock Assessment, Monitoring and Management Advice	Monitoring programmes to assess the status of commercially important stocks for fisheries management. Joint research with the industry on commercial fish catch rates and developing more selective and environmentally friendly fishing methods.	£9.0m
Sustainable Marine Environment R&D	Research potential impacts of human activities on the marine environment, provide understanding of ecosystem functioning and develop tools and techniques to achieve better marine and coastal management.	£4.8m

138 HC (2006-07) 68-I, para 38

139 Ev 162

Programme Title	Summary of programme scope	Indicative budget 06/07
Marine Monitoring and Management Advice	Provision of scientific evidence (monitoring, assessment) and advice relating to environmental protection, including meeting OSPAR and licensing requirements.	£5.6m
Coastal Flood and Erosion Risk Management R&D	Studies of coastal sediment processes for morphological prediction, beach management and design of coastal management structures, including economic, social and environmental impacts (part of the ongoing Joint Defra and Environment Agency R&D programme on Flood and Coastal Erosion risk).	£0.4m
Estuary Flood Risk Management R&D	Studies of estuary morphology, sediment movement, economic, social and environmental impacts (part of the ongoing Joint Defra and Environment Agency R&D programme on Flood and Coastal Erosion risk management).	£0.5m
Wildlife & Countryside R&D	Research on marine biodiversity and habitats to underpin marine nature conservation policy development, including the Marine Bill, Special Areas of Conservation (SACs) and Special Protection Areas (SPAs).	£0.8m
Climate	Long-term measurements of sea surface temperature (SST) and salinity for climate models, including; Projections of sea-level rise, ocean heat uptake, thermohaline circulation and sea ice coverage; Producing a risk assessment of rapid thermohaline circulation change; Work on observations of sea surface temperature; Modelling ocean biogeochemistry and its impact on the global carbon cycle.	£2m
Water Quality Research R&D	Developing operational models to forecast failures of faecal indicator organism limits in designated European Bathing Waters. Impacts of Intermittent discharges on microbial quality of shellfish flesh. Testing of Cost-effectiveness Methodology in Coastal and	£0.2m

Programme Title	Summary of programme scope	Indicative budget 06/07
	Transitional Waters.	

Source: Ev 154

86. Defra funds research in universities and research institutes, such as the Oceans 2025 NERC centres, and in the public sector fisheries laboratories (see below). The Department accepted in its memorandum that "Our knowledge of the marine environment as a whole is still far from complete. We need to enhance our understanding of ecosystem structure and functioning and its vulnerability to human impacts and climate change".[140] It identified "wide-ranging" priorities for further science, "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."[141] It was also upfront in pointing out that the UK Marine Monitoring and Assessment Strategy states that "to fully comply with increasing demands for evidence .... there needs to be an additional £22m per year spent on sustained marine observations by UK Departments, Agencies and industry." Defra acknowledged that its "current marine science budget is not sufficient to meet all these needs".[142] We examine Defra's role in funding monitoring programmes in Chapter 6 of this Report.

Fisheries laboratories

87. The government-owned fisheries laboratories include the Fisheries Research Service (FRS), an agency of the Scottish Executive Environment and Rural Affairs Department, and the Centre for Environment, Fisheries and Aquaculture Science (Cefas), an executive agency of Defra. These agencies provide research, monitoring and advisory services to underpin Government policy in their respective areas. They also conduct research not just for Government departments but also for the EU and the Research Councils and other public and private sector bodies. For example, the FRS in Scotland is participating in a NERC programme on fish toxicogenomics.[143] Cefas characterised its own research as "very applied to support the needs of the government policy divisions; it tends to be more short term than programmes managed by, for instance, NERC."[144]

88. Defra has agreed a ten year programme of flat funding for Cefas, which means a decline in real terms over that period. In order to fill the gap, Cefas has to look for other markets and become more competitive. Dr Horwood assured us that past experience of the contraction in funding since the 1960s and 1970s had shown that "this ability to go out into the wider market has enabled us to do a much richer range of research".[145] However,

140 Ev 150

141 Ibid

142 Ibid

143 Ev 98

144 Q 130

145 Q 144

IMarEST, for example, were concerned that the pressure to find consultancy work to supplement Cefas's departmentally-commissioned work "tends to reduce their opportunities for novel, questions-driven marine research of the kind that is commonly found in university departments." IMarEST argued that "Any decline in fundamental research, whether in government or university labs, will be detrimental, in the long term, to the standing of the UK in the global marine science arena".[146]

89. Evidence from the NERC centres suggested that the new competitive drive at Cefas was harming the relationship between the centres and the laboratories. PML perceived that "organizations such as CEFAS are gradually shifting their focus and becoming more aggressive competitors", with its own "anecdotal experience … that CEFAS was more collaborative in past years."[147] It called for "a wide review of the fisheries laboratories and Research Council institutes in supporting UK-wide marine science".[148] Similarly, POL argued that "Collaboration between CEFAS and NERC is also lacking and this is holding back research progress in the areas of marine bio-resources and marine spatial planning."[149] POL attributes this to "funding constraints at Defra" and identifies "the potential for a major advance in marine ecosystem management through closer collaboration between CEFAS and the laboratories participating in Oceans 2025."[150] Cefas itself complained that "The relevant rules have changed recently leaving Cefas unable to access Research Council funding".[151] Only two of Cefas's current portfolio of over 500 projects are directly funded by NERC. Cefas sees this as having a negative effect on co-ordination and collaboration as a whole: "there is still an impasse of free funding flow, and therefore information, between NERC and other Government laboratories that impedes better integration".[152]

90. The NERC directors identified a need for "greater collaboration and a need to avoid any tendency for duplication of activities between CEFAS and the NERC Centres where one or the other has a particularly strong existing capability".[153] We note that in the first call for SOFI, applicants were obliged to seek partnership and endorsement from at least one NERC centre and one fisheries laboratory, which placed the onus on the applicant to co-ordinate, rather than on the institutions themselves. We asked Defra whether there was a need to review how the research centres and the laboratories could work together more effectively. We did not receive a direct answer but Defra did tell us that as a result of our evidence sessions, Cefas had approached NERC with an offer of talks on the use of the Cefas research vessel.[154] This is one small example of how better dialogue could improve the efficient use of UK marine science facilities. **We recommend a review be commissioned by Defra and NERC jointly on mechanisms for improving the**

146 Ev 231

147 Ev 117-118

148 Ev 118

149 Ev 102

150 Ev 103

151 Ev 99

152 Ibid

153 Ev 201

154 Ev 263

relationship between the marine centres and the fisheries laboratories and for encouraging collaboration and co-ordination of research effort.

Ministry of Defence

91. The Ministry of Defence conducts a significant amount of defence-related marine research. Unlike in the US, where the Office of Naval Research is a major funder of marine research and development in the civil sector, most of the work sponsored by the MoD is not channelled through the public sector research route or through universities. We heard from industry witnesses that MoD funding for private sector companies had also ceased. The Association of Marine Scientific Industries told us that

> A few years ago, certainly, there was more marine science and technology undertaken by the MOD and placed with small and medium sized enterprises externally. That really has stopped now. Most of the contractual work that appears from the MOD relating to marine science and technology is in support of environmental mitigation: acoustics and mammals and things like that, and very little is done in what I would call the science of instrumentation for example. If you put acoustics to one side, which is very much a Navy remit, then there is very, very little done outside.[155]

IMarEST agreed that MoD funding for autonomous underwater vehicles (of military interest for mine clearance and mine hunting) "has dropped dramatically off over the last few years".[156]

92. The MoD is a member of the IACMST and claims that "there is good co-ordination between MOD and other Government Departments" in marine science and technology.[157] There is also bilateral co-ordination between NERC and the MoD through an initiative known as CAROS (Cooperative Arrangements for Search in Ocean Science), on which the UKHO is represented, along with NOCS, POL, PML, SAMS and SMRU. CAROS meets formally twice a year to discuss shared issues. Both NERC and the MoD supplied us with similar examples of how the two parties collaborate on the use of naval vessels for research.[158] In addition, the UKHO told us that "the NERC/MoD Joint Grant Scheme for funding research has been significant in terms of funding for marine science and is currently an issue for research organisations who find it difficult to secure funding from NERC by this route".[159] Interestingly, few in the science community mentioned this funding stream in evidence to our inquiry.

93. We have not examined military marine research in this inquiry but we have looked at marine-related work carried out for the MoD by the Met Office as part of the Defence Oceanographic Programme and by the UK Hydrographic Office as part of the Defence Hydrographic Programme, which we describe below. Issues relating to relations between

155 Q 328

156 Ibid

157 Ev 248

158 Ev 144-5; 248

159 Ev 96

the marine science community and MoD organisations are generally concerned with access to facilities and data and are discussed in those sections of this Report.

The Met Office

94. The Met Office contributes to marine science through its work in climate change research, seasonal forecasting, short-range ocean forecasting and marine measurements.[160] Its primary role in respect of marine science is "to use up-to-date marine science and technology to make predictions" on a climate, seasonal and short timescale.[161] It is responsible for the Hadley Centre which conducts research into the impact and likelihood of climate change. The Met Office also collaborates with NOCS, PML, POL and the Environmental Systems Science Centre in the National Centre for Ocean Forecasting (NCOF) which has the mission "to establish ocean forecasting as part of the national infrastructure based on world class research and development".[162] In 1999–2000 the Met Office spent £2.2m on marine-related research and development, down from £3m in 1994–95.[163]

95. Dr Bell of the Met Office told us that "there is quite a good and an increasingly good working relationship between the Met Office and quite a number of NERC research institutes".[164] There is a "list of 50 small collaborative projects between ourselves and the other members of NCOF, which is really helping to pull their work through into our operations".[165] The Met Office is also a member of the Marine Assessment Policy Committee which is overseeing the UK Marine Monitoring and Assessment Strategy, and of the IACMST. Internationally, the Met Office contributes to the Intergovernmental Panel on Climate Change (IPCC).

The UK Hydrographic Office

96. The UK Hydrographic Office claims not to conduct research itself but its Marine Environment Information Centre (MEIC) contributes to marine science through its management of "a significant volume of data", which is released periodically to the wider science community, via the British Oceanographic Data Centre, the National Oceanographic Data Centre (US) and, in the case of marine life observations, to Duke University in the US for dissemination via the OBIS website.[166] The MEIC also makes data available to support specific research projects such as marine mammal habitat preference modelling at SAMS.[167] In addition, UKHO told us that "We could have a role in requesting or requiring research to be done where there are gaps within the research".[168] It may be that

160 Ev 176

161 Q 134

162 Ev 177

163 Pugh & Skinner, p 21

164 Q 170

165 Ibid

166 Ev 96

167 Ibid

168 Q 130

the UKHO is adopting a rather narrow definition of research since its written evidence to us indicates that it analyses data from its own and external sources and also creates products from those data, both of which are research-driven activities.[169] In our view, its core task of managing such large quantities of data gives the UKHO a central role in working on data standards so that the data can be easily accessed and interpreted by scientists and policy-makers in the marine sector. The future structure and ownership of the UKHO is currently under review by the MoD. **We recommend that the role of the UKHO as a marine research establishment be explicitly considered as part of the MoD review of the future of the Office.**

Private sector

97. The private sector funds some marine-related research in public sector research bodies and also has its own research and development activities. It is very difficult to get accurate figures for spending in the latter area. Pugh and Skinner relied on data from the then OST, although this does not specifically differentiate marine-related research, except in the ship building and repair sector where £76m was spent on in-house R&D in 1999, the vast majority (£73m) defence-related.

98. Oil and gas and the extractive industries are generally considered to form the most significant sector, despite the figures from Pugh and Skinner which put it second to ship-building.[170] The size of the industry, its reliance upon exploration of the marine environment and its wealth make investment in marine-related research more of a priority than in many smaller or less directly-connected sectors. The oil and gas industry also works with researchers from academic institutions on a significant scale and produces quality research. BP told us that a major focus of its £220m total investment in 2007 in exploration and production technology research and development is the development of technologies and expertise in deepwater, including autonomous underwater vehicles.[171] It has strategic research relationships with a range of universities and academies worldwide, including Cambridge University and Imperial College. It is also developing projects aimed at gaining a better understanding of the marine environment and environmental monitoring, in close collaboration with the scientific community. For example, BP is funding DELOS (Deep ocean Environmental Long-term Observatory System) in conjunction with OceanLab Aberdeen in partnership with NOCS, Aberdeen University, Glasgow University and Texas A&M University, and has sponsored two postdoctoral posts jointly hosted by NOCS in the fields of deep-sea invertebrate taxonomy and biodiversity. The Director of SMRU told us of another oil and gas company project to study the problems of noise that the sector generates on marine life.[172] This involves a significant amount of funding over three years for peer-reviewed research that will produce outputs in the scientific literature.[173] In the environmental field, much of the information available comes from industry surveys. Dr Tew of Natural England commented that "the quality of

169 Ev 95

170 Pugh & Skinner; Q 22

171 Ev 250

172 Q 421

173 Ibid

the seabed seismic research they do is fantastic, and that is allowing the nation to map the seabed".[174]

99. Pugh and Skinner report that other industrial sectors are less likely to conduct research in-house and more likely to look to specialised research companies, such as British Maritime Technology, or to rely on the public sector to pass on results. This accords with evidence we received from IMarEST that the marine technology industry sees itself less as a direct sponsor of research activity than as a "a recipient of the benefits of that research and the benefits of data and information that are collected from public funds and a user of that information to create secondary products".[175] This underlines the importance of technology transfer in this sector, which we discuss in Chapter 8.

Overall funding

100. The overall trend in funding over the last two decades has been dispiriting to those who are concerned with the importance of studying the oceans. Cefas told us that

> Support for particular areas of marine science have changed markedly during the last 20 years. We have seen reduced funding for research vessel based work on oceanography and productivity of the seas. Large open-ended monitoring programmes fell out of favour and have only recently seen limited renewed interest for long-term data sets in the context of climate change. Funding for mariculture in England and Wales was largely discontinued in the 1990's and work on the impacts of hazardous substances peaked in the 1990s.[176]

Witnesses in general agreed that ocean science is underfunded. Professor Sir Howard Dalton, speaking as Chairman of the IACMST, told us that "I think there is no doubt about it, it is seriously underfunded" as far as monitoring is concerned, and that in general the amount of money NERC, Defra and other funding agencies are putting in is insufficient, "judging by the value that the marine environment brings to the economy".[177] He later added that "If you look at the amount of money that we were putting into the marine environment research spend in 1994 … it is less" now than then.[178] On the NERC side, Professor Hill of NOCS asked for a "times two increase in marine science funding".[179] He was supported by Professor Liss of the Challenger Society on the basis that he believed that less than 20% of proposals to NERC for responsive mode funding were successful[180] and that there was also a need for more funds to meet the substantial costs of international programmes.[181]

174 Q 426

175 Q 258

176 Ev 100

177 Q 12

178 Q 512

179 Q 222

180 Q 222, Figures from NERC, reproduced above in paragraph 65, indicate that this is an exaggeration of the real position.

181 Q 223

101. Some witnesses identified particular areas which were in need of funds. The JNCC argued that "research funding for UK marine science needs to be increased but also rebalanced to address major shortfalls, e.g. in relation to biological resources and the effects of human impacts."[182] IMarEST pointed to the same weakness, claiming that "It is fair to say that there is shrinking budget for fisheries research, and for marine biodiversity studies".[183] Similarly, Natural England argued that funding from NERC for research into long-term ecological issues and change was inadequate, leaving itself and others to "struggle to help support through opportunistic contributions from small-scale resources".[184] It also argued for "a significant increase in funding for investigating our seas and oceans … to keep pace with the increasing demands being placed on Natural England and other agencies to produce more evidence to underpin our advice as part of Government's better regulation agenda".[185] In oral evidence, however, Dr Tew, the Natural England Chief Scientist, stressed that "there should be more money going into both" deep ocean blue skies research and near shore applied research.[186]

102. The greatest gaps in funding are for monitoring, as we discuss later, but there is also a need for money for basic science and facilities. This situation is likely to become ever more difficult as demands for both research and monitoring will rise considerably as a result of the proposals for the UK's Marine Bill and the European Marine Strategy Directive. We do not see how current funding levels will enable this challenge to be met. It would be unwise to support NOCS' call for a doubling of funds for marine science, without first obtaining a full costing of what is required. **A full review of future needs for increases in funding, along the lines of the work undertaken already on marine monitoring requirements, is urgently needed.** We note that at the moment, there is no organisation who could take forward such an exercise, by demanding co-operation with its work from all parts of the funding spectrum. A stronger co-ordinating body, such as we discuss below, would be better equipped to monitor the overall level of funding. **Nevertheless, it is clear, even without such a detailed review, that a substantial increase in funding is necessary if marine science is to meet the challenges before it.**

182 Ev 40

183 Ev 138

184 Ev 116

185 Ibid

186 Q 413

4 Co-ordination of research effort and funding

103. It has long been recognised that marine science is not well-served by the current complexity of organisations involved in co-ordinating and funding research in this area. The Lords Science and Technology Committee Report of 1986 concluded that UK marine science was fragmented and underfunded, despite being technically excellent, and that the UK was suffering through the lack of an overall strategy for marine research. In 1990 the Co-ordinating Committee on Marine Science and Technology (CCMST), established in response to the Lords Report, produced its own report which set out a marine strategy for the UK, and recommended that a co-ordinating body of representatives from these areas, including the public, private and university sectors, should be made responsible for co-ordinating, monitoring, advising, supporting and promoting marine science and technology. This proposal was regarded by some observers as "laying the foundations of a comprehensive and co-ordinated approach to MS&T in the UK that would bring together government, academia and industry".[187] However, while accepting the need for some form of overall co-ordination, the Government rejected the recommendation for such a broad-based and central body in favour of a committee composed of members of relevant Government departments and Research Councils: the Inter-Agency Committee for Marine Science and Technology (IACMST).

Inter-Agency Committee for Marine Science and Technology (IACMST)

104. The objectives of the IACMST are to ensure arrangements for information exchange between all the publicly-funded bodies in marine science and technology, and to maintain an overview of national and international activities. Its primary responsibilities are the broad oversight of marine science research and technology activities within and beyond government agencies and to ensure the existence of adequate co-ordination mechanisms.[188] Its terms of reference are to:

- maintain an overview of national and international activities in marine science and technology.
- ensure that there are satisfactory arrangements for the co-ordination of national and international marine science and technology activities;
- encourage the optimum use of major UK facilities for marine science and technology;
- enhance wealth creation and the quality of life through targeted interaction between science and industrial and other user interests in marine science and technology;
- encourage training and education in marine science and technology; and

187 POST report, *Marine Science and Technology*, July 1999

188 Ev 128

- report on IACMST activities and the broad scope of all Departmental marine science and technology activities to the Chief Scientific Adviser annually, and to other member agencies as and when appropriate.

105. The IACMST membership is drawn mainly from Government departments and agencies, with the addition of a small number of independent members and, since May 2006, IMarEST, representing the private sector. The current membership is:

- Centre for Environment, Fisheries and Aquaculture Science
- Department for Environment, Food & Rural Affairs
- Department for International Development
- Department for Transport
- Department of Trade and Industry
- Environment Agency
- Engineering and Physical Sciences Research Council
- Fisheries Research Services
- Foreign and Commonwealth Office
- Institute of Marine Engineering, Science and Technology
- Meteorological Office
- Ministry of Defence
- Natural Environment Research Council
- Northern Ireland Office
- Office of Science and Innovation
- UK Hydrographic Office
- Welsh Assembly Government
- Professor Peter Liss (President, the Challenger Society)
- Mr Ian Townend
- Professor Graham Shimmield (Director, SAMS)

We assume that the successor departments to DTI and OSI (Department for Business, Enterprise and Regulatory Reform and Department for Innovation, Universities and Skills, respectively) will take their places on the Committee. The IACMST was initially chaired by an independent industry representative, and it reverted to an independent chairmanship with the resignation of its current chairman, Professor Sir Howard Dalton, from his

position as Chief Scientific Adviser at Defra since he is to continue as IACMST chairman for at least a year.[189] The IACMST secretariat is based at NOCS.

106. The IACMST stressed to us that its remit was "to ensure that there are satisfactory arrangements for the coordination of national and international MST activities" and not necessarily to do that co-ordination itself.[190] However, the IACMST has established several initiatives to improve the co-ordination of UK marine research. These include a horizon scanning capability for new policy-related research areas (for example, the effect of sound on marine mammals) and action groups which focus on global observing systems and data issues. Of these, the GOOS AG (Global Ocean Observing System Action Group) works to co-ordinate marine observation programmes operated by the UK, to improve the co-ordination, development and application of operational models of the shelf seas around the UK and to improve co-ordination of UK input to the GOOS programme. The MED AG (Marine Environmental Action Group) focuses on improving access to marine environmental data, including through its oceannet website. These arrangements are likely to change. The IACMST told us that "discussions are underway exploring the transfer of some of these responsibilities to a new body arising from the Government's marine stewardship commitments [the Marine Assessment Policy Committee]; the organisation of marine science in the UK is not static."[191]

107. The IACMST also runs the Marine Data and Information Partnership, which provides a co-ordinating framework for managing marine data and information to facilitate improved management of the UK seas (see paragraph 192 below).

Departmental responsibility

108. There is confusion over departmental responsibility for the IACMST. When the Committee was first established, it was formally responsible to the Office of Science and Technology and from an early stage was chaired by an OST representative. In 2003, funding for the IACMST was transferred to Defra and Professor Sir Howard Dalton, Defra's CSA, took over as Chairman. The OST/OSI retained formal membership of the Committee. The OSI explained that the change was made because the creation of Defra "created a focus for marine policy and science in Whitehall that had not existed previously".[192] The OSI clearly regarded its responsibility for IACMST as ending at this point. However, the IACMST still considers itself as reporting to the OSI, and indeed its letterheads and all publications describe it as "a Government Committee reporting to the Office of Science and Innovation". The IACMST secretary told us that his understanding, at the time of taking up his post in 2003 and since, was that despite the changes, "IACMST continued formally to report to OST and I have been able to find no record of any change to this".[193] The IACMST Chairman, Professor Sir Howard Dalton, also assured us that "we report to the OSI",[194] although DIUS claimed not to have received an annual report, as

189 Q 487

190 Ev 128

191 Ibid

192 Ev 235

193 Ev 254

194 Q 32

required by the terms of reference of the IACMST, since the transfer of the IACMST to Defra.[195]

109. It is important to determine which department is in charge of the IACMST and of overall co-ordination on marine science. The GCSA, Professor Sir David King, accepted that "we need to go away and make sure that the reporting lines are clear".[196] At the moment there are no reporting lines at all, since the IACMST is not reporting to either DIUS or Defra in any active sense. **It is unacceptable for a Government-funded body chaired by a Chief Scientific Adviser to be ignorant of its formal reporting responsibilities. We recommend that reporting lines for the IACMST be clarified without delay. Defra and DIUS, including the Government Office for Science, need to discuss lines of responsibility and what reporting procedures are required and communicate the results clearly to the IACMST.**

110. We have not attempted to apportion blame for the failure to transfer responsibility from the OSI to Defra, but the relationship between the OSI and the IACMST following the transfer has certainly been inadequate. The OSI told us that it was still a member of IACMST and received circulated papers.[197] This transpires to be a euphemism for non-attendance at plenary meetings where such papers are discussed, since the OSI has not been represented at such a meeting since January 2004. Such neglect makes it less surprising that the OSI was the only witness to offer the opinion that "If IACMST members had doubts about the effectiveness of the body [as a co-ordinating mechanism] we would expect them, or the IACMST Chair, to draw these to OSI's attention", adding that "This has not so far occurred".[198] We also note Professor Sir David King's dismissive attitude towards the IACMST in oral evidence when he suggested that "I personally think that we have rather over stressed the Inter-Agency Committee and its position in the discussion" on co-ordination.[199] We are not satisfied with the attitude of OSI/DIUS towards attendance at meetings of the IACMST or towards the organisation in general. **We recommend that DIUS play a more active part in the successor body to the IACMST which we recommend later in this Report.**

Effectiveness of the IACMST

111. The IACMST has had some success, such as its work on marine noise and in establishing the MDIP. Its website lists several useful publications of its own, including the Pugh and Skinner report and work on monitoring, and it effectively co-ordinates links to funders and education providers, for example. The Committee also plays a valuable role as a forum in which different stakeholders can discuss important issues. IMarEST told us that "The Interagency Committee for Marine Science and Technology (IACMST) provides a vital role in bringing together the departments."[200] In addition, it is not a bureaucratic

195 Ev 262

196 Q 484

197 Ev 263

198 Ev 237

199 Q 505

200 Ev 230

organisation, avoiding the danger of merely adding another layer of officialdom to the already complex structure of organisations and co-ordinating bodies.

112. However, the fatal flaw of IACMST is that it has not provided the central focus on marine research for which the community is looking and which was identified as missing as long ago as 1986. Dr Horwood of Cefas told us rather sadly "I do not believe IACMST has worked but I do not know why."[201] Other witnesses attributed its failure to lack of powers to compel its membership to take a wider view or to contribute to its work. The strongest critic was the IACMST chairman who told us:

> We do not have enough teeth, in IACMST, to bring about many of the changes which…need to be brought about. We do not have resource, we act there in just an advisory role; we are a catalyst, to try to bring people together, and all that we can do is try to bring people together, tell them what the problems are, tell them what the issues are and rely very much upon them to try to sort it out. I think there are a lot of issues which really we do need to address properly, in terms of co ordinating and developing the science, and in some areas I think it is going very well, in other areas not so well.[202]

113. Attendance records for plenary meetings show that many departments attend very infrequently, including the Department for Transport which is responsible for leading the UK response to the proposed EU maritime strategy, DfID, the DTI and the FCO, not to mention the OSI. This has a detrimental impact on the influence of the IACMST, which, lacking powers of compulsion, is reduced to a mere "talking-shop". The President of the Challenger Society argued that the IACMST had "been only partially successful in [its role of promoting co-ordination] because the component bodies are primarily focussed on their own (policy-driven) research agendas. They are often unwilling to contribute to the bigger picture—which may be more about new research ideas than immediate policy issues."[203] The Chief Executive of NERC agreed that the IACMST did not appear to have the necessary "strong feed into the policy and ministerial lead",[204] while from the industry point of view, Dr Rayner of IMarEST argued that the IACMST "needs to have more capacity to effect linkages, to enforce linkages … the problem at the moment is that it is representative of the different bodies in government but it has no ability to do anything other than talk about coordination as opposed to drive coordination".[205]

114. The Secretary of the IACMST suggested that "one useful thing which perhaps could be done is to have added to our terms of reference that the member departments and agencies should be required to report regularly to the Committee".[206] This would encourage attendance and attention from departments but would require a fundamental change in the terms of reference of the Committee. It is also unlikely to win favour from departments. There is also the question of resources. The IACMST has "a two-person

201 Q 168

202 Q 2

203 Ev 121

204 Q 577

205 Q 276

206 Q 6

secretariat funded by one member agency (NERC), a central government pot of ~£50K per annum and annual subscriptions for annually approved programmes from a few of the member agencies."[207] With such limited resources, it is commendable that the IACMST has been able to publish work of such a high standard or take any steps towards co-ordination, but it is clear that it is severely restricted in what more it could do. Granting additional funding for staff or activity, however, would be unwise before first determining what is needed in the way of co-ordination and how best this could be delivered. **We do not believe that the IACMST as currently constituted is capable of fulfilling the role required of it by the challenges facing marine science. It is fundamentally flawed in its constitution, and minor amendments to its budget or resources will not transform the organisation of marine science in the UK.**

Other initiatives

115. There have been a number of recent attempts to introduce better co-ordination of marine science. Cefas cited the Environment Research Funders Forum (ERFF) as an initiative which attempts "to join up the community effort."[208] In addition, Defra has made efforts to pull together marine research from different funding sources, particularly in the area of monitoring and climate change. The United Kingdom Marine Monitoring Assessment Strategy (UKMMAS) (see further below) has been welcomed by the community, although we were told by the IACMST that another recent initiative, the Office for Climate Change, "needs to give attention to integrating the contribution of the marine science community".[209] A third body, the Marine Climate Change Impact Partnership (MCCIP), aims to "provide a co-ordinating framework within the UK for the transfer of high-quality evidence on marine climate change impacts and advice to policy-advisers and decision-makers."[210] It has been generally welcomed by witnesses and held up as a good example of how work in this area should be co-ordinated. Natural England claimed that the MCCIP had "demonstrated in one process how to circumvent the lag time between science and policy, and how a framework can champion UK marine science excellence, where the sum is far more than the individual parts."[211] IMarEST called for greater support for such partnerships, particularly in areas where there is an urgent need to fill the scientific knowledge gaps.[212]

116. We asked witnesses whether there were too many co-ordinating organisations and therefore the danger of further fragmentation. Professor Shimmield of SAMS disagreed, arguing that the number of bodies showed "the breadth and pervasiveness of understanding climate change impact across the marine and terrestrial environment".[213] He felt that "they have been quite effective in producing some of the new status reports that are coming out".[214] Professor Watson countered that, from a university point of view,

207 Ev 128

208 Ev 99

209 Ev 130

210 www.mccip.org.uk/summaryaimshtml

211 Ev 211

212 Ev 229

213 Q 449

214 Q 450

"many of these do not make a lot of difference at the practical level of the day-to-day doing of the research".[215] Dr Horwood of Cefas told us that "there is a huge amount of co-ordination that goes on".[216] However, he identified the existence of "the weak bit from our type of organisation to NERC, the research councils and the universities"[217], and in written evidence Cefas conceded that "the evidence of well-integrated programmes is sparse".[218]

Self-organisation

117. The NERC marine directors pointed to a strong trend within marine science towards self-organisation. A good example of this in terms of the research centres is Oceans 2025. The Challenger Society also saw "signs that the recently reconfigured National Oceanography Centre (NOC) at Southampton is now beginning to take on a national leadership role", which had "not been forthcoming in the past."[219] This change arises from the bestowing on NOCS of "an explicit remit by NERC to act to facilitate coordination of marine science in an impartial and inclusive manner".[220] NOCS has established a National Marine Co-ordination Office, to assist the marine directors to deliver the national vision and the remit of the marine directors' forum. We note, however, that this mandate is ambiguous as NERC does not have any power outside its own institutional network: the universities in particular are very wary of this initiative and have not been consulted on the development. There are other examples of similar developments elsewhere in the sector, In Scotland there are moves to develop a "virtual" Scottish marine science group (Marine Science Scotland), involving the universities and the Fisheries Research Services.[221] We could also include here the formation of the National Centre for Ocean Forecasting (NCOF), a consortium of the Met Office, and four NERC-funded institutions, which seeks to develop more rapid uptake of ocean modelling advances into operational simulation systems.[222]

118. Self-organisation can also be observed at the EU level. The European Science Foundation (ESF) Marine Board plays an important role in bringing together the marine community. The NERC centre directors considered that the ESF was "taking an increasingly proactive role in highlighting the contribution that marine sciences can make to the policy agenda".[223] NOCS described the ESF's November 2006 report, *Navigating the Future III*, as "an excellent synthesis of perspectives on marine science and technology in Europe".[224] In addition, the recent EurOCEAN conference in Aberdeen brought together 200 representatives of the European marine and maritime science and technology community, policy makers and non-governmental organisations from fifteen EU coastal

215 Q 450

216 Q 165

217 Q 166

218 Ev 99

219 Ev 121

220 Ev 168

221 Ev 98

222 Ev 173

223 Ev 202

224 Ev 170; www.esf.org/marineboard

states. The purpose of the conference was to comment on the EU maritime green paper and to issue a joint "Aberdeen declaration" on marine science and technology (see further below).

119. Moves towards self-organisation furnish a good example of grassroots action to adopt structures to meet their needs. The bottom-up approach is an effective mechanism for ensuring that the voice of scientists has a real influence in determining strategy. Nevertheless, there are limits to this approach in that it does not allow for a national strategic overview nor the inclusion of all players. It also limits the ability to change to those structures over which the grassroots have direct control. We note that NOCS argued that the drive towards self-organisation "perhaps points to a weakness in existing institutional structures for coordination".[225] We welcome the development of closer collaboration between scientists and institutions but individual arrangements are not an effective substitute for more cross-government organisation and national and international co-ordination.

Co-ordination in other countries

120. We have received evidence that co-ordination is more effective in other countries. For example, the Challenger Society cited France as an example of a country which appeared to have better arrangements for the co-ordination of their marine activities than exist in the UK.[226] We also had the opportunity to discuss co-ordination in the US and in Portugal. In the US, the National Oceanic and Atmospheric Administration (NOAA), which is embedded in the Department of Commerce, oversees the funding and co-ordination of the country's strategic marine science research. This has the advantage of tying together marine and atmospheric research. As an agency, NOAA has higher status and greater power than a committee. It also funds its own research and is a key player in the US oceans strategy for marine research (see paragraph 291 below).

121. Portugal is not a world leader in marine research, unlike the US, but it has addressed this under its reorganisation of its maritime policy and the priorities set for marine research within that structure. The resulting National Ocean Strategy is overseen by a Government Task Force for the Seas which brings together the major players in a much more dynamic form than the IACMST. Again, a task force of senior officials reporting to a Minister and with a clear remit and unifying strategy is a step-change from a committee.

Improving co-ordination of marine science and technology in the UK

122. There is a strong thread of dissatisfaction throughout the evidence to this inquiry with the effectiveness of co-ordination of marine science across all funding bodies. For example, the IACMST told us that

> There is a need for continuing and strengthening coordination across all of the UK marine science community. Marine science and technology (MST) responsibilities are distributed widely across Government departments, agencies and NDPBs.

225 Ev 173

226 Ev 121

> Within any one of these, MST may be distributed across a number of different parts of the organisation. Several coordination mechanisms exist but many suffer from being identified too closely with individual departments.[227]

The Society for Underwater Technology argued that "Despite IACMST's best efforts there still appears to be a lack of co-ordination in marine matters between the Departments."[228] Similarly, the Biosciences Federation stated that "the UK's marine sciences remain seriously under-funded and surprisingly disconnected, reflecting a lack of overall co-ordination and an under-appreciation of our true depth of ignorance regarding the composition and dynamics of oceanic ecosystems."[229] The Challenger Society too were concerned at the "few mechanisms for integrating the activities of the many contributors.'[230] They reminded us that the universities are not represented on IACMST at all.[231] Neither of course is the private sector, with the exception of IMarEST.

123. The fragmented nature of oversight and responsibility for marine research by multiple organisations with different interests has led to criticism that UK marine research is unnecessarily complex. This has inevitable consequences. As Natural England explained, "It is still challenging for stakeholders to understand how the various elements integrate together, who is doing what, and therefore how to take advantage of the relevance and value of particular aspects of their work".[232] In oral evidence, Dr Tew of Natural England argued that the current lack of knowledge about the oceans is largely due to "the lack of structure, funding and integration" of marine research in the UK.[233]

124. These criticisms largely focus on co-ordination of strategy and research effort but there are also issues that arise over the lack of co-ordination of funding. Dr Rayner of IMarEST commented that "One of the problems you have is that, once you start talking about funding for marine science and technology, the beneficiaries of the funding are distributed and they are each vying for their individual sources of funds. There is no collective pot, either at a UK level or indeed at the European level, so there has always been this problem of the marine sector being very diffuse."[234] Scientists from the Marine Biological Association agreed that without an improved funding structure, the UK may be in danger of losing its leading position internationally, since "a more coherent approach to funding has led to countries such as Germany, France and the Netherlands challenging the UK's lead role in Europe in certain sectors".[235] This does not necessarily mean a single source of funding: the MBA also observed that "diversity of funding enables much applied research and knowledge transfer".[236] However, it does imply the need for greater co-

227 Ev 128

228 Ev 140

229 Ev 141

230 Ev 120

231 Ev 121

232 Ev 209

233 Q 369

234 Q 253

235 Ev 168

236 Ev 161

ordination to ensure that public research funds are spent effectively and efficiently, whether in research institutes, universities or public laboratories.

125. The importance of greater co-ordination cannot be doubted, especially in the light of increasing efforts to develop holistic strategies that include all with an interest in the sea. The IACMST itself argued that "the brief of IACMST may need to be changed from one of co-ordination to actively drawing forward an updated version of the strategy first developed in CCMST 1990".[237] The Committee would also need powers to implement that strategy. It is interesting that the responsible Minister suggested that "the IACMST is the catalyst that identifies particular areas of research that are required".[238] At present, its performance of this role is limited by inadequate powers and resources but the Minister's answer implies government acceptance that there is a need for an organisation which does take a strategic approach to co-ordination of research needs.

An agency for marine science

126. The Challenger Society suggested that "the merits of having a UK `Wet office' might usefully be considered".[239] It put forward two potential structures. One was to use the proposed Marine Management Organisation (MMO) as "the starting point for such an organisation" , but this found little support among witnesses and we consider that it would be insufficient to roll up this additional responsibility into the fledgling MMO which is already suffering from inter-agency turf issues. It would also mean delaying action until the implementation of an Act which currently exists only as a White Paper. The other possibility proposed was adopting the model of NOAA, the agency which is responsible for ocean and atmospheric monitoring and research in the US.[240]

127. We have looked closely at the recommendation that the UK needs an agency to co-ordinate marine research effectively. In general, witnesses were in favour of the idea. Asked if he supported a specific marine agency to co-ordinate research and to drive the science, Professor Sir Howard Dalton told us that "personally, I think that would make a lot of sense".[241] He added that "there is a whole series of activities … which, I think, if it were to come under some sort of agency operation, would make a lot of sense, in trying to bring about the co-ordination".[242] The three witnesses from industry who gave oral evidence all agreed that the equivalent of NOAA in the UK would be an advantage.[243]

128. Dr Thompson of EPSRC put two arguments against an agency: first, that it might be an unnecessary extra layer of bureaucracy ("people dread—and my own organisation is as guilty of this as anyone—getting entwined in lots of discussion meetings without seeing very positive forward action"; and second, that it might weaken the existing links between

237 Ev 128

238 Q 480

239 Ev 121

240 Ev 122

241 Q 32

242 Ibid

243 Q 367

marine and terrestrial activities.[244] Dr Bell of the Met Office was not keen on the idea of an agency precisely because it could cut across the Office's work and break the synergy between weather forecasting and ocean forecasting.[245]

129. Professor Thorpe of NERC suggested that "in many respects, of course, we have parts of NOAA already, and it is called the Met Office … One can see the Met Office as playing a key role in a UK analogue to NOAA".[246] Dr Bell, however, considered that this would give the Met Office responsibilities which it did not have the right expertise to take on in its current form: "The Met Office has a rather small group of people involved in marine research. That would not be an appropriate place to bring all the marine research institutes. Those need to be closer to the universities".[247] In addition, Dr Williamson from the UEA warned that "NOAA includes the fishery responsibility and management, so any UK equivalent of NOAA would then have to take under its umbrella the fishery laboratories in the UK and Scotland; and that is quite a major issue, bringing all of that under one area".[248] Fisheries would not be a natural fit with the Met Office.

130. An alternative to an agency would be to place greater responsibility for strategic oversight of marine science within a Government department. Professor Sir David King felt that it was better for Defra "to take on full responsibility for the marine environment", including co-ordination with other government departments.[249] However, Professor Sir Howard Dalton argued that, in view of the industries which are generating most of the economic output from the maritime sector, Defra might not be the natural home for responsibility for marine science and technology.[250] As mentioned previously, NOAA sits within the US Department of Commerce. Defra's lack of connections with other important sectors such as oil and gas, renewable energy and defence make it an unnatural home for the whole of marine science and technology, and there would also be the position of the Department for Transport as lead department on maritime strategy to consider.

131. We conclude that marine science and technology is a vitally important area, and one to which policy-makers are increasingly looking for solutions to crucial questions. It is not a niche area of interest, which can be shunted off to an obscure committee, but a central concern across Government which requires prominence and proper organisation. The current situation in which lack of effective co-ordination of effort and funding is hampering, rather than assisting, marine research cannot be allowed to continue. Strengthening the IACMST to encourage buy-in from Government departments and provide more resources to expand its activities would still leave a relatively weak body with little influence and few executive functions.

132. We believe that a stronger body than the IACMST is needed. The role of this new body would be to co-ordinate the activities of the funding bodies, to develop strategy (see

244 Q 285

245 Q 68

246 Q 578

247 Q 168

248 Q 580

249 Q 505

250 Q 507

below) and to enforce co-operation between the agencies involved. Clarity of purpose and buy-in from Government departments would be essential prerequisites of success. **We recommend that a new co-ordinating body for marine science, reporting to Defra, be established. This body should bring together all public-sector funders of marine research, together with stakeholders such as the universities and end-users of marine science, and should be properly resourced to fulfil its functions. Because of the range of activities for which greater co-ordination is required at an executive level, our preference would be for this co-ordinating function to be placed with a new marine agency, which should be given executive powers and a budget to oversee operational observations (see further below).** We attach two figures at Annex A, summarising the functions and key relationships which we propose for the new agency.

133. The question arises of how the new marine agency would relate to the new institutions to be established under the Marine Bill. It is essential that there is a defined relationship with the MMO which could address the challenges presented by devolutionary issues. The agency would also provide a natural focal point of international co-operation on marine issues. This proposal would create an agency with a wider remit than just marine science but we believe that it merits serious consideration. **We believe that the transfer of functions to the new marine agency should provide an opportunity to reduce the number of co-ordinating bodies operating in this area and we recommend that the Government review the organisations, committees and other bodies co-ordinating marine-related activities with this aim in mind.**

5 Facilities and government support for marine research

Research Vessels

134. The availability of research vessels is fundamental to marine science. As POL told us, "Without large ships the UK cannot participate in international marine science".[251] The NERC marine directors stressed that the value of scientific cruises is measured not just in the immediate outputs but in their operation as "a major platform for bringing together interdisciplinary science teams and for providing strong cohesion within the national and international marine science community as a whole".[252] At present, NERC has two dedicated research ships operated by the NMF from Southampton. This is a reduction from the three vessels in operation prior to 2002 when the RRS Challenger was taken out of service. NERC also has the RRS James Clark Ross and the RRS Ernest Shackleton operated by BAS, and use of the privately operated RV Prince Madog. Further ship time can be obtained for scientists through bartering, chartering or more novel approaches.

NERC's research vessel fleet

135. The latest research vessel purchased by the UK, the RRS James Cook, was launched in February 2007, having cost nearly £40m, and has recently completed its second research cruise in European waters. There are some concerns amongst scientists who have used the James Cook over certain design problems that have come to light. For example, 'bubbling' (cavitation) from the ship's bow interferes with the sophisticated acoustic equipment and the vessel is considered to be difficult to operate in heavy seas. However, scientists are generally pleased with the RRS James Cook and its facilities which are a huge improvement on its predecessor, and we welcome the James Cook as a significant addition to the UK's research capabilities.

136. The second research ship, the Discovery, was built in 1962 and converted in 1992 to maximise its operational flexibility. The NERC marine centre directors expressed concern that it was becoming increasingly unreliable and therefore jeopardising the UK's position in international bartering negotiations.[253] This was supported by the Challenger Society who told us that "in the past year, three research cruises (each of ~ 1 month duration, involving 20-25 researchers and a total investment in excess of £1M) have been either abandoned or postponed for a further year or so due to severe technical problems" with the Discovery.[254] The NERC directors argued that "This creates gaps and uncertainties in the UK science programmes and demotivates our leading researchers".[255] The ship will be retired in 2011 but a replacement will not be available before then. NERC's ocean-going vessel capacity has therefore been reduced to one new ship and one unreliable one, which

251 Ev 103

252 Ev 203

253 Ibid

254 Ev 122

255 Ev 203

inevitably has a detrimental impact upon the amount of marine science which can be undertaken in the field.

137. There is also concern about the lack of a coastal vessel. The Challenger Society pointed out that:

> With the reduction in the NERC fleet and with Cefas and FRS Aberdeen now possessing only one suitable vessel each, we have lost significant capacity for near-shore work. This is arguably as important as open ocean studies for detecting the effects of climate change—for example, changes in river flow, flooding and sea level are likely to deliver more nutrients and sediments to coastal waters, hence affecting planktonic and benthic biodiversity, fishery productivity etc. For these reasons, we need to expand monitoring and research in coastal and shelf waters, the opposite to the present direction of travel.[256]

This was supported by Natural England[257] and NOCS who told us of "concern that coastal and shelf sea marine science is currently compromised by lack of a research vessel".[258] The problem dates back some years. A former Chief Executive at NERC, Professor Sir John Lawton, told us that he had "had at least two requests to fund the provision of new inshore research vessels by good UK laboratories. No doubt the science they would have carried out would have been excellent, but NERC did not have the funds to support these bids."[259]

Bartering arrangements

138. In 1996, a tripartite agreement was signed between NERC and counterparts in France and Germany for managing the respective fleets of scientific research ships and major marine facilities, primarily through the use of bartering mechanisms for ship, equipment and crew time without involving the exchange of money.[260] Other organisations from a number of nations have since joined the scheme (including Norway, Spain, Netherlands) which is now known as the Ocean Facilities Exchange Group (OFEG). The OFEG meets twice a year to synchronise the annual planning cycle and bartering possibilities. NERC has also had bilateral arrangements with the NSF in the US since the 1980s.[261]

139. From NERC's perspective, these arrangements offers two significant advantages:

- They allow scientists access to a wider range of facilities and equipment than would otherwise be possible. This includes 44 research ships and other facilities such as manned submersibles, remotely operated vehicles, towed arrays and shipboard surveying systems. Such facilities are required to carry out "cutting edge" research, but are frequently so expensive that it makes little sense for each country to purchase their own facilities.

256 Ev 122

257 Ev 210

258 Ev 171

259 Ev 97

260 www.nerc.ac.uk/research/sites/facilities/marine/ofeg.asp

261 Ev 239

- It reduces wasted time and money spent on long passage legs between areas of scientific interest, and allows scientists access to a wider range of geographical areas in a given year. In these ways the agreement promotes more efficient and cost effective use of each country's national resources.[262]

140. We support NERC's policy on bartering and believe that it should be pursued wherever possible. However, the relationship between bartering and national capacity is a complex one. Bartering only works where NERC has something to offer. As POL told us, "This arrangement is only possible if the UK can continue to offer berths to international scientists on its own ocean going research vessels."[263] This means that the UK must retain sufficient, attractive capacity of its own, with a good offer of facilities and cruise schedules. Bartering is also unlikely to be the solution to any additional pressure on NERC's research vessels in the next few years: Dr Williamson, representing NERC, explained that "For the next two or three years the NERC schedule is pretty booked up, so any additional demand on that would not be solved by a bartering arrangement, although some of that might be region-figured because of that, but then we have to talk in terms of the full economic cost of buying in time on other people's research vessels, and that is expensive".[264]

Collaboration opportunities

141. The relationship between the civil research community and the Navy is much closer in the US than in the UK. This would seem to imply potential for greater use of MoD vessels by UK scientists. NERC gave evidence on the existing arrangements and commented that "the RN appears keen to provide a service to the marine science community where possible but the RN is not as large as the US Navy and the availability of vessels for research is inevitably limited".[265] The MoD stated that it "provides access to Royal Navy vessels for research purposes on a case by case basis whenever possible and practicable within the limitations of the operational employment of the ships concerned."[266]

142. At the moment, the Navy is involved in efforts ranging from the deployment of Argo floats (see below) to offering support to BAS in the Antarctic and the British Geological Survey in UK waters. Both parties have also made use of one-off opportunities, such as the use of HMS Scott (a MoD hydrographic vessel equipped with high-resolution multibeam bathymetry) after the December 2004 tsunami.[267] NERC reported that "BGS gained the impression that future joint exercises would be possible if the ship was available and if the imperative was significant" and that "the ship's complement during the Indian Ocean survey were very appreciative of having scientists aboard who could actually interpret the data they acquired."[268] The MoD said that "the experience on both sides (Royal Naval and

262 Ev 238

263 Ev 103

264 Q 608

265 Ev 237

266 Ev 248

267 Ev 238–239

268 Ev 238

scientific) was very positive".[269] The Oceans 2025 directors have met MoD to discuss the possibility of enhancing the use of the Royal Navy and their platforms.[270] Asked whether a lot more could be done, however, the Deputy Director, Science and Innovation at NERC, answered simply "yes".[271] A recent report from a NERC working group on polar science gave particular prominence to the role of submarines in this, recommending that "the potential for increased opportunistic use of UK Navy submarines should be exploited to the full".[272]

143. The fisheries laboratories also have a research fleet. The FRS, for example, operates two vessels, the FRV Scotia and the FRV Clupea. Cefas operates the Endeavour. There was agreement amongst witnesses that these vessels "are difficult to access by the wider NERC science community on account of their full commitment to statutory monitoring duties."[273] Professor Hill told us that "there is ultimately an issue about capacity here, and I suspect what could be achieved by bartering in some internal flexibility is rather marginal".[274] We are pleased that following the NERC directors' comments to us on the lack of a coastal vessel, Cefas approached NERC to see whether the Endeavour might be made available to NERC scientists.[275] **We believe that there is scope for better integrated management of the coastal fleet although this may well be limited in view of the demands upon it. A new marine body could act as a clearing house to co-ordinate research cruises and spare capacity on marine science vessels.**

144. There is also the potential for greater sharing of vessels across Europe. Gardline Environmental Limited argued that the James Cook was joining "a European public sector research vessel fleet that is already oversupplied … where each individual EU member state, and each research institute within it, feels the need to have its own, dedicated resource".[276] In preparing the Business Case for the replacement for the Discovery, NERC investigated co-ownership options with its barter partners to see if it were possible to provide the same number of sea days as the Discovery through a partnership. NERC reported that at that time there were no opportunities to co-own any large ocean-going research ships because no partners had any immediate requirement and/or funding in place for new ships.[277] However, we believe that the possibility must be kept open, particularly in the light of the large-scale collaborative efforts between European scientists in marine science (see Chapter 11).

269 Ev 249

270 Q 37

271 Q 38

272 Polar Science Working Group Draft Report, Version 5 for Comment, NERC Polar Science Working Group Report, para 66; www.nerc.ac.uk/research/areas/polar/consultation/documents/report.pdf

273 Ev 171

274 Q 233

275 Ev 264

276 Ev 137

277 Ev 243

Use of private vessels and ships of opportunity

145. Private vessels can be hired for research purposes. NERC has used Joint Infrastructure Funding to provide the University of Bangor with the privately-operated Prince Madog, which is used as a "pay as you go" facility for coastal and continental shelf work.[278] We note, however, Professor Willmott's caustic comment that "she is okay as long as you do not operate off northwest Europe or the Scottish shelf or in the Celtic Sea where, quite frankly, she is not capable of operating in the inclement weather conditions there."[279]

146. Marine scientists have also long taken advantage of ships of opportunity, chiefly to provide data and take measurements, rather than to conduct scientific experiments in the field. The oldest example of this is the Continuous Plankton Recorder (CPR) hosted at the Sir Alister Hardy Foundation for Ocean Science (SAHFOS) in Plymouth. The CPR survey monitors near-surface plankton and has a unique 70-year data record of plankton distribution, seasonal cycles and annual changes. This allows scientists to detect evidence of the reality and impact of rapid climate change on marine life. The aim of the CPR survey is to monitor the near-surface plankton of the North Atlantic and North Sea on a monthly basis, using Continuous Plankton Recorders on a network of shipping routes that cover the area. There are plans to promote the establishment of a CPR programme in all the oceans of the world to evaluate biological changes in the oceans on a global scale.[280] **We welcome the world-wide extension of the Continuous Plankton Recorder concept as an excellent initiative and we urge the UK Government to take the lead in promoting it to fellow Governments at the next GEO Ministerial.**

147. Commercial ships of opportunity are also being used in the North Atlantic, funded as a demonstration project under FP6, to measure the take up of carbon dioxide by the oceans. Professor Watson of UEA described this project and its possible extension to other areas in positive terms, although he called for Government support for some "slight incentive" to shipping companies, "because at the moment they will move their ships at a moment's notice, and this can be quite annoying if you have spent six months putting instrumentation in and then the ship goes off to the other side of the world".[281] Other examples of the use of commercial vessels include Ferrybox, under which programme NOCS have been fitting ferries with underway sampling systems.[282] They have also approached "container vessel operators who are really quite enthusiastic about operating underway systems like this and also probably the cruise liner business will get into this game as well."[283]

148. Professor Thorpe told us that "we are contemplating an extension of making measurements on the commercial fleet of the more routine variety."[284] On the Committee's visit to the US, we heard a proposal from Professor Rossby of the University of Rhode

278 Q 82

279 Q 234

280 Unpublished evidence to the Committee

281 Q 460

282 Q 235

283 Ibid

284 Q 611

Island for using commercial ships as an extra tool in taking measurements of the oceans. Marine scientists need repeated high resolution observations from which to undertake meaningful data analyses.[285] Ships making multiple sweeps could collect such data through a range of instruments that can be towed or carried by ships. Professor Rossby intended to take this concept forward through the Scientific Committee on Oceanic Research (SCOR) but it requires participation by industry and ports authorities, as well as government support. **We recommend that NERC investigate the costs and benefits of a scheme for the widespread use of commercial vessels to take ocean measurements, with a view to providing UK leadership on this project.**

Capacity and demand

149. There is some dispute over whether NERC is currently providing sufficient capacity through its fleet. At present NERC schedules around 550 science days at sea per year and it forecasts that "demand for ship time is expected to remain at current levels".[286] NERC told us that "in a typical year up to 350 scientists, engineers and students gain research training and experience on NERC's research ships".[287] NERC believed that it is meeting current demand and that "there is not strong evidence that NERC is not able to provide access to the ships which the science is demanding".[288] The Prince Madog, for example, has "availability year on year" for coastal and continental shelf work.[289] NERC also believed that "there is capacity at the moment in the UK to charter what we would call more coastal ships".[290]

150. Evidence to us indicates that there is demand for more ship capacity. NOCS, who is responsible for managing the ships, told us that "high quality science demand is outstripping ship capacity"[291] and called for continued investment in major capital infrastructure and facilities for the support of marine science (particularly research ships).[292] The Directors of the NERC Centres also observed that "heavy demand for cruise time from funded marine science programmes already suggests that NERC may have to explore novel approaches to meet demand, such as adding capacity though charter arrangements as well as supporting initiatives to enable use of other ocean going vessels."[293]

151. The historical pattern of use of research vessels is worth noting in this context. We have been told anecdotally that in the recent past, difficulties over funding research cruises meant that vessels were underused. In June 2000, this policy was changed, with the result that there was "a significant increase in ship-time usage".[294] Operational funding was then

285 Presentation to the Select Committee, May 2007

286 Ev 182

287 Ev 183

288 Q 82

289 Ibid

290 Q 85

291 Ev 171

292 Ev 169

293 Ev 203

294 Ev 182

increased from 2004–05 to allow both ships to operate at full capacity, and the demands of scientists have fully met this supply of ship-time. We found persuasive Professor Hill's argument that "It is very difficult to provide evidence for this but I do think that a lot of marine science is partly platform driven. If there is a ship capable of doing it you will find proposals coming in in that area, and because of the lack of capacity of ships for coastal research I think we have seen proposals for coastal science tend to dry up".[295] Research vessels are not a luxury but a vital necessity. **We conclude that there is greater demand for ship-time than the current arrangements are capable of delivering and that vessel capacity is a limiting factor in marine research.**

Conclusions on vessels

152. The importance of the UK retaining its own capacity in research vessels is not limited to their use by UK scientists since the availability of such facilities is a crucial factor in attracting international collaboration. NERC told us that in the last five years, "50% of NERC's research cruises have involved collaboration with international scientists, from 49 institutions and 17 countries".[296] In addition, UK scientists benefit from the bartering arrangements which have been developed with other nations. This would not be possible if the UK did not have its own vessels to offer in exchange.

153. The cost of building new vessels is very significant, although the IACMST urged us to remember that "the vessels have a lifetime as a research platform of 20 years or more and still have a market value beyond that so it is important to apportion the large one-off costs over a long period."[297] The next big project will be the replacement for RRS Discovery, for which a bid to the Large Facilities Capital Fund for £38.5m towards the £60m cost was approved in 2006. POL voiced concerns that "the cost of building new ships continues to rise rapidly and we are concerned that there will be insufficient funds to build a vessel with capability similar, if not greater, than the RRS Discovery".[298] POL argued that "The challenge for the UK Government, and in particular the NERC, is to develop a long-term funding model to support large-scale infrastructure such as aircraft and ships."[299]

154. We commend the use of private vessels and encourage bartering and co-operation between scientists and Government departments to make full use of fisheries vessels and MoD ships. We are concerned that these arrangements at the moment lack overall strategy and foresight. We believe that a review of NERC's capacity and arrangements for managing bartering, chartering and co-operation would be helpful. This review should investigate how NERC could increase the value of its current fleet, as well as extract greatest benefit from the vessels of others. For example, we received evidence from a private operator of survey vessels that the private sector could operate government research vessels for around 20% less than current practice.[300] The review could build on NERC's previous work in this area. We note that "as part of the evidence base which NERC had to build to

295 Q 230

296 Ev 182

297 Ev 129

298 Ev 103

299 Ibid

300 Ev 94

submit a case to OSI for capital funding for the replacement of The Discovery, we had to make a compelling case that we were using our existing facilities effectively and that there was the demand there to use them".[301] **We recommend that an independent review be conducted of the cost-effectiveness of NERC's operation of its research vessels and management of alternative arrangements for access to vessels.**

155. This review should take as given that the replacement for the RRS Discovery will be provided. **We fully support the development of the new vessel planned for 2011 and recommend that the Government and NERC commit to ensuring that this vessel is delivered on time and to specification.** We also accept that there is a need for further vessels beyond this, especially for coastal work. This need is likely to intensify with the new demands made by as a result of the Marine Bill and the European Marine Strategy Directive. **We recommend that NERC develop a case for a new coastal vessel for submission to the large facilities roadmap and that DIUS look sympathetically upon such a bid.**

Other facilities

156. The challenges of the ocean environment makes heavy demands on marine science in terms of expensive equipment and infrastructure. There is therefore great pressure on marine scientists to pool resources and co-ordinate the use of facilities. For this reason, NERC provides centralised marine facilities through the National Marine Equipment Pool (NMEP), the National Facility for Scientific Diving, High-Performance Computing (HPC), airborne research facilities, Arctic and Antarctic bases, the new Centre for Earth Observation Instrumentation (jointly with DTI), the European Space Agency's environmental science missions and marine-related research programmes with a technology-development component.[302] The NMEP, for example, maintains a wide range of equipment, with an asset value in excess of £20m, for use by the UK marine science community.[303] In addition, part of the role of the marine research centres, now gathered under the Oceans 2025 umbrella, is to provide research infrastructure to the rest of the UK marine science community. For example, at PML, facilities made available to researchers and research students include use of inshore research vessels; seawater experimental mesocosms; and world-class capability in ecosystem modelling and satellite remote sensing.[304] Similarly, POL hosts the largely NERC-funded British Oceanographic Data Centre. We have received no adverse comments about these arrangements and conclude that they are working effectively. Nevertheless, **we recommend that the provision of facilities be regularly reviewed as part of the mandate of the proposed new co-ordinating body which would be the best available independent body to obtain objective information from potential users and providers, especially from those outside the NERC community.**

157. Infrastructure and equipment can also be shared across Europe. The Director of NOCS was particularly keen to stress the useful role of the European Strategy Forum on

301 Q 86

302 Ev 182

303 Ibid

304 Ev 118

Research Infrastructure (ESFRI) in co-operation at the European level. He argued that one of the criteria for the UK to remain at the leading edge of marine science was to "increasingly recognise that the scale of investments in major infrastructure required over the coming decades (e.g. cabled sea-floor observatories) will require cooperation" within Europe.[305] In addition to the EMSO (European Multidisciplinary Seafloor Observatory), he singled out EURO-ARGO (European contribution to the global profiling float programme) from the 35-strong ESFRI list for particular attention.[306] NERC also suggested that "partnership arrangements with other countries for the shared resourcing and use of expensive marine equipment, such as the ROV and marine seismics, would seem sensible in the future to ensure that such equipment is fully utilised."[307] **We encourage the development of partnership arrangements within Europe for the provision of highly advanced underwater technologies and infrastructure.**

Technical crew and personnel

158. A new addition to the National Marine Equipment Pool is Isis. Isis is an unmanned deep-diving submersible of the type that has transformed marine science. Professor Thorpe told us that NERC was "very impressed with the measurements that ISIS has been taking and ... what great potential it has".[308] Having seen the preliminary results from the early usage of Isis aboard the James Cook, we imagine that the excitement of the new potential arising from this equipment will encourage scientists to wish to exploit it to the full. However, they will be deterred if they cannot be guaranteed access in the reasonably near future. We were disappointed to be told informally that this resource was underused due to a lack of appropriately trained technicians to maintain and operate it. NERC clarified that the ROV has a dedicated team of technicians who can support its deployment for approximately 100 days a year. This is considered sufficient as Isis is "only required to support a small proportion of NERC sea-going science and the main platform for ROV deployments is the RRS James Cook, which is also required to deliver other marine science activities".[309] NERC's Chief Executive accepted that "Should NERC science require greater access to the ROV in future then the technical support arrangements for the ROV would need to be reconsidered."[310] Just as with demand for ship-time, we are concerned that demand for Isis will be conditioned by the availability of technical support and that bids will not be made as a result. **We recommend that NERC keep the use of Isis under review and ensure that its potential is not undermined by factors such as the availability of crews or platforms. We further recommend that NERC investigate whether there would be more demand for use of Isis, if more time were offered.**

305 Ev 169

306 Ev 171

307 Ev 260

308 Q 617

309 Ev 260

310 Ibid

Information technologies for marine science

159. The transformation of ocean science in recent years has been attributable in large part to the development of computers and software with the power to run large-scale models of ocean processes. Dr Rodgers of BAS told us that "supercomputing … offers us integration … to bring data and theory together".[311] However, there are concerns that the computing power available now is insufficient for the work that needs to be done. Dr Bell of the Met Office told us that "the computing resources to which … the Met Office has access are not as large as the resources that are available in some other countries, for example the USA, Japan and, in our case, also France".[312] He told us that the issue was "being addressed by the Hadley Centre in discussions with Defra and MOD. There are also discussions with NERC as to whether we can share computer resources in the future and get better computer resources".[313] Researchers working in the polar oceans also told us that they need higher resolution computer models in order to understand ocean circulation and to make predictions about changes in the sea ice.[314] The absence of powerful computing resources was "the reason why we are not further forward than we might be".[315] Dr Rodger of BAS explained that, with regard to computer modelling of oceanographic data, "We need multiple runs, for example, in the environment rather than a single run; we do not have the resources to run as many multiple, high-resolution runs for as long as we would wish at the current time."[316]

160. The Chief Executive of NERC accepted that "there is a great demand for increased computing power to utilise the observations that we are making with the ships and to feed it into the climate change question."[317] We recognise that the availability of computing power is an issue not limited to marine science and that greater power is needed to meet the demands of modern science in many fields. **We recommend that NERC keep under review the computing resources needed in the environmental sciences, particularly with regard to NERC's new theme of environmental change.**

Government support

161. The then OSI told us that "Funding is provided for marine science via the Research Councils, in the same manner as for other research areas".[318] This includes funding via applications to the Large Facilities Capital Fund, such as the bid for £25 million towards the purchase of the RRS James Cook and the earmarking of £38.5m for a replacement for the RRS Discovery to be ready for service in 2011/12. Otherwise, the OSI takes a hands-off attitude towards support for marine science, leaving it to NERC to distribute funding as it sees fit. This has consistently been the approach taken by the OSI, with the exception of the establishment and sponsorship of the Marine Foresight Panel in the mid 1990s.

311 Q 446

312 Q 190

313 Q 192

314 Q 431

315 Ibid

316 Q 448

317 Q 613

318 Ev 235

The Marine Foresight Panel

162. The Marine Foresight Panel was set up somewhat later than the other panels in the first Foresight round from 1994 and it published its main report in 1997. The report identified "many opportunities to exploit the diverse marine technology activities where the UK has unique skills and capabilities", in the areas of offshore energies, maritime transport and construction, marine fisheries and aquaculture, coastal waters and maritime leisure and the exploitation of non-living marine resources. It made recommendations for each of these five specific sectors and also for generic research and development necessary to achieve the objectives in these sectors and for policy. The key policy recommendations were:

- appointment of a lead Government department to act as the UK authority for coordinating and sponsoring marine affairs with industry;
- formulation of Government department strategies for marine technology for the next 10 to 20 years;
- effective coordination of individual Government Departments' strategies for marine technology, together with those of the Research Councils' and other funding agencies, in support of competitive development of the marine market sector;
- leading roles for EPSRC, NERC and BBSRC to support strategic and targeted research in marine technology and for marine science in HEIs;
- support for a national assessment of the requirements for marine specialists and for marine education and training;
- a campaign to improve public awareness of the importance of the marine sector to wealth creation and improving the quality of life in the UK; and
- national and international collaborations, wherever opportunities arise, to enable UK to benefit from external sources of funding and to exploit overseas markets for research and technology.[319]

163. When no similar panel was established in the second Foresight round, the Marine Panel considered that its work was "sufficiently successful and thought-provoking" to persuade its members to continue in a private capacity. Foresight provided it with funding of £40k over the next two years.[320] This funding stopped with the move of the Foresight programme as a whole away from standing panels to project-based activities. Since that time, marine science has had a major input into one Foresight project, that on flooding and coastal defence. However, the panel continued for some time in its private capacity; for example, in January 2005 it produced a study on biotechnology, supported by the DTI and the South West England Regional Development Agency.

319 Marine Foresight Panel report, pp.8-9

320 Ev 236

164. Professor Sir David King told us that "Much of the outcome [of the original Panel report] has gone into both the industry and the Research Councils in terms of current work."[321] Asked about monitoring of the report's recommendations, Defra told us that its new marine fisheries research programmes "incorporates all of the recommendations of the Foresight Marine Panel on marine fisheries".[322] However, there appears to have been no systematic follow up of how the Foresight recommendations have been implemented. **We regret the lack of attention paid by Government, in particular the OSI/DIUS, to marine science since the disbandment of the Marine Foresight Panel. We also regret that there has been no systematic attempt to track implementation of the recommendations made by the Marine Foresight Panel. We believe that greater effort is needed in horizon-scanning within the marine science and technology sector, and we recommend that this be included in the remit of the new marine body.**

321 Q 547

322 Ev 265

6 Observations and monitoring

165. Long-term datasets comprising oceanographic measurements and information on oceanic biodiversity are fundamental to the understanding of ocean processes, as well as for the analysis of climate change and other changes in the environment. POL stressed that "long-term monitoring of environmental fields (e.g. temperature and salinity of our coastal seas) provides a vital benchmark for assessing the impact of climate change. Long time series provide an invaluable method for assessing the predictive capability of climate prediction models."[323] The study of the oceans requires measurements over a wide range of timescales, from milliseconds (during the development of tsunamis) to decades (changes in species in a particular region) to millennia (modelling climate change), and a wide range of spaces, from millimetres to many hundreds of kilometres.

166. Monitoring and observation programmes may be nationally or internationally based. Defra listed some 370 such programmes in the UK, run by organizations such as the NERC centres, the fisheries laboratories, agencies, conservation groups and others.[324] Internationally, the UK is involved in programmes such as the Scientific Committee on Oceanic Research (SCOR); the Partnership for Observation of the Global Oceans (POGO); the Global Ocean Ecosystem Dynamics (GLOBEC) programme; and Land-Ocean Interactions in the Coastal Zone (LOICZ) of the International Geosphere-Biosphere Programme. Another such programme is the Argo project: a global array of 3,000 free-drifting profiling floats that measure and report the real-time temperature, salinity and velocity of the upper surface of the ocean. The UK Argo Project has been funded by Defra and the MoD (through the Met Office who manage it) and by NERC (through the National Oceanography Centre, Southampton and the British Oceanographic Data Centre). Dr Bell of the Met Office singled out Argo as a "rather good example" of how technologies have changed dramatically in the last five years, enabling improved remote ocean monitoring.[325] The Met Office use the data "to keep our forecasts on track and close to reality"[326] and Argo data is used by the Hadley Centre for its climate model work, crucial to making decadal climate predictions.

Role of Defra and UKMMAS

167. Defra plays a pivotal role in marine observations as both customer and funder of the different operating systems. The department requires data to underpin its many marine-related policies, both in environmental protection and in climate change work. It is also the UK co-ordinator of GMES, which involves remote sensing of the seas using satellites, and it funds instruments on the satellite ENVISAT (for measuring sea surface temperatures with the accuracy necessary to detect climate change), as well as the Argo programme.[327] There is concern amongst the science community that Defra's investment in monitoring is

323 Ev 103

324 Ev 264

325 Q 138

326 Q 138

327 Ev 152

declining. POL told us that "Persuading Defra to fund long-term monitoring is always an uphill struggle, and the situation is likely to become more challenging with Defra's funding cuts".[328] They cite the tide gauge network (which records UK coastal sea levels) as a casualty of these cuts, explaining that "About 2 years ago the funding of the tide gauge network was transferred to the EA, and now their funding constraints may well jeopardise the future funding and development of the network."[329]

168. In recognition of the need to co-ordinate the collection and use of data, Defra has set up the UK Marine Monitoring and Assessment Strategy (UKMMAS) with the aim of shaping "the UK's ability to provide the evidence to fulfill our vision".[330] UKMMAS has been in development since 2005 and it is expected that it will be ready by December 2007 for implementation during 2008. It will establish a "revised structure through which policy aims, statutory requirements and operational needs are translated to field work, data are managed and assessed in a form that meets those aims and requirements for assessment of the marine environment and the best use is made of available resources".[331] UKMMAS is led by the Marine Assessment Policy Committee (MAPC). At the next level down, the Marine Assessment and Reporting Group (MARG) reports to MAPC and is itself informed by three Evidence Groups. A wry aside in Defra's FAQs on these arrangements notes that how the evidence groups will incorporate the ecosystem approach "is a challenge being investigated in the Evidence Groups".[332]

169. Defra describe UKMMAS as "a step-change in the way we monitor and assess in the UK" and Cefas also believed UKMMAS to be "a good step in the right direction of better-integrated observational science".[333] However, there are concerns about the strategy and what it is intended to achieve, as well as its ability to deliver. NERC commented that "the focus is currently on compliance monitoring, and there is a need for more consideration of how better to include generic marine research and meet longer-term and global-scale monitoring requirements".[334] In addition, NERC believed that "Almost inevitably, more resources are required than have so far been committed."[335] These concerns must be addressed by Defra as UKMMAS progresses.

Gaps in data

170. The importance of monitoring and data-gathering has become of increasing prominence in recent years. It is widely agreed that there are gaps in monitoring of the oceans to meet the evidence needs of policies to address climate change or marine biodiversity. For example, IMarEST listed eight projects in the open ocean and five in coastal waters to which they asked the Government to commit immediately.[336] The £22m

328 Ev 103

329 Ibid

330 Ev 150

331 UKMMAS: A Strategy for UK Marine Monitoring and Assessment, revised 12 March 2007, 1.7

332 http://www.defra.gov.uk/environment/water/marine/uk/science/ukmas-faq.htm#evidgroupea

333 Ev 100

334 Ev 271

335 Ibid

336 Ev 231

funding gap in monitoring identified by UKMMAS was composed of estimates calculated from proposals collated from various publications and bodies, including the IACMST, JNCC and others. The most expensive of these demands was a bid for £8m for mapping the seabed made by the UKHO, BGS and Cefas.[337]

171. There are also questions about the detail of the data that is being gathered. The Biosciences Federation argued that "many of the projects designed to understand the functioning of oceanic ecosystems—an essential pre-requisite for addressing climate change—are obliged to collect data at worryingly coarse levels of resolution."[338] They identify particular gaps in understanding groups in the coastal supratidal (lichens) and subtidal (algae) zones.[339] The MBA added that "There is particular need to separate broad scale low-amplitude global change from regional and local impacts".[340] Professor Sir Howard Dalton agreed, telling us: "We have got all of the sensors in place, except that we do not have enough of them necessarily and the level of detail is insufficient. We have got some pretty broad observational systems, which cover very large areas, but we do not get very much local information. I think the problems really are trying to drill down and get a higher resolution of what is actually going on, because in order to make much better predictions for the future we need measurements of much higher resolution."[341]

172. One aspect of data gathering that became apparent to us as the inquiry proceeded was the lack of information on the human science aspects of the UK's marine environment. We have struggled to find reliable and up to date estimates of the economic value of the marine sector, for example, and have seen no comprehensive information on the social implications of the seas and coast (such as how many people's jobs depend on the marine environment or how human perceptions and values are changing regarding the sea). Information on the social system is crucial for the implementation of the ecosystem approach and for the development of effective policies. Defra's survey of public attitudes (which included very limited information on the marine environment) has not been updated for six years and it is important not to neglect these aspects if the comprehensive approach announced in policy documents is to become a reality. **We recommend that social system indicators be part of future research and monitoring priorities for UK marine science.**

Funding and co-ordination

173. For many years, monitoring work has been a "Cinderella" science and the maintenance of long term datasets was considered an out-dated activity. The MBA pointed out that many such data sets were closed down in the 1980s to make way for marine science that was more fashionable at the time, and that "climate change impacts have 're-vitalised' interest" in this work.[342] The Biosciences Federation also commented that

337 Ev 266

338 Ev 144

339 Ibid

340 Ev 162

341 Q 57

342 Ev 162

> Long-term data gathering has proven especially vulnerable to funding cuts (often management-driven) through the last two decades. Arguments commonly offered in an attempt to justify such decisions include: (a) sufficient knowledge has already been gathered, (b) these are "stamp collecting" exercises rather than hypothesis-testing science, (c) only hypothesis-testing will bring external funding into the organisation, and (d) the expertise needed to maintain such programmes is no longer available.[343]

The Federation argued that it is still "far easier to obtain funds for establishing a database than for populating it with data, analysing those data, or archiving the outcomes".[344] However, the current strong focus on environmental change and sustainability has changed the perception of the value of such monitoring. Dr Horwood of Cefas, in surveying developments in marine science and technology, argued that the key change at the moment, "rather than the wonderful technologies that are coming on board, it is the increasing interest in getting proper baseline information".[345]

174. Given this context, it is perhaps unsurprising that monitoring and difficulties with funding and co-ordinating monitoring programmes were prominent in evidence to our inquiry. At its most basic, there is a problem with absolute levels of funding. The Secretary of the IACMST told us that shifting more funds into monitoring was "the single most important area I would identify where more resources need to be concentrated if the UK is going to be able to underpin its policy in marine better and if it is going to be able to fulfil its commitments on the international scene as well".[346] The ERFF has highlighted that the UK provides £500m for terrestrial observations per year and £36m for marine monitoring.[347] In addition, there are concerns about the stability of funding, especially for programmes such as Argo. Dr Bell of the Met Office, which leads on Argo, was adamant that the Argo funding needed to be made secure.[348] POL also noted the insecurity of funding for long–term monitoring and in addition pointed out that the situation whereby "long-term ocean monitoring ranging from remote sensing to ARGO floats is funded by a number of organizations … is unnecessarily complicated."[349]

175. The source of the difficulty appears to lie in the way in which funding for monitoring programmes is organised in the UK. Professor Sir Howard Dalton told us that

> In many areas of science the UK punches very much above its weight. In this area, I think, probably we do not. I think this is an area where we do need to have a much more co ordinated and sustained effort, in terms of global observation systems. We do make our contributions. I think the problem is that the way in which it has been funded and resourced in the UK is fragmentary. We have had real problems trying to raise sufficient resources in order to be able to play our international part in being

343 Ev 144

344 Ibid

345 Q 143

346 Q 13

347 Ev 129

348 Q 177

349 Ev 102

> able to support and encourage and develop global monitoring systems. I think there is more that should be done.[350]

176. The problem hinges on whether such programmes are regarded as science and therefore funded by NERC, where it has the money, or operational, in which case other funders, such as Government departments or agencies, might step in. This is a crucial distinction, and an important decision since observational programmes require a commitment to long-term, sustained funding. The tension between observations for research and for ongoing operations was highlighted by several witnesses. For example, Mr Gallett of the Society for Underwater Technology explained:

> I think oceanography is going through a fundamental transition with the science at the moment, in that operational oceanography is a relatively new activity and there are huge problems with continuity of observations. Most observations in the oceans have their origin in research projects and research projects are generally short lived, so we get snapshots of the way the ocean behaves from a particular perspective and then that snapshot may cease. I see the biggest problem here is how do you ensure that certain key observations are made continuously and made consistently. This is not research. It may underpin research but it is not research. It is a fundamentally different activity and it needs to be managed and operated in a different way.[351]

The IACMST observed that "the criteria for monitoring national needs are different from those used in the evaluation of research proposals where observations are needed to meet specific, short-term research objectives".[352] It concluded, from its experiences with the use of short-term research programmes to fund long-term data in the case of the Jason-2 altimeter mission and the Argo programme, that "the present UK funding system is not well-suited to funding cross-departmental contributions to observing programmes."[353]

177. Professor Thorpe of NERC concurred that the these two programmes were among instances where "we have been close to the brink" of losing important datasets through shortage of funds.[354] He believed that this situation arose from a further complication where "research monitoring and instrumentation is set up, perhaps with funding, and is then translated into operational long-term use, because the hand-over of funding for that from the purely research to the purely operational, where NERC finds it much more difficult to invest long-term, is troublesome."[355] Dr Williamson, representing NERC, reassured us that "I do not think we have lost anything serious in the last five years, but it has been tough holding it all together".[356] He explained that

> The problem is that there is no shortage of new things that we ought to be monitoring and measuring and that come up through the science, through NERC

350 Q 53

351 Q 340

352 Ev 129

353 Ibid

354 Q 589

355 Q 587

356 Q 588

> that start as a time series of three years, then it is five years and then there can be very awkward decisions: do they get another five years from NERC and another five years after that, or is there a hand-over time? Some things have European funding and some of them have different agencies. Sometimes NERC pays for half and Defra pays for half, and we keep things going on that basis. It is getting harder all the time, in that the number of additional changes now that we feel we ought to have a handle on and that we ought to know about—ocean acidification, the plankton changes, the hydrographic changes—the value of having a time series is that you do not stop for five years, put them to one side and then come back again. All the time, the number of commitments is increasing, and that is a headache.[357]

178. These concerns have led organisations such as the IACMST to argue that there is "an urgent need for a new mechanism to fund sustained measurements that serve UK-wide interests in a cost effective way".[358] UKMMAS is doing good work in identifying gaps and trying to ensure that they are filled but it was suggested by the Met Office that UKMMAS "needs co-ordination of funding as well as just co-ordination in meeting up to get some common ideas".[359] POL explained that "There is a generic issue that as observing and predicting systems progress from research to ongoing operational status, beneficiaries should be identified and assume corresponding shares of the funding responsibility."[360] However, The Challenger Society told us that "it has proved impossible to date to find a funding mechanism for these studies or even a route by which to request new funds, for example via a bid in a Comprehensive Spending Review."[361] Sir Howard Dalton suggested that "Personally, I believe that we might need again some sort of central pot of resources which addresses this issue."[362]

179. In addition, there is the question of strategic oversight and co-ordination. IMarEST argued that, in relation to observations and monitoring, "UK marine science needs to be organised in a more coherent fashion, through a plan agreed by all departments and agencies, to ensure (i) that value is added by each observation made, (ii) that duplication of effort is avoided, and (iii) that gaps in geographic coverage or in technology are filled".[363] NOCS called for "science funders (e.g. NERC) and operational agencies (e.g. Met Office) [to] work more closely together on global ocean observing systems", identifying "a gulf between operational funding for observational infrastructure and that for science."[364] Professor Sir Howard Dalton agreed that "We need a strategy for bringing all of that [monitoring] information together under one roof".[365] NERC's strategy is clear: it invests where there is a science-driven need to have long term monitoring[366], but as decadal

357 Q 589
358 Ev 129
359 Q 163
360 Ev 103
361 Ev 122
362 Q 53
363 Ev 230
364 Ev 171
365 Q 521
366 Q 587

datasets become all the more important in monitoring climate change, the need for sustained observation systems to continue beyond the immediate scientific grant period will become ever more pressing.

180. It is clear that there is a need for more co-ordination, more clarity over responsibilities, more sense of strategy and more funding in the area of marine monitoring. Dr Rayner of IMarEST argued that "those sorts of observations are so critical to understanding climate change that they should be regarded more as critical infrastructure in which nationally and globally we need to engage in effectively".[367] He suggested that the Met Office could take on this role, but conceded that "perhaps we do need a new body" to take responsibility in this area.[368] Professor Watson of the UEA pointed out that "When one looks at the countries that do this well, the United States with NOAA, Japan with JAMSTEC, they have dedicated agencies that do this monitoring".[369] It is not simply a case of dividing monitoring for research purposes from operational observations since there is a continued need in all cases for dialogue between monitoring and research so that data is used to its best purpose and that new ideas can be incorporated into existing programmes. Those responsible for operations should therefore be closely linked to the scientists who design such programmes in the first place, not least so that potential operational requirements may be built into data collection from the outset. **We recommend that the new marine agency, proposed in this Report, be made responsible for marine monitoring. It should also be responsible for setting priorities for monitoring and should have a central budget for operational monitoring and long-term international projects such as Argo. We also recommend that the £22m funding gap identified by UKMMAS be met from central Government funds.**

181. There will always be more demands for monitoring activities than there are funds to meet them. Clearly, there may be occasions where funding should cease. We were interested to hear that the IACMST has provided the methodology for conducting a cost-benefit assessment to establish the value of maintaining or stopping long-term monitoring programmes.[370] **We support this approach and recommend that it be adopted by the new marine body to ensure the efficiency of the UK monitoring programme and secure individual projects against threat of closure merely because they drop out of fashion.**

International ocean monitoring systems

182. The problems identified above in securing funding for long term monitoring are not unique to the UK. Several witnesses called for the UK to take a lead in finding a solution, possible through the forum of the Group on Earth Observation (GEO), on which the UK is represented by Defra.[371] We encourage the UK to do so.

183. There are concerns at the moment that the Government has not previously played its full part in international activity in this area. NOCS described Defra's "commitment to the

367 Q 227

368 Q 338

369 Q 439

370 Ev 129

371 Ev 167, 198

international effort" on global observing as "more fragile" than its support for its immediate statutory and international obligations in coastal waters.[372] For example, several organisations, including the IACMST, called for increased and sustained funding for large-scale and long-term international ocean-observing projects such as the Global Ocean Observing System (GOOS).

184. GOOS is an international programme to record and disseminate data from sustained collection of ocean observations for use in a variety of applications, notably in earth systems modelling and climate forecasting. The UK was instrumental in getting GOOS started, through work with the Intergovernmental Oceanographic Commission, a process that has taken over 15 years since its inception. However, IMarEST described GOOS as only around 50% developed and recommended that the UK should double its investment in GOOS "to meet the increasing requirement for detailed and accurate information in support of global sustainable development".[373] The Society for Underwater Technology also expressed concern that "the requisite network of ocean observatories in and adjacent to UK waters, and in areas of interest to the UK, is not yet in place", adding that "this will reduce the value of the other data being collected, with the UK lagging behind other nations in its commitments to both the GOOS and the GEOSS."[374] Dr Rayner of IMarEST argued that GOOS was too fundamental to our understanding and routine monitoring of the planet to be left to the IACMST and the Research Councils and "should receive much more attention and perhaps be elevated to a different position".[375] **We recommend that the UK Government renew its commitment to GOOS and ensure that the network of observatories is completed according to the timetable.**

185. During the course of this inquiry, we have heard frequent reference to the importance of the Argo programme and concern about the sustainability of its funding. **We recommend that funding be guaranteed for the Argo programme from centralised funds.**

Satellites

186. In our recent inquiry into UK space policy, we heard much evidence about the need to invest in satellites and the benefits that remote sensing can bring to society. The role of satellites in ocean science is particularly remarkable since they can provide real-time data on a global scale. EADS Astrium pointed out that "measurements of the oceans by satellites have long been a major contribution to scientific understanding due to their ability to provide data over large areas of otherwise inaccessible locations".[376] The IACMST added that "Application of satellite remote sensing has matured over the last 20 years to the point where it is now regarded as an indispensable tool for most marine science, particularly when combined with in situ observations and numerical models."[377] Satellite altimetry has

372 Ev 171

373 Ev 232

374 Ev 141

375 Q 347

376 Ev 212

377 Ev 130

demonstrated capability to measure changes in sea level rise and ocean currents on regional to global scales to unprecedented accuracies.

187. The Met Office argued that the UK contribution to satellite monitoring "could be significantly stronger than it is".[378] The IACMST agreed and identified two specific challenges: "how to maximise the benefit to the UK from participation in Global Monitoring for Environment and Security (GMES) and to ensure that the UK can take advantage of very cost-effective arrangements for participating in non-ESA satellite programmes that are of relevance to marine science", citing the Jason-2 altimeter mission as an example of the difficulties in this area.[379] IMarEST also stressed the need to "continue shared funding of the European Space Agency's (ESA) programme of measurements of the open ocean and increase funds to ESA for new sensors (e.g. salinity)".[380] The Institute was particularly concerned about the maintenance and continuity of the network of satellite altimeters which make observations of ocean circulation, stating that "At present there is a critical gap between existing missions (which are near to the end of their design lives) and replacement missions (which are not scheduled for launch until 2013)."[381]

188. The IACMST suggested that the UK "should also consider investing in constellations of small satellites", which "would overcome some of the sampling problems associated with observing the oceans and may also open up new possibilities for UK industry."[382] The IACMST Secretary told us:

> The UK does have real, leading expertise in small satellites and that is something really which could be exploited much better by the UK. There is a real sampling problem with the ocean, compared with the land, where you have got things changing rapidly, and this can be overcome partially by having constellations of satellites, equipped with suitable sensors. There is a real opportunity there for the UK to carve out a niche, which would be not only in line with UK technology and industry but actually would meet a number of user requirements in the research councils and in terms of meeting policy agendas of Government.[383]

We discussed the UK's small satellite sector in our recent Report, *2007: A space policy* and we agree that there is potential for exciting developments here.

189. POL argued that "The UK needs to get its act together regarding all aspects of space research" and that "a proper strategy for space research, including who is responsible for funding the processing and archiving of remotely-sensed data is urgently required."[384] The importance of satellites to marine science was underlined by the NERC report on polar science which argued that "it is hard to overstate the contribution to our knowledge of

378 Q 182

379 Ev 130

380 Ev 232

381 Ibid

382 Ev 130

383 Q 54

384 Ev 103

long-term, ongoing change in the polar regions provided by satellite observations".[385] It went on to "emphasis the need to maintain these observations via the NERC Earth Observation programme of the ESA Earth Explorer and GMES programmes".[386] We note that there is likely to be a serious gap in the deployment of colour sensing satellites, key to understanding the earth's biological systems, particularly in the sea. This will affect a number of monitoring programmes that rely on the provision of this information in real time. Such looming problems demonstrate that there is no room for complacency and that international co-operation is essential in this field. **We recommend that the new marine agency, proposed in this Report, become a partner of the British National Space Centre in order that the needs of the marine science community be fully represented when discussing and determining space issues.**

Sharing data

190. Data from monitoring and indeed research projects is usually made freely available to all scientists who might find it of use. A common policy is that those directly involved have a period of up to two years of unique access to data, after which the data is made widely available to other researchers. However, issues do arise with access to data from certain organisations, including parts of Government.

191. The national facility for storing and sharing marine research data is the British Oceanographic Data Centre based in POL. This holds data which can be used by NERC centres, universities, other UK stakeholders and international institutions.[387] NERC's Chief Executive told us that "We have put quite a bit of investment into making sure that our data is made available, and that our researchers have access to international data sets as well. My feeling is that researchers in the UK anyway have pretty good access to data sets from NERC-generated projects but also world-wide."[388]

192. The IACMST has also been active in trying to reduce barriers to the exchange of data. It has established a network of marine data managers (MEDAG) and developed inventories, catalogues and products, including recent work on photographic and video records. It also hosts the cross-UK Marine Data and Information Partnership (MDIP) which was formed in 2005 to build "the framework for marine data stewardship in the UK in which data collected by any organization can be managed in the long term".[389] Great things appear to be expected of MDIP that it might not be able to deliver. IMarEST expressed concern that:

> Within the [draft Marine Bill white paper] the Marine Data Information Partnership (MDIP) appears to be considered as a permanent body that is appropriately funded, that could undertake some of the data storage and dissemination that will be required by the Marine Bill. In reality MDIP is a 2-year project coordinated by

385 Polar Science Working Group Draft Report, Version 5 for Comment, NERC Polar Science Working Group Report, para 66; www.nerc.ac.uk/research/areas/polar/consultation/documents/report.pdf

386 Ibid

387 Ev 183

388 Q 590

389 Ev 130

> IACMST, with a single permanent member of staff. It is grossly underfunded and relies on the goodwill of industry, government agencies and academia.[390]

This view is supported by the chair of the MDIP group, Professor Liss, who told us that what the group was attempting

> is a very difficult job to do because the data is collected by lots of different organisations, and the attempt is to try to get this into a common framework, common standards, recognised data centres which obey those standards and make the data, as far as is possible, available to the whole marine community in the UK and further afield. That difficult job is run by MDIP, which is a professional organisation, which I chair, but is run on an amateur funding basis because we have only 0.8 of an individual who is paid to lead that work. All the other people have day jobs, which they have to do because they are paid to do them and they put time in whenever they can to contribute to the process. I do not think that is a satisfactory way of doing business because data is extremely important, particularly when we come to the MMO and marine protected areas and licensing and all those policy issues—you have to have the data to start otherwise you make wrong decisions even if you have a perfect system."[391]

We note these concerns and trust that Defra will take them fully into account in its plans under the Marine Bill.

193. Defra claims that data should be captured on the "collect once, use many times" principle. Its Marine Environment Division is currently drafting a marine data policy, including wording to be inserted into research contracts, to "facilitate the collation, release, re-use and storage of marine data", in line with the work of the MDIP.[392] However, concerns were expressed about access to data on three fronts. First, the IACMST, and others, were concerned that the release of data may be affected by "the way that Government activities are structured and funded, including the establishment of trading funds".[393] Dr Williamson of UEA believed that the obligation placed on trading funds to sell their data wherever possible caused particular difficulties for the universities in dealing with the Met Office, for example.[394] Professor Hill of NOCS supported this argument:

> In the UK I do think that there are some serious barriers in the system about being able to fuse certain data sets, not least because some important data—and it is not actually the data as such but the added value information products that are created from those data—are commercially tradable items. Three important sources of those data are the Ordnance Survey, the Hydrographic Office and the Met Office are trading funds and so there is a trade in their added value data products. Other bodies, such as Cefas and the British Geological Survey, whilst not trading funds are

390 Ev 234

391 Q 203

392 Ev 264

393 Ev 129

394 Q 590

operating under increasingly commercial models whereby revenue generation is important.[395]

The IACMST had also experienced cases "where ownership of IPR is compromising what can be delivered in terms of inter-agency working and is a major disincentive for commercial organisations to propose innovative solutions to problems".[396]

194. Secondly, scientists reported difficulties in access to data from the MoD. In an otherwise positive account of its relationship with the MoD, NERC reported that "one area that may be raised in future discussion with the RN is access to the data HMS Scott acquires in her service role".[397] This clearly is not available at the moment for scientific research. Mr Gallett of the SUT, who had direct experience of working in the Navy, observed that "The MOD has quite a lot of data that it is very unhappy to release because perhaps it might reveal operational activities of vessels".[398]

195. Thirdly, POL argued that "Data collected by Crown Estates on marine SSSIs should be deposited in the British Oceanographic Data Centre to facilitate its wide dissemination in the marine science community."[399] The Crown Estate collects a great deal of data to support its business interests which arise from ownership of the seabed and much of the foreshore around the United Kingdom. This data is made available on their website or on an easy access basis to researchers. In these circumstances it does not appear to us necessary to deposit Crown Estate data in the BODC but we encourage full co-operation between the Crown Estate and the BODC and individual scientists.

196. The Society for Underwater Technology reminded us that "users of these data and measurements do not always come from the government laboratories and agencies. There are many companies providing services to a wide range of user communities and who have need of this input data. There is a need to ensure that our scarce resources are well spent and well co-ordinated in the gathering of this data, which can then be made available to the full range of user communities."[400] Another end-user, IMarEST, argued that "To gain full benefit the quality controlled data gathered by the UK must be made readily available within the framework of the EU Inspire Directive and UK commitments to other international data exchange initiatives",[401] while the Environment Agency complained that, despite the British Oceanographic Data Centre, "there is no common database for archiving and disseminating ocean and other marine data".[402]

197. It should not be forgotten that private sector data is also useful to scientists. BP told us that "in general terms BP's marine meteorological and oceanographic … data is available to the scientific community".[403] Having recognised the difficulty that scientists might not

395 Q 237

396 Ev 130

397 Ev 238

398 Q 340

399 Ev 102

400 Ev 141

401 Ev 231

402 Ev 221

403 Ev 252

know what is available, BP and several other companies have joined an initiative called SIMORC (System of Industry Metocean Data for the Offshore and Research Communities) which consists of an index metadatabase and a database of actual data sets, accessible through the internet. SIMORC is funded under an EU framework VI programme and is intended to make data freely available to registered users in consistent and high quality, harmonised data sets.[404]

Conclusions on the release of data

198. In general, we believe that data should be made as widely available as possible as early as possible, through a co-ordinated mechanism such as the BODC. We accept that raw data may in fact be misleading and there will need to be a period of refinement in some cases, although in other cases, real time or near-real time data is already available. We also note the warning of Professor Boyd of SMRU that "making data available does not mean that it is useable".[405] He explained that

> Data needs to be interpreted and, however that data is used, there will almost certainly be an interactive process between the producers and suppliers of the data and the users of the data and we need to find a mechanism that allows that to happen much more smoothly than it does at the moment. We have a mechanism in the marine mammal sector to allow that to happen in the UK which comes out of a rather quirky piece of legislation that came up in 1970, the Conservation of Seals Act, and I personally think that that is a model by which could work in the future in a much wider scale.[406]

We recommend that the principle of "collect once, use many times" be applied to marine data across Government, including the Royal Navy. We further recommend that the new marine agency which we have recommended, or an equivalent body, be charged with finding mechanisms to facilitate the release of data and interaction between producers, suppliers and users of data to maximise its value to the community at large.

European Marine Observation and Data Network

199. The EC maritime Green Paper proposed the establishment of a European Marine Observation and Data Network to give public and private organisations access to all monitoring data via a single portal. The UK Government's position on this proposal is that "We are not persuaded that a new … network is needed".[407] The Government argues that "it would be better to fund [existing] networks effectively and collect this data on a longer term basis than establish another network".[408] This position is difficult to understand as the network is not intended to act as a monitoring agency in its own right. Shared data sets will be critically important for managing transboundary waters (that is, everything that

404 Ev 252

405 Q 413

406 Ibid

407 Com (2006) 275 final, p 22

408 Ibid

surrounds the UK). **We recommend that the Government reconsider its opposition to discussions on a European Marine Observation and Data Network.**

Modelling

200. Data from observations has traditionally been used to track changes but it is increasingly being used for modelling future scenarios. These models can then be tested against real-life events and the results fed back into the model to improve their accuracy. In this way, scientists aim to be able to predict the future and model how different actions might affect it. Models in use or development at the moment include a Defra-funded £11m pa research programme with the Hadley Centre. Ocean modelling is an important component of this state-of-the-art climate model which is being developed and run to inform policies to address climate change.[409] The Met Office also creates "complex models of the Earth System which are used to make weather forecasts, seasonal forecasts and to simulate the Earth's climate and changes in its climate".[410] Within these models, there are separate model components to simulate the atmosphere, the oceans, sea-ice, land vegetation and other components of the environment.

201. Access to these models by scientists and collaboration in their development is an important factor in their effectiveness. The Met Office told us that its policy was to enable NERC staff to contribute to the scientific development of these models and to have access to them for scientific experiments and evaluation.[411] **We commend collaborations on modelling, such as those between NERC scientists and the Hadley Centre and Met Office. We note that it is also important to simulate alternative future economic scenarios. This has been the basis of several IPCC predictions for climate change and the Millennium Ecosystem Assessment that looked at how global and regional biodiversity is likely to be influenced by future development patterns. Economic predictions underpinned the Stern Report on climate change, and a similar approach might be considered for the UK's marine environment**.

409 Ev 152

410 Ev 178

411 Ibid

7 Marine science in the polar regions

The importance of studying the polar oceans

202. The polar oceans play a particularly important role in climate change studies. The impact of climate change on the ice caps and on the circulation of the oceans could have devastating consequences for the planet. Information about past ice ages stored in the ice in the Arctic and Antarctic could assist scientists in understanding both the normal range of changes in temperature and other factors and the phenomena linked to extreme events.

International Polar Year

203. April 2007 saw the launch of the two-year International Polar Year (IPY) programme which is the largest co-ordinated scientific effort for 50 years, bringing together more than 200 Arctic and Antarctic projects and people from 63 nations. The total expenditure will be more than $2bn.[412] We were told that the UK is contributing to 40% of the projects and British scientists are participating in 33 projects, including polar ocean monitoring, circumpolar studies of marine ecosystems and polar gateways.[413] An update in August 2007 suggested that more than half of the 459 projects approved by IPY had the involvement of UK scientists.[414] We commend IPY as an excellent example of international collaboration and interdisciplinary work.

204. There is a question over NERC funding for the IPY. POL stated that NERC has invested just £5m for polar research under its recent IPY funding initiative, which supported only two major projects.[415] Professor Shimmield of SAMS also told us that although "the International Polar Year has been a strong catalyst in grouping people into clusters and setting the priorities accordingly … Resources are still a limitation".[416] In addition, it is important that IPY should not be seen by NERC as merely a two year-long project, but as a long-term refocusing of effort. IMarEST argued that "it is imperative that measurement and monitoring funded by the UK as contributions to the International Polar Year are sustainable and not simply seen as short term research projects".[417] **We welcome NERC's commitment to the International Polar Year but consider that the additional funding dedicated to the UK contribution is less than generous. NERC must confirm that it will provide sustained funding to IPY projects after the end of the programme.**

412 Ev 182

413 Ev Ibid

414 Polar Science Working Group Draft Report, Version 5 for Comment, NERC Polar Science Working Group Report, para 44; www.nerc.ac.uk/research/areas/polar/consultation/documents/report.pdf

415 Ev 102

416 Q 432

417 Ev 230

The UK's role in polar science

205. The UK has a strong presence in the Antarctic through the British Antarctic Survey but has only limited resources expended in the Arctic which may have more direct relevance for the North Atlantic region, including Great Britain. Earlier this year NERC set up a working group to advise NERC Council on the major scientific priorities in the polar regions, and to recommend national and international approaches to supplying the infrastructure required to support these polar science priorities. This includes assessment of NERC's relative investment in the Arctic and Antarctic. The working group published a draft strategy for consultation in August 2007, requesting comment by 1 October 2007. We welcome the review of NERC's activities in polar science.

The Antarctic

206. The UK's involvement in polar science has historically been focussed in the Antarctic where the British Antarctic Survey (BAS) has an established and highly regarded scientific presence. The Southern Ocean surrounding Antarctica is described by BAS as "highly relevant politically, socially and economically to the UK".[418] It cools 40% of the world's oceans and regulates regional and global climate; it contains the planet's largest unexploited marine protein resource; and it has unique ecosystems and exceptional biodiversity.[419] It could also be a direct threat to the UK since if all the Southern Ocean ice were to melt, the sea level around the world would rise by up to 60 metres.[420]

207. Research in the Antarctic is co-ordinated through the Scientific Committee for Antarctic Research (SCAR). The largest individual contribution to this research comes from the US but the second largest comes from the UK, delivered through BAS which provides "the national focus for polar science undertaken by the wider UK science community".[421] BAS has committed itself to become, by 2012, the leading international centre making use of the exceptional importance of the Antarctic and the surrounding Southern Ocean to achieve new insights into key global phenomena and scientific fundamentals. To this end, it has established a five-year research programme Global Science in the Antarctic Context. Its research topics cover climate change; biodiversity, evolution and ecosystems; sustainability of Southern Ocean biological resources; and geology.

208. BAS's facilities include two ice-strengthened research vessels, one of which can be deployed elsewhere for four months of the year, and four shore-based research stations. It also draws on support from the Royal Navy in the form of HMS Endurance. Its research areas cover

209. Whilst most UK effort in the Antarctic is from BAS scientists, there have also been attempts to involve more scientists from other institutions. The Antarctic Funding Initiative (AFI), co-ordinated by BAS, provides responsive mode funding to scientists from

418 Ev 158

419 Ibid

420 Ibid

421 Ev 159

NERC centres and from universities. The recent NERC working group report concluded that AFI was "regarded as providing sufficient access to UK bases in Antarctica for investigators pursuing research that lies outside the BAS core programme".[422]

210. **The UK effort in the Southern Ocean conducted through BAS is truly impressive and gives the UK a genuinely world-leading position in this area of expertise. We support the continuation of this research focus and the resources dedicated to it.** This is particularly important in view of the impact that climate change may be having in the Antarctic and its implications for the rest of the planet. Research into the Southern Ocean needs to be closely aligned and co-ordinated with research into the other oceans of the world, and we were pleased to note that BAS is contributing towards NERC's new Living with Environmental Change programme. However, we were concerned that BAS was not fully involved in the development of Oceans 2025, being merely "linked" to the programme.[423] As a NERC centre with a major focus on marine research, BAS should not have been regarded as at the periphery of the science proposal for the marine centres. **We recommend that BAS be brought fully within the scope of NERC's marine policy as it affects the research centres.**

The Arctic

211. SAMS and Cefas both work in the Arctic but on a much smaller scale to the effort of BAS in the southern polar seas. SAMS has a long history of Arctic interests and has received NERC strategic funding over the past six years for a range of polar studies in the European Arctic.[424] It has also worked with EU programmes, most recently the Damocles project to measure the properties and volume of the water leaving the Arctic system in the coastal waters of Greenland, and is the only UK partner in the Marine Laboratory at Ny Alesund, Svalbard, for which it has dedicated funding for ten years.[425] Cefas is involved in measurements of the flow of cold dense water out of the Arctic region in the sea east of Greenland, which measurements "form a component of the largest ocean-observing system in the hemisphere, the Arctic-Subarctic Ocean Flux study, which was instigated and is currently chaired by Cefas".[426] The aim of this study is "to map out and quantify the freshwater flux out of the Arctic, which is thought to modulate the thermohaline circulation of the World Ocean and provides us with an understanding to support prediction of future climate change".[427] Cefas is also participating in Damocles.[428]

212. Evidence from NERC centres suggests that more attention needs to be paid by the UK to the Arctic. POL described the Arctic as a "barometer" and as the "engine room" for rapid climate change. They argued that "In view of the extreme climate sensitivity of the Arctic, the likely global impact that it will create and the sensitivity of UK climate thereto

422 Polar Science Working Group Draft Report, Version 5 for Comment, NERC Polar Science Working Group Report, para 65; www.nerc.ac.uk/research/areas/polar/consultation/documents/report.pdf

423 Ev 160

424 Ev 165

425 Ibid

426 Ev 101

427 Ibid

428 Ibid

via the thermohaline circulation, we believe that the UK should be at the forefront of research aimed at developing regional (including Arctic) climate prediction models."[429] NOCS agreed that there needs to be a shift of focus of marine science towards the Arctic seas and that "the UK will need to develop its particular contribution in this field of research where other nations have more experience and resources".[430] This might be a matter of co-ordination, rather than substantial extra funding. At the moment, Arctic work is reliant on responsive mode grants, and Professor Willmott of POL suggested that these needs to be harnessed "in a more effective way under a common umbrella to better address some of these really important questions relating to global change driven by the change in the Arctic".[431] BAS agreed that "it is not as much a question necessarily of resource but being more integrated".[432] We note that the recent report from NERC concluded that "a more strategic, long-term approach" to Arctic science was needed on the part of NERC to make a significant impact in the field.[433]

213. There is no UK equivalent for BAS working in the Arctic to lead and co-ordinate activity. Witnesses agreed that the necessary expansion of British involvement in the Arctic would best be done in combination with other nations, led by one of the institutes with current experience in this area. Professor Willmott of POL explained that "we [the UK] have the intellectual base; we have the people, but I think we do not have the infrastructure to go up there and carry out programmes either in marine environment or working looking at meteorological changes".[434] He suggested that "there is a strong case for us over the next ten years to up our game in partnership probably with other European countries, such as Norway and countries like Canada, bordering on the Arctic".[435] Professor Shimmield of SAMS pointed out that there had been "in the last five years a dramatic shift in the way in which Arctic research and Arctic marine research is being carried out", exemplified by "joint education programmes for the universities in the Arctic and UK universities and the University of Svalbard, which is an international organisation for training both at undergraduate and postgraduate level".[436] SAMS is "a founder member of the EU Integrated Infrastructure Programme—ENVINET working in the European high Arctic."[437]

214. International co-operation on infrastructure for Arctic research would certainly need to include the use of research vessels. BAS research vessels are not appropriate for Arctic cruises and are heavily committed in the Southern Ocean, so new dedicated facilities, including an ice-breaker, would be needed to provide year-round data from the Arctic. Professor Shimmield of SAMS agreed that the provision of such vessels "would clearly

429 Ev 102

430 Ev 169

431 Q 251

432 Q 469

433 Polar Science Working Group Draft Report , Version 5 for Comment, NERC Polar Science Working Group Report, para 60; www.nerc.ac.uk/research/areas/polar/consultation/documents/report.pdf

434 Q 252

435 Q 251

436 Q 469

437 Ev 165

need to be done, I think, at a European co-ordination level now".[438] One possibility would be the long-standing proposal to build a European ice-breaker,[439] although the NERC polar working group was decidedly equivocal in its support for this vessel.[440] Instead, the group argued that there should be collaborative arrangements to permit UK scientists to use Canadian, Russian and Swedish vessels, with the necessary proviso that the UK should have a significant partnership role, allowing participation in the planning of cruises, for example.[441]

215. Another expansion of UK capability in the Arctic could be through logistics support. SAMS called in its evidence for NERC to establish "a physical co-ordination and logistics centre" in the Arctic as part of IPY, preferably run by SAMS.[442] POL pointed out that SAMS has "a long track record of collaborating with Arctic nations, in particular the Norwegians".[443] If it were decided to designate a NERC centre as a focus of Arctic activity, SAMS would be an obvious choice. POL argued that BAS was not in a position to provide leadership for Arctic research in addition to their work in the Antarctic because they lacked the facilities and time to do so.[444]

216. The UK could also offer capability in the development of regional Arctic climate prediction models through the Hadley Centre, BAS, the National Centre for Atmospheric Sciences, the Centre for Polar Observation and Modelling, the National Oceanography Centre and the Proudman Oceanographic Laboratory.[445] POL suggested that the modelling capabilities of these centres should be co-ordinated "under the umbrella of a new UK initiative, the Arctic Climate Prediction Programme, say" to enhance their effectiveness.[446] There is clearly scope for the development of collaboration in this area.

217. Professor Dickson of Cefas argued that UK effort had increased in the Arctic in the last ten years and there was now much more information available about the region than before.[447] The NERC Chief Executive accepted that the Council needed to invest more in Arctic research. He pointed out that NERC was working to identify future priority areas[448] and examining opportunities to collaborate with other countries in Arctic research.[449] We believe that the UK should be more involved in Arctic science. We do not, however, believe that this expansion in the north should be at the expense of the UK effort in Antarctica. Nor do we believe that it should be grafted on to the remit of BAS who have a very specific expertise. Instead, we would prefer to see the UK take a leading role in international co-

438 Q 471

439 Q 253

440 Polar Science Working Group Draft Report , Version 5 for Comment, NERC Polar Science Working Group Report, para 64; www.nerc.ac.uk/research/areas/polar/consultation/documents/report.pdf

441 Ibid, para 63

442 Ev 169

443 Ev 102

444 Ibid

445 Ev 102

446 Ibid

447 Q 430

448 Q 567

449 Ibid

ordinating bodies, such as the International Arctic Science Committee, with more support given to SAMS, in particular, to take up this increase in responsibilities, and a strong focus on UK strengths, rather than trying to provide independent capacity. **We recommend that NERC identify funding for an expansion of Arctic research in collaboration with other nations which already have substantial presence there.**

8 Marine ecosystems and biodiversity

Conservation of marine areas

218. There is growing interest in monitoring and protecting marine biodiversity and growing pressure on the Government, arising from various international commitments as well as from lobbying by non-governmental organisations, to establish marine protected areas. At present there is a complex variety of designations which may be applied to marine areas to provide them with a measure of protection. For example, the terms of reference of this inquiry refer to Sites of Special Scientific Interest (SSSIs). We note, however, there are no entirely marine SSSIs in England or Wales and the current SSSI system does not extend below the low water line. The UK also has policy commitments to identify areas for special protection under the Convention for Biological Diversity (CBD), the Johannesburg Declaration (2002), regional seas conventions, such as OSPAR, and EU regulations such as the Habitats and Birds Directive. These agreements set different standards and timetables: the Johannesburg Declaration requires the establishment of a network of marine protected areas by 2012, while the EU directive requires the establishment of marine Special Areas of Conservation (SACs). Finally, there is a power under the home-grown Wildlife and Countryside Act 1981 to designate sites as marine nature reserves (MNRs).

219. These attempts to designate marine nature reserves and marine special areas of conservation have been largely unsuccessful. Just 1.8m hectares or 2.2% of UK waters have been designated under such measures. As yet no entirely marine sites have been designated as SACs, although there are a number with marine habitats or species, and there are only two MNRs in England and Wales, at Lundy and Skomer. In Scotland the Darwin Mounds has also been protected because of its unique cold water coral habitat. This protection followed a landmark High Court ruling in 1999 as a result of litigation between a consortium of NGOs (including Greenpeace and WWF) and the British Government and subsequently a further case where the European Commission took the Government to court for *inter alia* not having properly implemented its regulations in the offshore zone. The paucity of designated sites is despite the emphasis in the Johannesburg Declaration, for example, on establishing a network, rather than individual sites: MPAs in isolation are unlikely to bring major benefits for mobile species or to allow species and habitats to move when the climate changes significantly.

220. Evidence to us objected that site designation is too slow, that attempts to identify candidate sites have failed due to the withdrawal of funding from Defra and more generally that there is a lack of data to underpin the sites.[450] This data includes information on biodiversity but also, according to NERC, basic detailed national seabed maps based on modern techniques.[451] NERC saw this as "a major hindrance to sustainable development of our UK marine resources".[452] Other examples of lack of knowledge included information on cold water corals such as found in the protected Darwin Mounds site, coastal supratidal

450 Ev 107, 136

451 Ev 184

452 Ev 194

(lichens) and subtidal (algal) zones and overall knowledge of species.[453] The RSPB believed that there are data gaps "on both a spatial and a temporal scale for many species and habitats in UK waters" and also in knowledge of "the location and status of mobile marine species such as cetaceans and seabirds".[454]

221. Witnesses to the inquiry argued that these data gaps were sufficient to undermine the whole approach towards designating and protecting sites. The Biosciences Federation were concerned about the paucity of "information on connectivity and ecological functioning of the biotas of particular reserves … to the extent that it is not yet clear whether the current conservation designations are likely to have any useful impact in the longer term,"[455] while the JNCC complained that "systematic surveillance of marine biodiversity in UK continental shelf waters is currently very poorly developed … with the result that it is currently very difficult to assess the status of, and trends in, marine biodiversity or to give a quantitative assessment of the impact of human activities on this".[456] There is also a lack of knowledge with regard to the special nature of marine environments as opposed to terrestrial protected zones. The WWF-UK pointed out that research is needed to allow marine protected sites to be flexible as marine features are likely to move.[457] These gaps in knowledge make it difficult to define suitable sites for protection and to monitor the state of the environment within those sites once designated.

222. There is also a view that part of the failure to establish marine SSSIs in the recent past might be owing to the "acute" fragmentation of research responsibilities in this areas between various conservation bodies, fisheries laboratories and NERC.[458] To combat this difficulty in future, Natural England stresses the importance of multidisciplinary partnerships to underpin the conservation of marine biodiversity.[459] This is supported by the RSPB's call for "multi-disciplinary work to address, coherently and strategically, the monitoring of seabird populations, climate change, oceanography, plankton community dynamics, fish stocks and commercial fisheries".[460]

223. In addition, there is major uncertainty regarding the science underpinning MPAs. This is often based on modelling because of the lack of designated sites from which to gather necessary empirical evidence. This is a chicken and egg situation that can only be overcome by designating a number of meaningful full-scale pilot sites from which suitable evidence can be gathered. In many senses this is equivalent to the creation of a large experimental facility that will provide the basis for excellent science of huge significance for biodiversity conservation and sustainable development. This is a matter of urgency given the failure of current resources to protect the marine environment. **We urge the Government to establish a number of full-scale pilot sites immediately, ahead of the**

453 Ev 141,167

454 Ev 109

455 Ev 146

456 Ev 133

457 Ev 219

458 Ev 123

459 Ev 210

460 Ev 111

Bill, in order to gather the evidence necessary to develop the science needed to underpin MPAs and to enable the UK to become a leader in conservation science.

The Marine Bill

224. The looming deadlines for existing commitments and forthcoming legislation such as the European Commission's proposals for "eco-system based spatial planning" as outlined in its Green Paper *Towards a future Maritime Policy for the Union: A European vision for the oceans and seas* and the EU draft Marine Directive have focussed renewed attention on the Government's plans to designate areas for conservation measures. In March 2007 Defra published a consultation document, *A Sea Change: A Marine Bill White Paper*, which contained proposals to introduce:

- a new UK-wide system of marine planning;
- a streamlined, transparent and consistent system for licensing marine developments;
- a new mechanism to protect marine biodiversity, including marine protected areas (MPAs);
- improvements to the management of marine fisheries; and
- a Marine Management Organisation (MMO) to join up the approach to the marine environment.

The fifth issue of the Marine Bill newsletter published at the same time indicated that the creation of the new MPAs was intended to "introduce new tools for the conservation of marine wildlife to help halt the deterioration of biodiversity and promote recovery where practicable, to support healthy, functioning and resilient ecosystems, and provide mechanisms that can deliver current and future European and international conservation obligations."[461] The proposals include "new powers to designate Marine Conservation Zones using a flexible, objective-based site mechanism, new by-law-making powers to control currently unregulated damaging activities, and improved enforcement measures".

225. These developments have generally been welcomed by witnesses to this inquiry, including the conservation groups, but also the science community. PML, for example, told us that "Some form of very serious protection of an appropriate mosaic of protected areas is the minimum requirement of these vital, yet hugely sensitive, areas. It is also crucial to understand that these areas provide a huge and previously unquantified economic benefit to the UK amounting to many £billions in goods and services".[462] However, there are serious concerns about the feasibility of the current plans. Many of these are generic to the discussion on the availability of data to support selection and monitoring of the sites, as detailed above, but there are also new concerns, specific to the Marine Bill, as to the purpose of the MPAs and the place of science within Defra's new policy.

461 Defra, Marine Bill newsletter, Issue 5, March 2007, www.defra.gov.uk/environment/water/marine/uk/policy/marine-bill/pdf/newsletter5.pdf

462 Ev 119

Purpose of MPAs

226. Defra states that the aim of the Marine Bill is to "help develop and implement the necessary regulation and planning regime for the sustainable use and protection of our seas, coasts, estuaries and marine wildlife".[463] Defra wants to "conserve enough rare, threatened and representative species and habitats to maintain and improve biodiversity and ecosystems whilst covering as small an area as possible".[464] The JNCC, responsible for identifying SACs and SPAs beyond 12 nautical miles from the coast,[465] saw MPAs as providing "a wide range of services, including to biodiversity and ecosystem conservation, the sustainable use of natural resources, and as a resource for education, training and research", adding that "Their value to both conservation and science is increased when they are strictly protected".[466] It is looking for "a representative sample of protected areas of the different habitat types which have had relatively little disturbance".[467] Dr Tew of Natural England suggested that not all of the MPAs needed to provide the whole range of benefits. He explained that "We are also alive to different possible mechanisms where you have highly protected marine reserves which are really left to recover in a completely pristine state and MPAs where they are of a variety of sustainable uses. The concept that MPAs are exclusively just for nature conservation is an old-fashioned one and the conservation community is very alive to the win-wins".[468]

227. The overwhelming emphasis on conservation and environmental protection has worried some in the science community. NOCS warned that "MPAs might inhibit the undertaking of research in these sites, perhaps by prohibiting the operation of research vessels or platforms in particular areas or at specific times".[469] It called for "Full access for well planned scientific research … to be built in to the designation and operating conditions on a site by site basis."[470] However, Wildlife and Countryside Link argued that while "Monitoring and scientific study of marine protected areas, particularly highly protected areas, would enable us to improve our understanding of marine biodiversity and ecosystems", "it would be important to ensure that any scientific research beyond monitoring of the status of an MPA was agreed as part of the MPA designation and management process, and did not impact negatively on the site".[471] There had been an expectation among scientists that some MPAs would be in effect marine SSSIs but Professor Sir Howard Dalton was unable to offer reassurance to us that this would be the case.[472]

463 Ev 148

464 Q 538

465 Ev 265

466 Ev 135

467 Q 391

468 Q 398

469 Ev 172

470 Ibid

471 Ev 157

472 Q 540

The scientific basis for MPAs

228. The place of science within the designation of sites has also been questioned. Decisions will have to be taken on whether they will be selected purely on scientific grounds, with other interests coming into consideration in the development of management plans once the sites had already been identified, or whether all stakeholders will be considered together (for example, those who wish to exploit the seas for energy, food or bioprospecting as well as conservationists and scientists). The RSPB called for sites to be chosen only on scientific grounds, with the impact of sites on socio-economic interests considered only through the preparation of management plans.[473] Conversely, IMarEST argued that "It is vital that economic and social factors should be taken into account and they should be a fundamental inclusion."[474] The Society for Underwater Technology argued that the Marine Bill concentrates "solely on environmental matters, but suggests that Marine Spatial Planning (MSP) would be worthwhile": "to be effective, MSP would need to engage with all users of the UK's seas and, if some of the main ones [eg oil, gas, renewable energy, defence] are not included, it is difficult to see how this would work."[475]

229. However, other witnesses argued that it may not be possible for MPAs to be underpinned by science at all. The EC maritime strategy green paper and the Convention for Biological Diversity, to which the UK is committed, follow an ecosystem management approach which recognises that improvement in biodiversity conservation requires the management of human activities and knowledge of how humans interact with the natural environment. This requires joined-up thinking, which is not in evidence at the moment. The University of Plymouth, for example, suggested that the research necessary to support this new integrated approach to marine policy falls between the remits of the various Research Councils and is currently hard to gain funding for.[476] The IACMST commented that "it is difficult to see how the feed through of marine science into policy on MPAs would work"[477] and questioned "the paucity of scientific knowledge on which policy decisions necessarily have to be made; the transfer mechanism itself; and the resources needed to carry it out."[478] We note, however, that there has been considerable work done to develop the science-based tools for selecting MPAs and managing them.

230. What is needed is a pilot of MPAs of meaningful dimensions in order to test these tools and use them to develop networks. We believe that the choice of marine protected sites must be underpinned by science and linked to the controlled exploitation of oceans. In particular, we believe that policy on MPAs needs to be closely related to the draft bills on climate change and energy. We further believe that MPAs should be capable of being treated as SSSIs and should be accessible to researchers for scientific study, wherever possible.

473 Ev 109

474 Ev 233

475 Ev 140

476 Ev 146

477 Ev 129

478 Ibid

Steps to be taken

231. The gaps in the data are worrying but witnesses were equally concerned that the Government should not wait until all information was available before acting to designate sites. Dr Vincent of the JNCC observed that

> It may be that we have to change the way that we think and be prepared to accept rather lesser data in support of measures at sea than on land. We have just got ourselves into a sort of mindset about the sea. In relation to MPAs, it is possible for us to use the geophysical data to actually pinpoint probable areas that are likely to be rich in biodiversity terms and then target those for survey. So, we do not necessarily have to survey the entire continental shelf and adjacent waters in order to be able to come up with a suite of ecologically-coherent sites.[479]

Dr Tew of Natural England told us that all were agreed on two things: "One is that the process must be based on science … The other thing that we are all agreed on is that we want to proceed with all possible haste because industry suffers from uncertainty just as much as conservationists suffer from uncertainty."[480] We note that the Minister told us that "We are committed to the Marine Bill. We anticipate seeing a draft Bill early next year".[481] His intention is "by 2012 to have made substantial progress in completing our network by designating additional European sites, bringing the total of fully marine sites into the territorial sea adjacent to England and the UK offshore area to around 30."[482]

232. The RSPB called on the Government to "carry out an ecologically-driven assessment of the work needed to identify, designate and monitor a marine SPA (and SAC network) within a timescale that fits as closely as possible with its international commitments to implement a marine protected area network, ie by 2010".[483] Evidence to us suggests Government bodies are aware of the extent of the work required if not the detail. For example, Cefas acknowledged that "the proposed European Marine Strategy Directive … will require significant innovation in assessment and monitoring as well as in marine natural resource management."[484]

233. **We recommend that the draft Marine Bill be brought forward without further delay, despite concerns about Defra's ability to deliver a network of MPAs. We require an assurance from the department as to the speedy presentation of the draft bill and the subsequent bill itself, and a commitment to ensuring that the bill is enacted by the end of the next parliamentary session. We recommend that Defra publish a clear timetable for the bill to complete its passage through Parliament within this timeframe. We recommend that Defra conduct and publish an assessment of what is needed to enable it to designate and monitor chosen sites. However, this assessment should not be used**

479 Q 381

480 Q 398

481 Q 491

482 Q 537

483 Ev 109

484 Ev 100

as an excuse to delay proceedings on the bill: if the department waits until it has all the necessary data, it will never proceed.

9 Technology and knowledge transfer

234. Marine technology encompasses two main areas: provision of technologies to support marine science (such as developing measuring or sampling equipment), or the provision of technologies to support marine engineering (such as the development of vessels and structures placed in the marine environment, such as coastal defences and offshore oil rigs).[485] Knowledge transfer covers the use of scientific or technological development to industry for commercialisation and the use of knowledge or data to support policy or statutory obligations or other activities.

Marine technology

235. There are many different applications for marine technologies, including:

- Transport of goods and people by sea.
- Naval activities in the marine environment.
- Improving safety at sea, for example by designing safe vessels and structures, and helping to predict the location of a vessel, crew or cargo after an accident.
- Exploitation and management of both living and non-living resources including fish, oil, natural gas, aggregates and minerals.
- Renewable energy.
- Protection of property and life, for example by forecasting weather events and protecting coastlines against erosion.
- Safeguarding the environment such as by monitoring water quality, protecting areas and species of marine conservation importance and understanding global environmental variability and changes.
- Recognising, enhancing and conserving marine-based cultural heritage.

236. Industry witnesses told us that the strongest areas of growth were in the oil and gas industry, offshore fish farming, renewable energy and carbon capture and storage.[486] IMarEST suggested that opportunities existed in the development of "green" ship technologies, including "a stronger capability for recycling and environmentally friendly decommissioning and recycling of ships" and "decision support systems for the management of ballast water and associated treatment techniques to minimise the transfer of alien species".[487] There will also be a need for ships that are more fuel-efficient and have lower emissions. Dr Thompson of EPSRC identified key sources of future demand for marine technology in responding to environmental change and in creating more efficient

485 POST Report 128, *Marine Science and Technology,* July 1999

486 Qq 262-3, 267

487 Ev 232

marine transportation systems.[488] Finally, new technology is urgently needed for the fishing industry, not to catch more fish but to be more selective and reduce by-catch.

237. Public support to encourage the development of technology in the marine area and the transfer of knowledge from the academic to the commercial sector comes from the Government and the Research Councils, such as NERC and EPSRC (see below). The newest "Research Council", the Technology Strategy Board, also supports collaboration between industry and academia. Part of its current range of research looking at future commercial potential includes investigating micro organisms as a source of novel enzymes for biocatalysis and supporting research into wave and tidal energy.[489]

Marine technology and scientific advances

238. Marine scientists need new technology to meet the demands of the discipline. IMarEST described the ocean as being "like outer space—an environment that is difficult and costly to reach and hostile to work in" with "the added disadvantage that it is largely non-transparent beyond depths of around 100 meters".[490] This means that those who wish to explore it require novel technologies since, as the Institute astutely comments, "ocean science is blind without ocean technology."[491] The JNCC agreed that "Because of the scale of the marine environment and difficulties of researcher access, technological innovation and development is proving of the utmost importance."[492] They highlighted the value of technological developments such as GPS, remote sensing technologies, electronic tagging, satellite tracking and multi-beam sonar, and predicted that "Mapping, surveillance and monitoring, both of the state of the marine environment, and of human activities, and the effect of those, on the marine environment, will be key areas for future innovation."[493]

239. During this inquiry, we have seen many examples of how new technology can transform science. Autonomous underwater vehicles can now be deployed to remote locations such as beneath the Antarctic ice sheet or to ocean floor hydrothermal vents. These types of location are of great interest to scientists since they are relatively unexplored and uncharted and previous studies have shown them to be areas of great interest in terms of new biodiversity or geological features. Technologies are also complementary to the traditional model of recording observations and taking measurements of the marine environment from a research vessel. Data can be collected using a variety of remotely operated unmanned submersible vehicles (ROVs), autonomous underwater vehicles (AUVs) or fixed or drifting buoys, moorings and gliders.

240. Dr Rodger from BAS told us how there had been advances in the Arctic in the last decade due to new technology.[494] He went on to suggest that any new investment from NERC should be spent on new technologies, such as gliders, towed systems, buoys and new

488 Q 269

489 Ev 261

490 Ev 232

491 Ibid

492 Ev 134

493 Ibid

494 Q 430

moorings, which already existed but were not available in the UK.[495] Professor Dickson of Cefas added that some of what was required had yet to be invented: "we are waiting for sea gliders that will work under the ice and within the shelf [and] that will go all the way to the ocean floor".[496] The NERC directors agreed that the availability of technology in the guise of new instruments and platforms was holding them back: "the identification, understanding, and prediction of many interdisciplinary oceanographic processes remains as elusive because we do not have the tools to make necessary observations and measurements".[497] Similarly, Mr Gallett of the SUT identified technology for filling the gaps in observational datasets as an area that needed "bringing up to speed".[498]

241. There are concerns about the level of investment in marine technology to support science. NOCS told us that "UK investment in marine technology remains relatively low compared to other nations, particularly Japan, USA, France and Germany";[499] while POL argued that

> Apart from the NERC there are few bodies willing to fund marine technology. Better collaboration with EPSRC may benefit technology funding. At present the UK is weak in developing and deploying "big in situ technology" such as robots, deep sea submersibles and autonomous under water vehicles. Sea floor observatories, particularly of the cabled type, are talked about, but nothing happens. We believe that the UK is missing out by not getting involved with "big technology".[500]

NERC supports technology development through its directed programmes (for example, Autosub Under Ice and the SeaSense LINK programme) and through the Oceans 2025 centres.[501] The reorgnisation of funding for the centres under Oceans 2025 has seen an increase in the priority given to technology development, which now forms a central theme with three main research units: Enabling technology for ocean telescience, Development of instruments, platforms and measurement systems, and Towards an optimal observing network. The largest technology R&D team supporting UK marine science is based in the NOCS Underwater Systems Laboratory, where Autosub, a long-range, deep-diving, autonomous underwater vehicle, was developed.[502] BGS is also an important player in developing technology for subsea drilling.[503]

242. EPSRC also funds programmes, mainly concentrating on marine energy research but also marine, coastal and waterways engineering. It has concerns about the strength of the UK research sector in renewable marine energy and has targeted this through their science and innovation award scheme.[504]

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495 Q 437-8

496 Q 442

497 Ev 203

498 Q 340

499 Ev 171

500 Ev 104

501 Ev 183

502 Ibid

503 Ibid

504 Q 270

243. The private sector often has better facilities than the public science sector. Gardline offered the example of the development of systems which undertake seabed stills photography and video imagery.[505] They commented that

> Whilst the private sector has embraced these developments, a number of issues including funding, running costs and lack of knowledge of the latest technologies available have restrained the public sector and research organisations. As a result, outdated systems are being employed on research programmes, resulting in poor data quality, slow acquisition speeds and resultant cost implications.[506]

Private sector facilities are often underused, although there are programmes to exploit them through joint working. For example, the Serpent (Scientific and Environmental ROV Partnership using Existing iNdustrial Technology) programme allows scientists access to ROVs on private vessels. Gardline argued that where systems and technologies have been developed in the public sector, these remain underused within the organisation due to restrictions on their use or prohibitive charges and are often superseded by developments in the private sector.[507]

244. Cefas stressed the role of the private sector in pushing forward technological advances, arguing that progress has "largely been driven by private sector requirements such as in oil and gas exploitation and more recently in the renewables sector" and that "Recent advances in molecular technologies in the marine sector are largely spin-offs from medical research."[508] In order to develop their own science and technology, to make remote measurements (for example, nitrate in marine systems) and to introduce the latest molecular technologies, Cefas has utilised a "seedcorn" investment programme, "partly sponsored by Defra and partly by returns generated from wider markets income when necessary". Cefas commented that this is necessary because "individual customers for our work rarely take the long view of developing such technologies".[509] This implicitly includes Government departments as well as other customers.

245. There is a need to support development of new technologies through industry-academic collaborations. We welcome schemes such as Serpent which enable scientists to use private sector facilities and believe that these moves should be encouraged. However, marine science is an area in which new technology can revolutionise research and allow significant steps forward in understanding fundamental questions. We will be interested to see how Oceans 2025 affects the development of technology in marine sciences, but NERC must be ready to support industry-academic collaborations, international co-operation or the development of new technologies where these are essential to furthering marine science in the UK. Investment in new technology offers the opportunity to improve ocean and coastal sea observations radically and to increase the sustainability of exploitation of marine resources. An investment at this time could enable the UK to be leaders in the field rather than having to purchase technology at a very high cost at a later stage.

505 Ev 138

506 Ibid

507 Ibid

508 Ev 101

509 Ibid

Technology transfer to the commercial sector

246. The private sector with interests in marine science and technology is characterised by a sharp divide between the large international companies operating in the energy fields, for example, and the much smaller companies in the marine technology area. The Association of Marine Scientific Industries told us that the commercial marine science and technology market was predominantly a niche market for specialised products and services, consisting mainly of very small companies.[510] They estimated that there were "probably less than ten or 12 companies in the UK".[511] AMSI argued that "much of the effort to exploit government funded technology has been inappropriate to the MST sector" because of these characteristics.[512] In oral evidence Mr Burt from AMSI explained:

> The financial mechanisms to make [technology transfer] happen are poor, to say the least. There are very little opportunities to get significant funding to pull through technology to the market place. There are DTI schemes, there are NERC schemes, but when we lay these alongside, for example, US schemes, then I think the UK is poorly placed.[513]

247. Mr Burt argued that the DTI schemes, even at their most generous, "contribute very, very little, if anything, as you enter production and bring products to a commercial realisation, so there are significant overheads for the UK to have to recoup once it starts to sell product".[514] Similar rules do not apply in other countries which leaves UK companies at a commercial disadvantage. He also criticised current technology transfer arrangements on the ground that "the disadvantage with the current system is that, more often than not, (a) there is no mechanism to enable early engagement between industry and the centres of excellence, and (b) there are really no formal funding mechanisms to take that through."[515]

248. IMarEST agreed that much of the government effort in technology transfer in this field had been wasted, finding "many of the marine technology transfer offices set up by academics organisations … excessively bureaucratic" and that "the current scheme which encourages and funds academics to exploit their research and technology is often ineffective and can even be damaging to existing businesses where unfair competition may be the result".[516] Dr Rayner explained that IMarEST wanted more funding for existing companies, rather than new spin-off companies, to foster the process of creating a position in the global market.[517] He argued that, given the characteristics of the industry "companies tend to specialise in a very narrow niche and what is really required for small companies is helping them to exploit that niche on a wider geographical basis and helping them to create new technologies into those global niche markets".[518] NOAA in the US plays a much more

510 Ev 228

511 Q 312

512 Ev 228

513 Q 289

514 Ibid

515 Q 260

516 Ev 138

517 Q 309

518 Q 291

active role in promoting the marketing of technologies. This level of integrated support for getting products to the international marketplace is missing in the UK.

249. EPSRC accepted that "If we are developing technology and the UK is not making best use of it, then that is a concern for all of us."[519] Dr Thompson of EPSRC told us that "Within the resources we have, we work very hard to make sure that, where it is appropriate, there are good contacts with companies, so certainly 40 per cent of the research portfolio we support is collaboration with industry."[520] EPSRC is taking steps to address this by going directly to companies and through intermediaries to make companies aware of the support available. The Research Council has also just reorganised its internal structures so that EPSRC have a defined point of contact with every regional development agency in order to "jointly promote companies working in the science base, as well as doing lots of things on a national level working with the DTI."[521] One example of this closer collaboration is a joint NERC/EPSRC project at NOCS, looking at sensors where there were three companies already involved.[522] EPSRC "hope that will shorten the innovation circle because they are there watching over the shoulders of the academics. As soon as they see something that they can go and take value and make a new product from, they will be in there exploiting it."[523] However, EPSRC expenditure on marine technology is "less than half a per cent" of their total budget.[524]

250. NERC told us that it "encourages commercialisation or other industrial application of its marine research and associated technology", citing the example of the Blue Microbe Knowledge Transfer Network.[525] Each NERC marine centre also engages in knowledge transfer, including three (PML, SAMS and SMRU) which have their own commercial companies.[526] SAMS and PML both received funding from the then OSI in the last round of the Public Sector Exploitation fund competition which provides support for the commercialisation of research carried out in public sector bodies.[527] On the other hand, IMarEST criticised the ending of the NERC Marine and Freshwater Microbial Biodiversity programme in 2005 as leaving "a potential gap in linkages between industry participants and research providers".[528] The Institute argued that "A five year funding timescale for such projects is unsuitable due to the lack of understanding of new products (by both governments and potential users) and the long lead times for screening, testing and development", and called for the bioscience industry to receive continued support to expand into marine research.[529]

519 Q 298

520 Ibid

521 Ibid

522 Q 318

523 Ibid

524 Q 317

525 Ev 180

526 Ev 208

527 Ev 261

528 Ev 232

529 Ibid

251. Not all of the products invented in academic laboratories will be suitable for commercialisation. Mr Burt of AMSI pointed out that "There are many, many technologies being developed in marine science and technology centres in the UK often for extreme applications. Very few of them are what I would call commercial products or capable of being commercially exploited".[530] However, IMarEST recognised that "good ideas for exploitable technologies do arise in academic and government labs", adding that "ideally these labs should be encouraged to work in partnership with industry to 'design for manufacture', so as to make their inventions saleable."[531] There are a significant number of products which could be taken on by the general market. We perceive a need to put more money into marine sector and to increase effort in technology transfer. **We commend projects such as EPSRC's efforts to stimulate work in sensor systems where Research Councils have identified a potential gap in the market and moved to address it. We believe that there is greater scope for such activity than has previously been explored and recommend that the Research Councils pursue an active approach to identify areas for technology development in the marine sector.**

Technology and policy formulation

252. NERC told us that "Many of NERC's marine science outputs find application in regulatory activities and policy making, for example in fisheries, flood-control and environmental protection."[532] Concerns were raised with us about access to knowledge by non-scientists for policy formulation. For example, the JNCC argued that "accessing research conclusions presents a major challenge" and called for a series of improvements including "providing electronic access to results, more effective communication of results, and infrastructure provision for reviews on important topics; all publicly-funded marine research data should be held electronically to agreed standards and placed in the public domain; techniques for assessing the degree of confidence of using scientific conclusions to address policy and operational questions".[533] Dr Vincent of the JNCC argued further that "there needs to be some better infrastructure in order to be able to collate information, particularly on key policy issues, and make it more available to the wider user." [534]

253. From the science side, the MBA felt in general that "knowledge transfer from the science community to policy advisors and to industry is not as strong and well-structured as it could be", although the UK "does far better than its European neighbours in transferring information from academic and government scientists to policy makers".[535] It commended the MCCIP as an example of good practice.[536] This was supported by Natural England who praised the MCCIP approach as "a mechanism that could be applied in other marine science areas and in other fields,"[537] and by IMarEST.[538]

530 Q 289

531 Ev 231

532 Ev 179

533 Ev 134-135

534 Q 412

535 Ev 162

536 Ibid

537 Ev 210

254. There are divergent views on whether or not the current findings of marine research are being taken up by policymakers. **We believe that there is an important role for a marine agency to promote knowledge transfer from scientists to policy formulation. This could include publishing data in an appropriate format and promoting stakeholder engagement.**

Industry and strategy

255. From the evidence before us, the UK appears to be missing out on marine technology support. We hope that this will now change with the increased awareness of the Research Councils of the importance of knowledge transfer in general and the welcome emphasis on technology development on Oceans 2025 in particular. One important aspect of this will be closer involvement of industry in marine science. It was a cause of regret to many that the CCMST's proposal to include industry in the new co-ordinating body for marine science and technology was rejected by the Government in the early 1990s. IMarEST emphasised to this inquiry that in improving co-ordination of research funding and strategy, "It is … essential that industry is also engaged with government and the scientific community."[539] Dr Burt of AMSI agreed that a cross-departmental agency would need "to build very clear bridges where industry can be incorporated into that because there may well be cases where industry needs to engage early in some of these programmes".[540] **We believe that the development of marine technology should be an important component of the work of new marine body which should ensure that it engages with industry in developing its strategy and plan of work.**

538 Ev 229

539 Ev 230

540 Q 279

10 Health of the research and skills base

Position of UK research

256. The UK occupies an enviable position in marine science. A former NERC Chief Executive, Professor Sir John Lawton, told us that "Overall, UK marine science is in excellent shape. Over the last decade we have done, and continue to do, world-class science in, for example: the development of Remotely Operated Vehicles (ROVs)—Autosub; monitoring the Themo-haline Circulation through the RAPID programme, of fundamental importance in understanding the impacts of climate change on the UK; carrying out pioneering work on sea surface—atmospheric coupling through the SOLAS Programme."[541] He cited the number of international collaborations involving NERC-funded UK marine scientists as a measure of this success.[542] Other witnesses identified the UK as supporting world-class research in palaeoceanography,[543] "at the forefront of the biological sciences"[544] or "across virtually all disciplines".[545] The MBA told us that "the UK is widely acknowledged as being second only to the United States in marine sciences."[546] This is supported by bibliometrics analysis cited by NERC.[547] There are 18 research groups in UK university departments graded 5 and 5* and four of the marine research institutes have recently been judged to be world class by peer review.[548]

Skills

257. The CCMST, the forerunner of the IACMST, commented in 1990 on the difficulties in training and retaining sufficient marine scientists and technologists, and the present-day IACMST argued that "many of the same comments still hold today".[549] Although the Plymouth Marine Laboratory claimed that the UK skills base for marine science is "extremely buoyant"[550], the difficulties of recruiting and retaining scientists to work in the marine sciences in the UK emerge clearly from the evidence. In the academic sector, Professor Henderson of Oxford University told us that "from a research and both a strategic and non-directed research point of view, there is a looming skills shortage in some areas".[551] Professor Shimmield from SAMS wrote that recruiting numerate PhD and post-doctoral staff was an ongoing problem. He added:

541 Ev 97
542 Ibid
543 Ev 114
544 Ev 126
545 Ev 118
546 Ev 161
547 Ev 183
548 Ibid
549 Ev 131
550 Ev 117
551 Q 122

> We also recognize the need to maintain expertise in marine taxonomy, but find that obtaining the research funding to sustain this skill is very hard indeed. In the past 2 years, we have lost substantial knowledge in deep sea biology and taxonomy, and despite an international search, have found it hard to recruit even at professorial level.'[552]

Recent work by NERC has highlighted possible skills shortages in taxonomy, physical oceanography, mathematical modeling and deep sea biology.[553] Other witnesses identified shortages of mathematicians, oceanographic and ecological modellers, molecular biologists and environmental geophysicists.[554]

258. The numerical disciplines were cited as a particular difficulty. The importance of complex computer modelling for climate change and other forecasting data requires a strong skills base in mathematics and physics. This makes it a matter of concern that POL, for example, told us that they "struggled to recruit well-qualified physicists and mathematicians trained in the UK".[555] Professor Willmott of POL believed that "for many undergraduates studying mathematics, physics, they perhaps do not always realise that there are some really very attractive, exciting careers in marine science. I think there is a lack of information to those sorts of people that there is a very large demand for highly numerate graduates in our field."[556]

259. Cefas offered a different explanation for its particular problem in the recruitment of highly numerate scientists with modelling and statistical skills, and also of experienced very senior scientists, attributing these difficulties to the availability of funding from Defra for salaries and for continuity of research.[557] Professor Sir Howard Dalton accepted that this was a problem.[558] NOCS too blamed availability of funding for recruitment and retention difficulties, arguing that German and US research institutes, the UK's main competitors, "are much better funded than in the UK generally and are becoming increasingly aggressive in their targeting of individuals within UK institutions and NOCS in particular".[559]

260. There is also a challenge in recruiting engineers into marine technology. The NERC directors told us that "The demography of the marine engineering community which risks losing key capabilities in the next few years, particularly in relation to experience of design and operation of moorings" was a serious concern.[560] IMarEST noted that, from an industrial perspective, "At a higher education level training provision is currently lagging behind employer need".[561] POL runs an apprentice scheme to train technicians, but it

552 Ev 166

553 Ev 184

554 Ev 134,162

555 Ev 102

556 Q 246

557 Ev 101

558 Q 556

559 Ev 172

560 Ev 203

561 Ev 233

stressed the links between the shortages of mathematicians and others noted above and the problem of engineering skills: "leadership for marine technology development requires physicists, material scientists and engineers trained up to postgraduate level and at POL we struggle to appoint such people, mainly due to non-competitive salaries."[562] We note, however, that for the oceanographic industry, the requirement is less for marine science graduates and more for electronic engineers and software programmers and designers.[563]

261. The picture is not uniformly gloomy. Professor Liss of the Challenger Society told us that "I think marine science is probably not as badly off as some other areas of science in the UK in terms of recruitment".[564] Several witnesses also identified biologists as a skills set which was well supplied. Cefas, for example, declared itself "able to recruit high calibre biologists at the postgraduate and postdoctoral level".[565] IMarEST attributed this to "Cousteau-effect".[566] Specifically on biology, however, one area of concern was fieldwork skills. The Biosciences Federation believed that "Biology-oriented students passing through the increasingly prescribed route of GCSE–A-level–BSc are not exposed to the practical skills that are essential for planning or conducting marine work in general and its organismal (ecology and systematics) aspects in particular."[567] NOCS too highlighted the lack of recognition from funding bodies such as HEFCE of the cost of fieldwork for undergraduate courses.[568]

262. Issues involving salaries and sustained research funding are not specific to marine science, although we recognise that an important characteristic of marine science is its global nature and several witnesses stressed the impact of this upon their own workforce. Cefas told us

> The mix of nationalities working for Cefas has altered markedly over the last 10 years and the workforce is more mobile with higher turnover rates. This brings many advantages in terms of international networking and joining up the science base, but has the disadvantage for the UK that many marine scientists regard their workplace as global rather than local and they are more ready to move for increases in salary.[569]

The MBA told us that "many research laboratories have a high proportion of non-UK scientists [as a result of lack of skills in the UK], although this reflects the open door policy of the UK scientific community to European and international scientific integration."[570]

263. Work has been undertaken or is planned to identify skills shortages by the Environmental Research Funders Forum, EPSRC and the IACMST. The ERFF is planning a review of the training needs that will be required to support environmental science in the

562 Ev 104
563 Q 331
564 Q 245
565 Ev 101
566 Ev 233
567 Ev 145
568 Ev 172
569 Ev 101
570 Ev 162

UK to meet academia, policy and commercial end-user needs.[571] This will be scoped in November and so will not be available for some time. EPSRC have tried to identify skills shortages and match them with university courses. Dr Thompson identified five current courses in marine technology areas, established in response to needs identified by employers.[572] Mr Guymer of the IACMST told us that his Committee had "identified not only that some skills which were needed in the past have declined but also that there are emerging needs, particularly surrounding the area of operational oceanography"[573] The IACMST has been "discussing with bodies such as the Institute of Marine Engineering Science and Technology how to identify … future needs and what strategies should be implemented to meet them", in areas such as operational oceanography where training provision is lagging behind employer needs.[574]

264. The IACMST suggested more effort should be focused on this issue. Its Chairman, Professor Sir Howard Dalton, admitted that trying "to stimulate industry to try to interact much more with the higher education institutions so that there could be a more active engagement for the universities to have an identification of the sorts of needs that it would have and the skills it would require in the future … is still an issue and it is still something that IACMST talked a little bit about, but it is not very high up on the agenda, I am afraid".[575] Mr Guymer, the IACMST secretary, argued that "We need to have a better understanding of industry's and government departments' present needs and what they anticipate they are going to be in the next ten to 20 years, and then establish a strategy to meet those".[576] In contrast, Professor Sir David King told us that "the prime responsibility [for monitoring and addressing skills shortages in marine science] must rest with employers who are able to make representations through the Sector Skills Councils".[577] We disagree with Sir David on this occasion. **We believe that one of the key tasks of the new marine body should be to review the training needs required to support marine science and technology in the UK and to propose a strategy for tackling identified shortages.** NOCS suggested that there should be more Research Council funding for Masters courses in areas of strategic skills shortages, adding that "In general in marine science we feel that the number of Masters studentships offered by research councils to support students in marine science is inadequate."[578] The review of training needs should cover both industrial and academic requirements across the field, including higher degrees as well as undergraduate and other skills.

Education and outreach

265. Witnesses pointed to the strong attractions of careers in marine science for young scientists. Professor Liss of the Challenger Society commented that "going on research

571 Ev 184

572 Q 332

573 Q 79

574 Ev 131

575 Q 79

576 Q 79

577 Ev 261

578 Ev 172

vessels and conducting measurements of the oceans, observing the oceans, going to Antarctica—these are all very big magnets for young people, as you might expect".[579] Professor Willmott of POL added that "Things like the International Polar Year I think provide a good platform for advertising and marine science, for example, through POL's involvement in an IPY project we have the opportunity to send a student and a science teacher to go on board the Canadian icebreaker next winter".[580]

266. However, this natural attraction is not well supported in the UK education system. At the school level, marine science and the study of the oceans are not covered in the national curriculum. IMarEST told us that "Marine science is typically integrated into the geography syllabus, or even, citizenship, as opposed to being incorporated into the traditional sciences".[581] This is disappointing when marine science has clear attractions to young people and could be drawn into many topics to increase interest in science, such as climate change or the variety of biodiversity in the deep ocean. It also means that there is no incentive at school level for young people to seek careers in oceanography or related disciplines and, at a wider level, it has a negative impact on the general state of public understanding of the relationship of humans to the oceans.

267. Several marine-related organisations are taking steps to increase their outreach work to schools. A section on the IACMST website points to internet resources for teachers and education provided by its members; BAS was praised for its education work during evidence; and we had the opportunity to discuss NOCS' classroom@sea project while visiting the James Cook in Lisbon. Professor Sir Howard Dalton also praised the work of the fisheries laboratories and the Plymouth institutions.[582] We commend these individual efforts but it remains the case that teachers and pupils have to seek out such opportunities and are not directed to them through the curriculum or official guidance. IMarEST called on the Government to "seek to support careers initiatives in Marine Science, Engineering and Technology" and to conduct "a review into the correct place for marine science education", together with paying "more attention …. to increase teacher confidence in teaching 'unusual subjects'".[583]

268. In the US we were struck by the work that has been undertaken by the National Science Federation to link marine science to all aspects of the school curriculum. **We recommend that the Department for Children, Families and Schools investigate the US programme and other ways of integrating marine science into schools and adopt a strategic programme to encourage the study of marine science-related subjects in UK schools.** This should involve inclusion of marine science in the mainstream school science curriculum and presenting it in an integrated manner, not just focussing on the biological aspects. Young people need to appreciate the importance of marine systems at various scales and the relevance to their daily lives and future prospects. We were also impressed by the US Sea Grant programme run by NOAA which gives funding to 30 public universities in the US to conduct programmes into marine science. **We recommend that**

579 Q 246

580 Ibid

581 Ev 233

582 Ev 561

583 Ev 233

DIUS and Defra jointly examine the US Sea Grant programme with a view to whether the new marine body could usefully expend funds of its own to encourage marine research in the HEI sector.

Role of learned societies

269. There are several learned societies with interests in this area, including The Challenger Society for Marine Science, the Society for Underwater Technology (SUT), the Marine Biological Association of the UK, SAMS and IMarEST. There are also some international learned societies, such as the Oceanographic Society, the Amercian Geophysical Union and the European Geophysical Union, which are highly influential in pursuing and facilitating developments in international marine science. We believe that there is scope for the UK societies to extend their own influence by adopting a similarly outward vision in order to take advantage of international scientific expertise.

270. Dr Rayner of IMarEST argued that in any attempts to improve co-ordination by the IACMST or a new agency, "you can use the links to the professional societies as well that have a strong role to play in this process. They can help to foster those linkages".[584] **We believe that the learned societies have a role to play in outreach work and encouraging greater knowledge of ocean-related issues among the general public and in promoting careers in marine science. We recommend that the new marine body, proposed in this Report, develop links with the learned societies for this purpose.**

Increasing public awareness

271. NOCS stressed the fascinating and inspirational aspect of the oceans and the "insatiable public appetite and interest in the sea".[585] They argued that "The oceans thus provide a natural common medium for the engagement of wider society with science".[586] Dr Rodger of BAS suggested that "the deep sea with all its peculiar animals is one way to inspire, so instead of necessarily looking at dinosaurs I would really like to see this generation of youngsters focus on the fantastic biodiversity that you get within the ocean and particularly the deep ocean."[587] Moreover, the current focus on environmental issues and sustainability led IMarEST to suggest that the importance of increasing public awareness of wider marine issues was such that "Government must promote the message that the health of the oceans rests with the entire community. To ensure this government must be committed to broadening its acceptance of the duty of care for marine heritage and to promoting marine science education for all".[588] This is in accordance with the spirit of the European Maritime Green Paper **The new marine body should be charged with raising public awareness of marine issues, including better use of facilities such as science centres and public aquaria. A focus on extreme environments (space and oceans) would entice young people into science. There should also be a duty placed on**

584 Q 283

585 Ev 168

586 Ibid

587 Q 473

588 Ev 230

the new body to raise awareness of marine sustainability issues so that the general public is accurately informed about the importance of the oceans in their lives.

11 International collaboration

International organisations

272. The UK is well represented on international co-ordinating bodies and secretariats for marine science, including an impressive number of UN bodies[589] and the International Council for the Exploration of the Seas (ICES). Witnesses saw scope for better exploitation of the UK's membership of these organisations. For example, the IMO, the only UN agency based in the UK, works on matter relevant to major maritime issues such as invasive species and ship emissions. IMarEST argued that the UK marine science community should "play a stronger role in [the IMO's] work", by providing more effective support to the UK delegation from the DfT and NGOs.[590] Dr Rayner of IMarEST explained that more forceful representation would ensure that the UK marine science and policy community "would be more informed by what is going on in other countries and what is going on at a global level."[591]

273. The IACMST outlined the shortcomings and inconsistencies in existing arrangements for UK participation in international dialogue and collaboration:

> Adequate briefing mechanisms exist for most of the delegations but many are ad hoc, as indeed are arrangements for liaison between the delegations. Much of this stems from the very limited resources available (cross-membership of the different briefing groups helps but is time consuming and often has to be arranged at short notice because of the late availability of documents produced by the international bodies). FCO, assisted by IACMST, are developing plans to improve overarching aspects of coordination.[592]

274. The IACMST secretary singled out the IOC and POGO as mechanisms in which international marine science can be advanced and in which the UK can play a key role, adding that "in those arenas we do punch above our weight; it is not only to do with financial resources, it is to do with our ideas, our intellectual capabilities."[593] We conclude that the UK needs to strengthen the resources dedicated to participation in international bodies and make a firm commitment to their work. There is also room for improvement in the mechanism to feed reports of the work of such bodies back to the scientific and wider communities. **We recommend that a co-ordinating committee, within the new agency, be established to bring together UK representatives on all relevant international bodies in order to establish agreed common policy goals and to make optimal use of UK expertise and technology.**

589 Examples include the Intergovernmental Oceanographic Commission (IOC) of UNESCO; the International Maritime Organisation (IMO); and a number of UN bodies whose work includes marine science, such as the IAEA, UNEP, WHO, UNIDO, FAO and UNDP.

590 Ev 232

591 Q 353

592 Ev 130

593 Q 67

International projects

275. The UK is prominently involved in several major international projects, including the IODP and IMAGES. These projects represent good value for money in that the UK profits from many times more science for its investment through these subscriptions than in direct, national projects. However, we recognise that UK involvement in such projects tends to be expensive. Professor Liss of the Challenger Society told us that "£10m or £20m [is] required for a UK reasonable contribution to one of those international programmes".[594] This raises the question of finding an appropriate mode of funding for such projects. The Challenger Society explained that there are "currently no directed funds for national participation" in several key programmes which "means that to take part in international activities under these projects, scientists have to individually obtain responsive-mode funding from NERC, a system that makes it very difficult to coordinate UK participation."[595] The Biosciences Federation agreed that "The UK is most likely to benefit when it is a full partner in the initiation of international programmes, but at present, establishing such programmes is extremely time consuming and necessitates extensive lobbying; this in turn requires substantial career-time investment by key individuals. Greater consensus on prioritising global issues, and determining the best methods of addressing them, is required."[596]

276. There are cases where UK marine scientists claim that they have missed out on opportunities because NERC has not invested in international projects. SAMS cited the EUROCORES (ESF) programme on the deep ocean (EURODEEP) as "an example where the NERC-based decision ran counter to both international and national expectation".[597] The UK is not a participant in EURODEEP, unlike all the other major European countries. SAMS claimed that "Issues over the use of national facilities (vessels and ROVs) should have been sorted out with the scientific community".[598]

277. There is a further issue over funding to enable UK scientists to exploit the results of their investigations using international platforms such as IMAGES and the IODP. NERC provides a specific pot of money to support science arising from IODP but this is much smaller than that available in Germany or the US.[599] Professor Thorpe told us that the existing research programme focussed on enabling research to be done with the data from the IODP "has been incredibly productive and some of the outputs from the previous phase of the Integrated Ocean Drilling Programme have been among some of the highest cited journal products that NERC has funded".[600] However, the scientists involved believe a little more investment from NERC could reap far greater rewards.

278. A new type of funding is required for international programmes. The UK-IMAGES team called for support for the IMAGES programme as part of a strategic funding

594 Q 223

595 Ev 122

596 Ev 143

597 Ev 165

598 Ibid

599 Ev 127

600 Q 628

programme.[601] POL argued further that "There should be a clear line of responsibility for funding global programmes like CLIVAR, GOOS etc. and not leave it to the fate of individual science proposals like Oceans 2025."[602] **We recommend that NERC examine alternative mechanisms for funding long-term international projects in marine science. It may be that there is also a role for the new marine body here in helping with co-ordination across funders. We also recommend that more funding be made available by NERC or other funders of programmes to enable scientists to exploit the results of international projects.**

International project offices

279. The UK hosts a number of International Project Offices (IPOs), based in each of the marine institutes. For example, PML hosts the International Project Office for GLOBEC, a major IGBP project concerned with marine bioresources, and was the host site for the early development of the IMBER International Project Office (now re-located to France). PML also hosts the national programme office for the Atlantic Meridional Transect programme (AMT) which has provided a platform for numerous international researchers. Together with its other PMSP partners in Plymouth, PML has recently supported the Secretariat of POGO, a subscription organisation comprising all the major research organisations worldwide which exists to promote collection and sharing of marine data and to develop capacity in developing nations. NOCS hosts the IPO for the CLIVAR programme; POL hosts GLOSS (The Global Sea Level Observing System), an IOC/UNESCO funded programme; and SAMS supports the European Census of Marine Life PO, and hosts the IPO on an Ecosystem Approach to Sustainable Aquaculture (ECASA).[603] NERC also funds the IPO for the Surface-Ocean Lower-Atmosphere Study (SOLAS) at UEA.

280. The advantages of hosting IPOs were emphasised by the Challenger Society, which saw the provision of such offices as giving "the UK a strong leadership role in what is planned and executed worldwide, with many benefits to both the UK community as well as to individual scientists who can participate in projects much larger than they or indeed the UK could mount alone."[604] The IACMST added that hosting an IPO "helps to raise the international profile of the hosting institutes" and enables the UK "to help set the scientific agenda of these international projects to maximise their value for the UK".[605]

281. Hosting such an office usually requires some subsidy by the host nation or institution. This makes the attitude of the Research Councils towards IPOs of critical importance. There was some disagreement over NERC's record in this area. NOCS stated that "NERC continues to be generally supportive of the hosting of IPOs".[606] Other centres felt that more support was needed from NERC to enable the host institute to fulfil this role and to communicate the results more effectively to a wider audience. For example, POL identified "a lack of scientific administrative support in the UK which prohibits our scientists in

601 Ev 116

602 Ev 103

603 Ev 165

604 Ev 122

605 Ev 120

606 Ev 170

getting involved in the leadership of international programmes", and argued that "the leadership of large international programmes carries a significant administrative overhead that most UK laboratories cannot easily accommodate."[607] **We conclude that NERC should continue to fund IPOs wherever possible and should provide direct support and assistance in the early stages of bidding for such offices, as well as during the period of operation.**

EU marine research

282. Research and technology has been accorded a chapter of its own in the European maritime Green Paper and this part of the document has generally attracted support from the UK. Dr Williamson of UEA told us that "the input that the NERC laboratories or the funded centres have given on that Green Paper have been favourable, saying that it is going in the right direction and that these are just the sorts of thing that we ought to be doing, that the key issues that have been identified on a European scale give a very good congruence matched to our national priorities and interests and that we think we could play a major part in taking that forward."[608] The official UK Government response supported the goal of developing a more co-ordinated approach to marine research in the EU but called for any measures taken forward to be "balanced and proportional".[609]

283. UK scientists were instrumental in organising the Aberdeen declaration, which emerged from the conference of the European marine and maritime science and technology community held in Aberdeen on 22 June 2007. The declaration welcomed and supported the Commission's proposal for an all embracing European Maritime Policy but called for urgent action by the European Commission and Member States to:

- initiate in 2008 a comprehensive and integrated European Marine and Maritime Science, Research, Technology and Innovation Strategy (to improve foresight activities and to promote multi-disciplinary research and co-operation between research and industry) in support of the EU Maritime Policy;
- establish an adequately resourced and sustained process to oversee the implementation and delivery of this Strategy to support the European Maritime Policy; and
- initiate and support funding mechanisms, specialised infrastructures, data collection and information management, and capacity building essential to manage the oceans and seas.

Professor Thorpe of NERC welcomed the declaration as "a welcome addition to getting better co-ordination and recognising the fact that we can do better."[610]

607 Ev 103

608 Q 623

609 Government Response to the EU Maritime Green Paper: Contribution from the United Kingdom of Great Britain and Northern Ireland on the European Commission Green Paper: Towards a future Maritime Policy for the Union: A European vision for the oceans and seas (COM(2006)275 Final), p 7

610 Q 624

284. **We believe that the UK should participate fully in the development of marine science and technology under the European maritime Green Paper process and show leadership to maximise the influence of UK scientists. We are concerned that this may not be easy with the Department for Transport in charge of Government policy in this area and we urge full consultation between that Department and those with greater knowledge of marine science and technology.** We return to the role of the Department for Transport in the next chapter.

Collaboration

285. Cefas told us that "collaboration on marine science has been greatly facilitated by EU research contracts aimed at joining up the European marine science community".[611] It gave examples of programmes such as EFARO which brings together senior scientists and directors of EU fisheries institutes to share resources, advise the EU Commission on future science needs and set up collaborative research programmes; and of the Networks of Excellence, including EUR-OCEANS which has the overall objective of achieving lasting integration of European research organisations on global change and pelagic marine ecosystems and the relevant scientific disciplines. Cefas is presently involved in more than 30 European programmes.[612] NERC is also involved in EU Networks of Excellence and projects, including MarinERA, a project funded by the EU Framework Programme 6 that brings together the leading marine research, technology and development funding organisations in 13 European Member States to improve the coordination of national and regional RTD activities.[613] Collaboration at the EU level is clearly very much in the interests of the UK and we are pleased to see organisations and individuals take advantage of the opportunities offered.

Framework Programme 7

286. The Seventh Research Framework Programme (FP7) brings together all research-related EU initiatives. Marine science is a cross-cutting issue in FP7, with marine resources covered in Theme 2 (Food, Agriculture and Fisheries and Biotechnology) of the Co-operation Specific Programme and pressures on the marine system and the management of marine environments covered in Theme 6 (Environment, including climate change).[614] NERC has recently had a meeting with senior Commission officials and concluded that "we felt on both sides that there was increasingly a very good convergence of the scientific agenda".[615] On the part of industry, Mr Burt of AMSI welcomed the change in FP7 to encourage the involvement of SMEs.[616] However, we note concern that little prominence has been given to marine science *per se* in FP7 and that the ending of the MAST programme has left the EU with no dedicated marine science funding stream.

611 Ev 181

612 Ev 100

613 Ev 181

614 Ev 261

615 Q 624

616 Q 359

287. One difficulty with European research funding as far as the universities are concerned was identified by Professor Henderson as "the sheer size of the typical consortia that are required at European level".[617] He commented that "That is a good format to do really targeted research in a few areas and I think the EU is very successful at doing that, but it funds very specific areas of ocean marine science".[618] Portuguese officials stressed the importance of the careful selection and establishment of consortia to exploit the opportunities under FP7.

288. Portugal's Ministries of Science and Technology, Economics and Defence have set out national priorities for marine science with supporting structures designed specifically for FP7. We are pleased that there already seems a good fit between UK science and what is proposed under FP7. Traditionally, the UK has done well out of Framework Programmes. For example, in the EC MAST Programme run under the Fourth Framework Programme, the UK gained more than any other country, gaining nearly twice the UK's *juste retour*, with UK scientists co-ordinating 22 (26%) of MAST projects, and involved in 66 projects (77% of the total).[619] **We recommend that the UK continue to work closely with EU to exploit FP7 to the full in the area of marine science.**

617 Q 96

618 Ibid

619 POST report, *Marine Science and Technology*, July 1999

12 A UK marine strategy

289. Throughout this inquiry, witnesses from all sides have stressed the need for a UK marine strategy, either for science and technology alone or across the whole maritime sector. In May and June 2007 we visited two countries which have recently adopted national strategies in respect of marine science.

290. In Portugal, the strategy was developed by the Task Force for Sea Affairs in 2006, as a first step towards the integration of policies and a holistic vision of oceans and activities. The Portuguese strategy covers maritime affairs in the round, with each priority area underpinned by science. Its intention is "to create the conditions and the mechanisms to enable agents to develop sea-related activities, in a balanced and articulated way, with the objective of improving the quality of the marine environment, fostering economic growth and creating new jobs and opportunities".[620] It gives priority "to the development of knowledge, skills and shared management tools that make it possible to deal with the causes of problems and not merely with their symptoms" and aims to "create a co-ordinating structure for maritime affairs that will promote policy articulation, the definition of strategic directions, the clarification of competences and areas of intervention, adding value to the sectoral objectives, so that the overall result is more than the sum of the sectoral results".[621] The strategy identifies three priority actions, including creating a structure to implement the plan and follow up work on the European Maritime Policy green paper, and eight strategic actions, which cover raising awareness, education and outreach, promotion of Portugal as a centre of excellence in ocean sciences, spatial planning, marine ecosystems, development of the maritime economy, new technology and defence-related measures. The inter-agency commission, established as the first measure of the strategy, met in May 2007 for the first time.

291. In the US, the National Science and Technology Council's Joint Subcommittee on Ocean Science and Technology published their Ocean Research Priorities Plan (ORPP) and Implementation Strategy in January 2007.[622] The ORPP developed research priorities that focus on issues in key areas of interaction between society and the ocean as well as guidance on how ocean science sectors (government, academia, industry, and non-governmental organisations) can be engaged to address the research priority areas. The ORPP identifies national ocean research priorities for the next ten years to ensure that the management, use and protection of the ocean ecosystem is based on the best available scientific evidence. It also outlines four key research areas that should be pursued in the next four years. The strategy was devised in collaboration with the academic marine community and involves engagement with private sector partners. It is important to note that the ORPP was developed in response to a recommendation in the holistic US Ocean Action Plan which "fundamentally restructured ocean governance, research and

620 National Ocean Strategy, Published by the Ministerio da Defesa Nacional, Portugal, p 10

621 Ibid, p 11

622 *Charting the Course for Ocean Science in the United States for the Next Decade, An Ocean Research Priorities Plan and Implementation Strategy*, NSTC Joint Sub-Committee on Ocean Science and Technology, 26 January, 2007

management to 'engender responsible use and stewardship of ocean and coastal resources for the benefit of all Americans'".[623]

292. These developments are part of a growing international trend, identified by witnesses, "towards more integrated policies for maritime activities and the marine environment".[624] To the US and Portuguese examples can be added Australia's Ocean Policy, Canada's Oceans Act 1997 and Japan's long term ocean policy for the 21st century set out by the Council for Science and Technology Subdivision on Ocean development in August 2002. In addition, we note that in the case of Portugal the development of a strategy is at least partly linked to the European Maritime Strategy green paper which is seeking a new approach to managing marine ecosystems and identifying priorities for research and policy development.

The need for a UK marine science strategy

293. At the moment, the UK lacks a strategy with clear priorities for marine research and the means of fulfilling them. The Society for Underwater Technology pointed out that "Despite identification of the fragmented nature of its provision in 1985, and again in 1990, the organisation of marine research, technology and affairs is still lacking an over-riding strategy and is spread amongst many agencies."[625] The JNCC argued strongly that

> So far as JNCC is aware, no overall objectives for publicly-funded marine science have been promoted by Government, nor is there any over-arching strategy for publicly-funded marine science. This is likely to be due, in large measure, to the manner in which research funding has developed and evolved in the UK over time, but the lack of central direction and co-ordination of publicly-funded science has the potential to lead to duplication of effort, lack of collaboration where this is desirable, gaps in research endeavour, and research funds being allocated with insufficient regard to national priorities.[626]

The JNCC also argued that a strategy is needed for UK participation in international projects where "so far as we are aware, there is no overall UK guidance or strategy in relation to the disbursement of UK publicly-funded marine science resources internationally, either in relation to the UK continental shelf, the various Overseas Territories, or elsewhere, nor any particular mechanism for allocating research expenditure or effort in accordance with policy priorities, with the range of international treaty obligations, or in relation to environmental pressures".[627] Similarly, Gardline, a private sector organisation, argued that

> National and international collaborative programmes deliver significant benefits for UK Policy and management advice. However, there is neither a strategic overview

623 *Charting the Course for Ocean Science in the United States for the Next Decade, An Ocean Research Priorities Plan and Implementation Strategy*, NSTC Joint Sub-Committee on Ocean Science and Technology, 26 January, 2007, foreword

624 Ev 198

625 Ev 139

626 Ev 132

627 Ev 133

> managing the research that is currently carried out under the wide variety of funding sources nor are these programmes generally required to meet objectives that have been defined in a coherent fashion to meet UK Policy objectives.[628]

A strategy has the potential therefore to offer clear direction, reduce duplication and encourage coherence of research effort.

294. One reason witnesses called for a strategy was to improve the performance of the Government in commissioning marine research. The IACMST suggested that "the Government needs to behave as a coherent commissioner for marine research across all its departments".[629] This was supported by IMarEST who argued that "it is essential that UK government as a whole is committed to understanding, commissioning and coordinating marine science for its policy and operational needs."[630] The Institute gave the example of the possible use of marine science to make improvements to efficiency and safety of shipping through improved weather forecasting for ship routing (Department for Transport), and to provide support for the offshore energy industry by, for example, providing evidence of the benefits of disposing of obsolete rigs as reefs (DTI).[631] A marine research strategy that covered the whole of Government would bring greater synergy between the research effort of different departments and enable them to work together to ensure that all sectors are considered in using the results of science.

295. A precedent for a UK strategy for marine science and technology was established by the CCMST report of 1990 which identified the following six objectives:

- Environmental protection—to protect against pollution; to monitor and improve biological productivity; to conserve natural resources; and to promote economic viability.
- Exploitation of resources—to maintain and enhance commercial and safe exploitation of energy resources, minerals, fisheries and the use of the sea.
- National defence—to improve the performance of naval vessels and understand the effects of the marine environment on ships and submarines.
- Prediction of climate change and its effects—to reduce uncertainties by improving observations and understanding of ocean-atmospheric interactions.
- Marine technology—to develop and maintain a strong, innovative industrial effort able to compete in world-wide markets.
- Statutory and regulatory obligations—to provide for and co-ordinate marine research necessary for official bodies to fulfil their duties.

This provides a good starting point for a strategy in 2007, which should then be developed in full consultation with all involved in marine science—academics, institutions, funders,

628 Ev 136

629 Ev 128

630 Ev 229

631 Ibid

end-users, including industry, NGOs, the education sector and many others—in order to determine the priorities and overall direction of the strategy. Its aim should be to ensure that the UK marine research effort as a whole is directed to meet the nation's needs.

296. A marine strategy could help to get the balance right between different areas of research and enable synergies to develop. This affects many of the issues identified in this report such as the balance between Arctic and Antarctic research, the balance between research in the open oceans and in the coastal and shelf areas, the balance between evidence-based and precautionary approaches and the balance between areas where self-standing UK expertise should be encouraged and those where international co-operation is paramount. There needs to be flexibility for individual scientists and research groups to work across these boundaries but an explicit statement of strategy and national priorities would be of great benefit.

A UK marine action plan

297. Both in Portugal and the US the marine science strategy statements have emerged from long processes resulting in a single report on the whole of the maritime sector. The EU maritime green paper, is following a similar path. We therefore examined the concept of a plan to cover all marine-related activities in the UK.

298. Dr Horwood of Cefas commented that "It would seem sensible that somewhere there is a very high level overview on whether we have the strategy right for UK plc, and whether all the key players are contributing."[632] Some have implied that Oceans 2025 fills the gap but, as Professor Willmott of POL told us, "Oceans 2025 is about a programme which is renewing the funding for a group of laboratories, it is not a UK-wide national marine strategy".[633] Dr Tew of Natural England said that:

> I think that we are searching for a national framework … The marine environment has to provide us with so much: it has to provide us with renewables and fish and biodiversity. Where is the balance between the Blue Sky research in the deep sea and the applied research in near shore? Who sets the framework for that?[634]

Professor Sir Howard Dalton agreed that "We need a proper marine strategy, you are absolutely right".[635] The Chief Executive of NERC also accepted that a holistic strategy was missing and would be beneficial to the nation.[636] He assured us that NERC would be happy to play a role in this.[637] IMarEST suggested that industry should also be closely involved: "Stronger linkages between the scientists, industry and policy makers in setting priorities and goals for marine science are critical to integrated ocean planning and management."

299. When we asked the Minister about a comprehensive national strategy, he referred to the Marine Bill and *Safeguarding Our Seas*, both of which concentrate on environmental

632 Q 168

633 Q 207

634 Q 389

635 Q 501

636 Qq 573-4

637 Q 576

issues rather than the whole picture.[638] Moreover, even within this area, the Minister listed separate strategies "to deal with marine life, … to deal with ensuring our coastal waters are clean … in terms of climate change and the effect that is having upon the marine life and the effect it is having on our oceans … we also have a strategy for marine monitoring under UKMMAS."[639] This underlines the fragmentation which currently characterises this area of policy. Defra is also working on marine objectives to underpin a marine policy statement as envisaged by the Marine Bill White Paper. We welcome this development but note that these too, whilst including economic activities, do not explicitly refer to areas such as science, public awareness or education. We accept that the Marine Bill process is a first stab at the development of a strategy but it does not include all the key players and interests who must be considered.

300. We believe that there should be a full, overarching UK marine strategy set out in an oceans action plan. We are concerned that this should have a firm basis in science. Professor Sir Howard Dalton argued that in order to have a marine strategy "it is essential that we get the science right".[640] We agree that a UK marine strategy should be underpinned by science and reliable data.

Implementation and oversight

301. We asked witnesses who should implement and oversee a marine strategy in the UK. The NERC Chief Executive suggested that the "marine strategy would feed into [the Defra minister for marine affairs], and a body like ERFF or IACMST could orchestrate the scientific component, and perhaps have a wider feed into the policy area".[641] We agree with this two level approach. On a day to day level the marine science strategy would be best implemented and managed by an executive body such as the agency advocated throughout this Report or by a successor body to the IACMST, with substantially greater powers, reporting to a Government minister. Which minister was a matter of debate during our inquiry. Dr Vincent of the JNCC told us that "there is a certain lack of clarity, at least I am not very clear, as to which minister is responsible for marine science in the sense that the portfolio seems to shift backwards and forwards between the Defra Minister and what was the Office of Science and Innovation".[642] He suggested that if this were clarified, the relevant minister should then give "a much greater policy steer or support" to the IACMST.[643] In oral evidence, the Government witnesses were confident about the position. Jonathan Shaw MP told us "I am the Minister for Marine Science".[644] However, the same panel of witnesses suggested that the champion for marine science should be the Defra CSA and not the Minister.[645]

638 Q 496

639 Q 498

640 Q 501

641 Q 575

642 Q 384

643 Q 414-5

644 Q 477

645 Qq 500-01

302. On marine issues, more generally, the lead department is generally Defra but many others have an interest in marine issues and the Department for Transport is co-ordinating policy on the European maritime Green Paper, which gives a dual focus within Government for marine and maritime matters. Defra told us that this is because of the Department of Transport's lead role on maritime transport which is "the key component of the Green Paper".[646] Given that the Green Paper covers a far broader spectrum of activities than transport, we believe that the role taken by the Department for Transport is more of a historical accident and should be reconsidered.

303. We agree with witnesses that Defra is the most appropriate department to take responsibility for the marine strategy and to host the champion for marine science. We believe that it is essential for a Minister, rather than a Chief Scientific Adviser, to take charge of the marine strategy in order to give marine science a sufficiently high profile across Government. This would also increase accountability to Parliament for the development and implementation of the new strategy. Appointing a Defra Minister as champion for marine science and maritime strategy would require some realignment of responsibilities within Whitehall but could lead to a stronger voice for marine issues on the international stage as well as at home. It is unacceptable that responsibility for the greatest geographical area in the UK (its seas) should be a minor part of a junior ministerial portfolio.

304. **We recommend that the UK Government develop a strategy for marine science, setting out priorities for fulfilment in the next ten years and identifying how these will be met. This strategy should be developed in full and open consultation with the science community, the private sector and all those with an interest in the health and exploitation of the oceans, including those involved in education. We further recommend that the marine science strategy be part of a larger holistic strategy or plan for maritime affairs, covering the range of uses of the sea, current and future. The priorities and objectives in this strategy should be underpinned by scientific data and evidence. We recommend that the strategies be the day to day responsibility of a new marine agency, an executive body with powers to require the co-operation of Government departments. At the top of this new structure, we recommend the designation of a Minister for Marine Science within Defra, who should act as the Government champion for the whole maritime strategy.**

305. **Under this new arrangement, it would be illogical to leave the Department for Transport in charge of Government policy on the European maritime Green Paper. We recommend that this responsibility be passed to the new marine agency.**

646 Ev 266

13 Conclusions

306. The effects of the oceans upon the weather, the climate and the sustainability of many human economic activities has been established beyond doubt by scientists. What has emerged over recent years is a new awareness of the connection between the air and the sea and the importance of the ocean in terms of a healthy environment and biodiversity. Marine science should therefore be at the heart of a national strategy and effort to find answers to the most topical questions with which humankind is faced. Instead, in the UK, this field of research lacks resources, attention, co-ordination and an official champion. We have been deeply disappointed at the apparent low regard in which marine science and the study of the sea is held by NERC and the Government. We hope that our recommendations for a new agency for marine science and a new champion for the whole marine area will change attitudes for the better.

307. The UK has the capacity to be a world leader in key aspects of marine science, such as coastal work which is vitally important because of climate change and the proportion of the population now living within coastal margins. Overall, we have identified a clear and pressing need for more support for scientists in their investigations of the oceans. At the very beginning of this long inquiry, we were told the story of how the Continuous Plankton Recorder dataset, begun in 1931, was nearly closed a few years ago as a result of NERC cuts. It has gone on to provide some of the most telling evidence that climate change is having an impact on our world. From this example, we take the lesson that the answers to many of our questions lie in the seas and that the UK should be very careful lest short term decisions be taken that unwittingly deprive society of vital pieces of evidence.

308. The ocean is a fascinating environment. It is essential that this quality is used to draw young people into science, to help find the answers to some of the most pressing questions facing this planet and to illustrate to the public at large just how precious are the oceans and how vital it is to the future of our society that scientists and policymakers are given the resources to develop sufficient knowledge both to reap their benefits and to mitigate the worst impacts of environmental change.

Conclusions and recommendations

Exploitation of the oceans

1. We recommend that greater research effort be directed by UK public sector funders towards the understanding and mitigation of the impact of fishing on marine environments, and the coming Marine Bill must address this issue. (Paragraph 32)

Priorities for marine research

2. The world's oceans are fundamental to the continuing ability of human beings to survive comfortably on this planet, and it is vital that efforts to understand them are pursued with clarity, co-ordination and purpose, but also with an open mind as to future areas of importance. (Paragraph 43)

Funding and organisation of marine science in the UK

3. We recommend that funding be identified by the sponsoring Government department for a regular survey of marine-related research and development in the UK by the IACMST or any successor body with responsibility for co-ordination in this area. (Paragraph 46)

Research Councils: NERC

4. The declining trend in NERC funding for marine science is a worrying one and we seek an explanation from NERC as to why marine science has apparently been less of a priority than other areas within the NERC remit. (Paragraph 62)

5. We accept that NERC acts in good faith to support the best science in awarding funding under the responsive mode and that the number of applications is small, but we believe that the apparent bias against funding for marine science applications requires investigation and explanation from NERC. (Paragraph 66)

6. We recommend that NERC commit funding to the full five years of the Oceans 2025 programme in order to enable proper planning and effective organsiation. In doing so, it needs to ensure that the longer term programmes and facilities are not packaged together with the short term projects in the same project cycle, so that each can be assessed against their natural lifespan. (Paragraph 70)

7. We recommend that NERC review the use of the Strategic Ocean Funding Initiative, with a view to increasing the amount allocated to it within the Oceans 2025 programme and encouraging participation from universities in Oceans 2025. (Paragraph 71)

8. We recommend that NERC review the need for a director of science for marine and atmospheric science. (Paragraph 74)

Other Research Councils

9. We recommend that RCUK monitor applications and inquiries to ascertain whether there has been improvement in funding interdisciplinary work in marine science areas as a result of recent changes. (Paragraph 82)

10. We recommend that scientists working in marine research in the UK be eligible to apply for funding to any of the Research Councils, regardless of their place of employment. (Paragraph 83)

Government departments

11. We recommend a review be commissioned by Defra and NERC jointly on mechanisms for improving the relationship between the marine centres and the fisheries laboratories and for encouraging collaboration and co-ordination of research effort. (Paragraph 90)

12. We recommend that the role of the UKHO as a marine research establishment be explicitly considered as part of the MoD review of the future of the Office. (Paragraph 96)

Overall funding

13. A full review of future needs for increases in funding marine science, along the lines of the work undertaken already on marine monitoring requirements, is urgently needed. Nevertheless, it is clear, even without such a detailed review, that a substantial increase in funding is necessary if marine science is to meet the challenges before it. (Paragraph 102)

Inter-Agency Committee for Marine Science and Technology (IACMST)

14. It is unacceptable for a Government-funded body chaired by a Chief Scientific Adviser to be ignorant of its formal reporting responsibilities. We recommend that reporting lines for the IACMST be clarified without delay. Defra and DIUS, including the Government Office for Science, need to discuss lines of responsibility and what reporting procedures are required and communicate the results clearly to the IACMST. (Paragraph 109)

15. We recommend that DIUS play a more active part in the successor body to the IACMST which we recommend later in this Report. (Paragraph 110)

16. We do not believe that the IACMST as currently constituted is capable of fulfilling the role required of it by the challenges facing marine science. It is fundamentally flawed in its constitution, and minor amendments to its budget or resources will not transform the organisation of marine science in the UK. (Paragraph 114)

Improving co-ordination of marine science and technology in the UK

17. We recommend that a new co-ordinating body for marine science, reporting to Defra, be established. This body should bring together all public-sector funders of

marine research, together with stakeholders such as the universities and end-users of marine science, and should be properly resourced to fulfil its functions. Because of the range of activities for which greater co-ordination is required at an executive level, our preference would be for this co-ordinating function to be placed with a new marine agency, which should be given executive powers and a budget to oversee operational observations (Paragraph 132)

18. We believe that the transfer of functions to the new marine agency should provide an opportunity to reduce the number of co-ordinating bodies operating in this area and we recommend that the Government review the organisations, committees and other bodies co-ordinating marine-related activities with this aim in mind. (Paragraph 133)

Research Vessels

19. We believe that there is scope for better integrated management of the coastal fleet although this may well be limited in view of the demands upon it. A new marine body could act as a clearing house to co-ordinate research cruises and spare capacity on marine science vessels. (Paragraph 143)

20. We welcome the world-wide extension of the Continuous Plankton Recorder concept as an excellent initiative and we urge the UK Government to take the lead in promoting it to fellow Governments at the next GEO Ministerial. (Paragraph 146)

21. We recommend that NERC investigate the costs and benefits of a scheme for the widespread use of commercial vessels to take ocean measurements, with a view to providing UK leadership on this project. (Paragraph 148)

22. We conclude that there is greater demand for ship-time than the current arrangements are capable of delivering and that vessel capacity is a limiting factor in marine research. (Paragraph 151)

23. We recommend that an independent review be conducted of the cost-effectiveness of NERC's operation of its research vessels and management of alternative arrangements for access to vessels. (Paragraph 154)

24. We fully support the development of the new vessel planned for 2011 and recommend that the Government and NERC commit to ensuring that this vessel is delivered on time and to specification. (Paragraph 155)

25. We recommend that NERC develop a case for a new coastal vessel for submission to the large facilities roadmap and that DIUS look sympathetically upon such a bid. (Paragraph 155)

Other facilities

26. We recommend that the provision of facilities be regularly reviewed as part of the mandate of the proposed new co-ordinating body which would be the best available independent body to obtain objective information from potential users and providers, especially from those outside the NERC community. (Paragraph 156)

27. We encourage the development of partnership arrangements within Europe for the provision of highly advanced underwater technologies and infrastructure. (Paragraph 157)

28. We recommend that NERC keep the use of Isis under review and ensure that its potential is not undermined by factors such as the availability of crews or platforms. We further recommend that NERC investigate whether there would be more demand for use of Isis, if more time were offered. (Paragraph 158)

Information technologies for marine science

29. We recommend that NERC keep under review the computing resources needed in the environmental sciences, particularly with regard to NERC's new theme of environmental change. (Paragraph 160)

Government support

30. We regret the lack of attention paid by Government, in particular the OSI/DIUS, to marine science since the disbandment of the Marine Foresight Panel. We also regret that there has been no systematic attempt to track implementation of the recommendations made by the Marine Foresight Panel. We believe that greater effort is needed in horizon-scanning within the marine science and technology sector, and we recommend that this be included in the remit of the new marine body. (Paragraph 164)

Gaps in data

31. We recommend that social system indicators be part of future research and monitoring priorities for UK marine science. (Paragraph 172)

Funding and Co-ordination

32. We recommend that the new marine agency, proposed in this Report, be made responsible for marine monitoring. It should also be responsible for setting priorities for monitoring and should have a central budget for operational monitoring and long-term international projects such as Argo. We also recommend that the £22m funding gap identified by UKMMAS be met from central Government funds. (Paragraph 180)

33. We support the use of cost-benefit assessment to establish the value of maintaining or stopping long-term monitoring programmes and recommend that it be adopted by the new marine body to ensure the efficiency of the UK monitoring programme and secure individual projects against threat of closure merely because they drop out of fashion. (Paragraph 181)

International ocean monitoring systems

34. We recommend that the UK Government renew its commitment to GOOS and ensure that the network of observatories is completed according to the timetable. (Paragraph 184)

35. We recommend that funding be guaranteed for the Argo programme from centralised funds. (Paragraph 185)

Satellites

36. We recommend that the new marine agency, proposed in this Report, become a partner of the British National Space Centre in order that the needs of the marine science community be fully represented when discussing and determining space issues. (Paragraph 189)

Sharing data

37. We recommend that the principle of "collect once, use many times" be applied to marine data across Government, including the Royal Navy. We further recommend that the new marine agency which we have recommended, or an equivalent body, be charged with finding mechanisms to facilitate the release of data and interaction between producers, suppliers and users of data to maximise its value to the community at large. (Paragraph 198)

38. We recommend that the Government reconsider its opposition to discussions on a European Marine Observation and Data Network. (Paragraph 199)

The importance of studying the polar oceans

39. We welcome NERC's commitment to the International Polar Year but consider that the additional funding dedicated to the UK contribution is less than generous. NERC must confirm that it will provide sustained funding to IPY projects after the end of the programme. (Paragraph 204)

The UK's role in polar science

40. The UK effort in the Southern Ocean conducted through BAS is truly impressive and gives the UK a genuinely world-leading position in this area of expertise. We support the continuation of this research focus and the resources dedicated to it. (Paragraph 210)

41. We recommend that BAS be brought fully within the scope of NERC's marine policy as it affects the research centres. (Paragraph 210)

42. We recommend that NERC identify funding for an expansion of Arctic research in collaboration with other nations which already have substantial presence there. (Paragraph 217)

Conservation of marine areas

43. We urge the Government to establish a number of full-scale MPA pilot sites immediately, ahead of the Marine Bill, in order to gather the evidence necessary to develop the science needed to underpin MPAs and to enable the UK to become a leader in conservation science. (Paragraph 223)

The Marine Bill

44. We recommend that the draft Marine Bill be brought forward without further delay, despite concerns about Defra's ability to deliver a network of MPAs. We require an assurance from the department as to the speedy presentation of the draft bill and the subsequent bill itself, and a commitment to ensuring that the bill is enacted by the end of the next parliamentary session. We recommend that Defra publish a clear timetable for the bill to complete its passage through Parliament within this timeframe. We recommend that Defra conduct and publish an assessment of what is needed to enable it to designate and monitor chosen sites. However, this assessment should not be used as an excuse to delay proceedings on the bill: if the department waits until it has all the necessary data, it will never proceed. (Paragraph 233)

Technology transfer to the commercial sector

45. We commend projects such as EPSRC's efforts to stimulate work in sensor systems where Research Councils have identified a potential gap in the market and moved to address it. We believe that there is greater scope for such activity than has previously been explored and recommend that the Research Councils pursue an active approach to identify areas for technology development in the marine sector. (Paragraph 251)

Technology and policy formulation

46. We believe that there is an important role for a marine agency to promote knowledge transfer from scientists to policy formulation. This could include publishing data in an appropriate format and promoting stakeholder engagement. (Paragraph 254)

Industry and strategy

47. We believe that the development of marine technology should be an important component of the work of new marine body which should ensure that it engages with industry in developing its strategy and plan of work. (Paragraph 255)

Skills

48. We believe that one of the key tasks of the new marine body should be to review the training needs required to support marine science and technology in the UK and to propose a strategy for tackling identified shortages. (Paragraph 264)

Education and outreach

49. We recommend that the Department for Children, Families and Schools investigate the US programme and other ways of integrating marine science into schools and adopt a strategic programme to encourage the study of marine science-related subjects in UK schools. (Paragraph 268)

50. We recommend that DIUS and Defra jointly examine the US Sea Grant programme with a view to whether the new marine body could usefully expend funds of its own to encourage marine research in the HEI sector. (Paragraph 268)

51. We believe that the learned societies have a role to play in outreach work and encouraging greater knowledge of ocean-related issues among the general public and in promoting careers in marine science. We recommend that the new marine body, proposed in this Report, develop links with the learned societies for this purpose. (Paragraph 270)

Increasing public awareness

52. The new marine body should be charged with raising public awareness of marine issues, including better use of facilities such as science centres and public aquaria. A focus on extreme environments (space and oceans) would entice young people into science. There should also be a duty placed on the new body to raise awareness of marine sustainability issues so that the general public is accurately informed about the importance of the oceans in their lives. (Paragraph 271)

International organisations

53. We recommend that a co-ordinating committee, within the new agency, be established to bring together UK representatives on all relevant international bodies in order to establish agreed common policy goals and to make optimal use of UK expertise and technology. (Paragraph 274)

International projects

54. We recommend that NERC examine alternative mechanisms for funding long-term international projects in marine science. It may be that there is also a role for the new marine body here in helping with co-ordination across funders. We also recommend that more funding be made available by NERC or other funders of programmes to enable scientists to exploit the results of international projects. (Paragraph 278)

55. We conclude that NERC should continue to fund IPOs wherever possible and should provide direct support and assistance in the early stages of bidding for such offices, as well as during the period of operation. (Paragraph 281)

EU marine research

56. We believe that the UK should participate fully in the development of marine science and technology under the European maritime Green Paper process and show

leadership to maximise the influence of UK scientists. We are concerned that this may not be easy with the Department for Transport in charge of Government policy in this area and we urge full consultation between that Department and those with greater knowledge of marine science and technology. (Paragraph 284)

57. We recommend that the UK continue to work closely with EU to exploit FP7 to the full in the area of marine science. (Paragraph 288)

A UK marine action plan

58. We recommend that the UK Government develop a strategy for marine science, setting out priorities for fulfilment in the next ten years and identifying how these will be met. This strategy should be developed in full and open consultation with the science community, the private sector and all those with an interest in the health and exploitation of the oceans, including those involved in education. We further recommend that the marine science strategy be part of a larger holistic strategy or plan for maritime affairs, covering the range of uses of the sea, current and future. The priorities and objectives in this strategy should be underpinned by scientific data and evidence. We recommend that the strategies be the day to day responsibility of a new marine agency, an executive body with powers to require the co-operation of Government departments. At the top of this new structure, we recommend the designation of a Minister for Marine Science within Defra, who should act as the Government champion for the whole maritime strategy. (Paragraph 304)

59. Under this new arrangement, it would be illogical to leave the Department for Transport in charge of Government policy on the European maritime Green Paper. We recommend that this responsibility be passed to the new marine agency. (Paragraph 305)

Annex A: The Marine Agency–functions and relationships

Figure 1: Proposed functions for the Maritime Agency

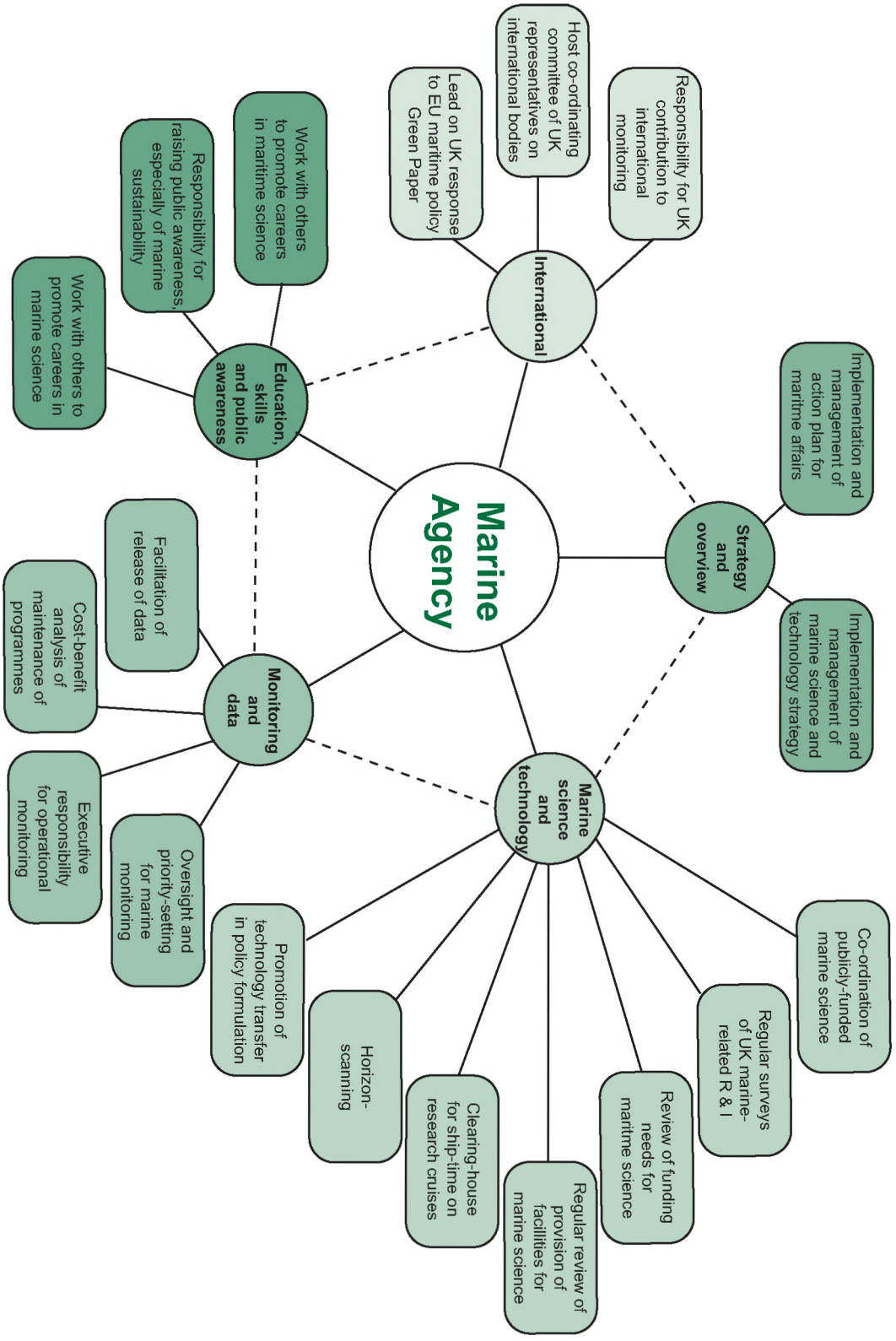
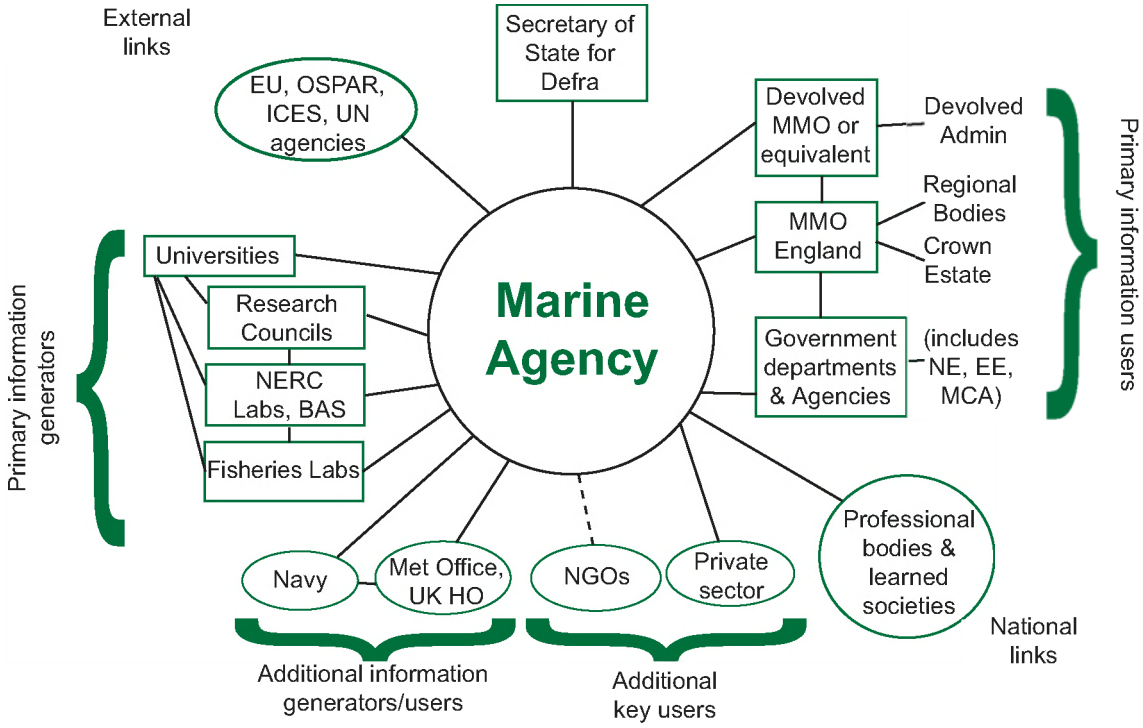


Figure 2: Key relationships of Maritime Agency



Acronyms and abbreviations

AMSI	Association of Marine Scientific Industries
AMT	Atlantic Meridional Transect
ARGO	Array for Real-Time Geostrophic Observations
Autosub	An unmanned Autonomous Underwater Vehicle developed in the UK
AUV	Autonomous Underwater Vehicle
BAS	British Antarctic Survey
BBSRC	Biotechnology and Biological Sciences Research Council
BGS	British Geological Survey
BODC	British Oceanographic Data Centre
Carboocean	CarboOcean Integrated Project
CAROS	Co-operative Arrangements for Research in Ocean Sciences
CBD	Convention on Biological Diversity
CCMST	Co-ordinating Committee on Marine Science and Technology
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CLIVAR	Climate Variability and Predictability Experiment
CPR	Continuous Plankton Recorder
CSR	Comprehensive Spending Review
Damocles	Developing Arctic Modelling and Observing Capabilities for Long-term Environmental Studies
DBERR	Department for Business, Enterprise and Regulatory Reform
Defra	Department for Environment, Food and Rural Affairs
DELOS	Deep ocean Environmental Long-term Observatory System
DERA	Defence Evaluation and Research Agency
DETR	Department of the Environment, Transport and the Regions
DfID	Department for International Development
DIUS	Department for Innovation, Universities and Skills
DoE	Department of Environment
DoT	Department of Transport
DTI	Department for Trade and Industry
EA	Environment Agency
EC	European Commission
ECASA	Ecosystem Approach to Sustainable Aquaculture
EFARO	European Fisheries and Aquaculture Organisation
EMSO	European Multidisciplinary Seafloor Observatories
ENVINET	An “Infrastructure Co-operation Network" focusing on multidisciplinary environmental research in Northern Europe.
ENVISAT	Earth Observation Spacecraft
EPSRC	Engineering and Physical Sciences Research Council
ERFF	Environment Research Funders’ Forum
ESA	European Space Agency
ESF	European Science Foundation

ESFRI	European Strategy Forum on Research Infrastructure
ESRC	Economic and Social Research Council
ESSC	Environmental Systems Science Centre
EURO-ARGO	European component of the Array for Real-Time Geostrophic Observations
EUROCORES	European Collaborative Research
EURODEEP	Ecosystem Functioning and Biodiversity in the Deep Sea
EUR-OCEANS	European Ocean Ecosystems Analysis Network
FAB	Funding, Allocation and Budgeting Project
FCO	Foreign and Commonwealth Office
FP6	Sixth Research Framework Programme
FP7	Seventh Research Framework Programme
FRS	Fisheries Research Services
FRV	Fisheries Research Vessel
GCOS	Global Climate Observing System
GCSA	Government Chief Scientific Adviser
GEO	Group on Earth Observations
GLOBEC	Global Ocean Ecosystem Dynamics
GMES	Global Monitoring for Environment and Security
GOOS (AG)	Global Ocean Observing System (Action Group)
GPS	Global Positioning System
HEFCE	Higher Education Funding Council for England
HEI	Higher Education Institution
HERMES	Hotspot Ecosystem Research on the Margins of European Seas
HPC	High-Performance Computing
HSE	Health and Safety Executive
IACMST	Inter-Agency Committee on Marine Science and Technology
IAEA	International Atomic Energy Agency
IMAGES	International Marine Past Global Change Study
IMarEST	Institute of Marine Engineering, Science and Technology
IMBER	Integrated marine Biogeochemistry and Ecosystem Research
IMO	International Maritime Organisation
IOC	International Oceanographic Commission
IODP	Integrated Ocean Drilling Programme
IPCC	Intergovernmental Panel on Climate Change
IPO	International Project Office
IPY	International Polar Year
JAMSTEC	Japan Agency for Marine-Earth Science and Technology
JNCC	Joint Nature Conservation Committee
M&FMB	Marine and Freshwater Microbial Biodiversity
MAFF	Ministry for Agriculture, Fisheries and Foods
MAPC	Marine Assessment Policy Committee
MarBEF	Marine Biodiversity and Ecosystem Functioning Network
MARG	Marine Assessment and Reporting Group
MAST	Marine Science and Technology Programme

MBA	Marine Biological Association
MCCIP	Marine Climate Change Impacts Partnership
MDIP	Marine Data and Information Partnership
MEDAG	Marine Environmental Data Action Group
MEIC	Marine Environment Information Centre
MNR	Marine Nature Reserve
MMO	Marine Management Organisation
MOD	Ministry of Defence
MPA	Marine Protected Area
MSA	Marine Safety Agency
MSP	Marine Spatial Planning
MST	Marine Science and Technology
NCOF	National Centre for Ocean Forecasting
NERC	Natural Environment Research Council
NIO	Northern Ireland Office
NMF	National Marine Facilities
NOAA	National Oceanic and Atmospheric Administration
NOCS	National Oceanography Centre, Southampton
NRA	National Rivers Authority
ODA	Overseas Development Administration
OFEG	Ocean Facilities Exchange Group
ORPP	Ocean Research Priorities Plan
OSI	Office of Science and Innovation
OSPAR	Oslo-Paris Agreement (The Convention for the Protection of the Marine Environment of the North-East Atlantic, signed at the Ministerial Meeting of the Oslo and Paris Commissions in 1992.)
OST	Office of Science and Technology
PML	Plymouth Marine Laboratory
PMSP	Plymouth Marine Sciences Partnership
POGO	Partnership for Observation of the Global Oceans
POL	Proudman Oceanographic Laboratory
POST	Parliamentary Office of Science and Technology
R&D	Research and Development
RAPID	Rapid Climate Change Programme
RCUK	Research Councils United Kingdom
RN	Royal Navy
ROV	Remotely Operated Vehicle
RRS	Royal Research Ship
RSPB	Royal Society for the Protection of Birds
RV	Research Vessel
SAC	Special Areas of Conservation
SAHFOS	Sir Alister Hardy Foundation for Ocean Science
SAMS	Scottish Association for Marine Science
SCAR	Scientific Committee for Antarctic Research
SCOR	Scientific Committee on Oceanic Research

SE	Scottish Executive
SeaSense LINK	A NERC programme, designed to support innovative pre-competitive research and development of marine sensors in collaboration with industry.
SEERAD	Scottish Executive Environment and Rural Affairs Department
SERPENT	Scientific and Environmental Remotely Operated Vehicle Partnership using Existing Industrial Technology
SIMORC	System of Industry Metocean Data for the Offshore and Research Communities
SMRU	Sea Mammal Research Unit
SOAEFD	Scottish Office Agriculture, Environment and Fisheries Department
SOFI	Strategic Ocean Funding Initiative
SOLAS	Surface-Ocean/Lower Atmosphere Study
SPA	Special Protection Areas
SSSI	Site of Special Scientific Interest
SST	Sea Surface Temperature
SUT	Society for Underwater Technology
UEA	University of East Anglia
UKHO	United Kingdom Hydrographic Office
UKMMAS	United Kingdom Marine Monitoring and Assessment Strategy
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNIDO	United Nations Industrial Development Organisation
WHO	World Health Organisation
WMO	World Meteorological Organization
WOCE	World Ocean Circulation Experiment
WWF	World Wildlife Fund

Formal minutes

Tuesday 9 October 2007

Members present:

Mr Phil Willis, in the Chair

Adam Afriyie	Dr Brian Iddon
Mrs Nadine Dorries	Chris Mole
Linda Gilroy	Graham Stringer
Dr Evan Harris	Dr Desmond Turner

The Committee considered this matter.

Draft Report (*Investigating the Oceans*), proposed by the Chairman, brought up and read.

Ordered, That the Chairman's draft Report be read a second time, paragraph by paragraph.

Paragraphs 1 to 308 read and agreed to.

Summary read and agreed to.

Annex A read and agreed to.

Acronyms and abbreviations read and agreed to.

Resolved, That the Report be the Tenth Report of the Committee to the House.

Ordered, That the Appendices to the Minutes of Evidence taken before the Committee be reported to the House.

Ordered, That the Chairman make the Report to the House.

Ordered, That embargoed copies of the Report be made available, in accordance with the provisions of Standing Order No. 134.

Several Memoranda were ordered to be reported to the House for printing with the Report, together with written evidence reported and ordered to be published on 1 May 2007.

[Adjourned till Wednesday 10 October at 9.00am

Witnesses

Tuesday 1 May 2007

Page

Professor Sir Howard Dalton, Chairman, Plenary Committee, and **Mr Trevor Guymer,** Secretary, Inter-Agency Committee on Marine Science and Technology (IACMST), **Dr Philip Newton**, Deputy Director, Science and Innovation, and **Dr Mike Webb**, Marine Science and Innovation Manager, Natural Environment Research Council (NERC) Ev 1

Professor Gideon Henderson, Department of Earth Sciences, University of Oxford Ev 14

Wednesday 16 May 2007

Dr Joe Horwood, Deputy Chief Executive, Centre for Environment, Fisheries & Aquaculture Science (Cefas), **Dr Robin Hensley**, International Partnering Programme Team Leader, UK Hydrographic Office, and **Dr Mike Bell**, Head, National Centre for Ocean Forecasting, Met Office Ev 20

Professor Andrew J Willmott, Director, Proudman Oceanographic Laboratory, **Professor Ed Hill**, Director, National Oceanographic Centre, Southampton, and **Professor Peter Liss**, President, Challenger Society for Marine Science and University of East Anglia. Ev 29

Wednesday 13 June 2007

Mr Ian Gallett, Executive Secretary, Society for Underwater Technology (SUT), **Dr Lesley Thompson**, Director, Research and Innovation, Engineering and Physical Sciences Research Council (EPSRC), **Dr Ralph Rayner**, Vice President, Institute of Marine Engineering, Science and Technology (IMarEST), and **Mr Richard Burt**, Member, Executive Committee, Association of Marine Scientific Industries (AMSI) Ev 37

Wednesday 4 July 2007

Dr Sharon Thompson, Senior Marine Policy Officer, Royal Society for the Protection of Birds, **Dr Malcolm Vincent**, Director of Science, Joint Nature Conservation Committee, **Professor Ian Boyd**, Sea Mammal Research Unit, University of St Andrews, and **Dr Tom Tew**, Chief Scientist, Natural England Ev 53

Dr Alan Rodger, Head of Science Programmes, British Antarctic Survey (BAS), **Professor Graham Shimmield**, Director, Scottish Association for Marine Science (SAMS), **Professor Bob Dickson**, Centre for Environment, Fisheries & Aquaculture Science (Cefas), and **Professor Andrew Watson**, School of Environmental Sciences, UEA, Royal Society of Chemistry. Ev 62

Monday 16 July 2007

Monday 23 July 2007

List of written evidence

List of unprinted evidence

The following memoranda have been reported to the House, but to save printing costs they have not been printed and copies have been placed in the House of Commons Library, where they may be inspected by Members. Other copies are in the Parliamentary Archives, and are available to the public for inspection. Requests for inspection should be addressed to The Parliamentary Archives, Houses of Parliament, London SW1A 0PW (tel. 020 7219 3074). Opening hours are from 9.30 am to 5.00 pm on Mondays to Fridays.

- ITO 42 Partnership for Observation of the Global Oceans
- ITO 29C Supplementary memorandum from the Natural Environment Research Council

List of Reports from the Committee during the current Parliament

The reference number of the Government's response to each Report is printed in brackets after the HC printing number.

Session 2006–07

First Report	Work of the Committee in 2005-06	HC 202
Second Report	Human Enhancement Technologies in Sport	HC 67-I (Cm 7088)
Third Report	The Cooksey Review	HC 204 (HC 978)
Fourth Report	Research Council Institutes	HC 68–I (HC 979)
Fifth Report	Government Proposals for the Regulation of Hybrid and Chimera Embryos	HC 272–I (Cm 7139)
Sixth Report	Office of Science and Innovation: Scrutiny Report 2005 and 2006	HC 203 (HC 635)
Seventh Report	2007: A Space Policy	HC 66-I
Eighth Report	Chairman of the Medical Research Council: Introductory Hearing	HC 476
Ninth Report	International Policies and Activities of the Research Councils	HC 472-I
First Special Report	Scientific Advice, Risk and Evidence Based Policy Making: Government Response to the Committee's Seventh Report of Session 2005-06	HC 307

Session 2005–06

First Report	Meeting UK Energy and Climate Needs: The Role of Carbon Capture and Storage	HC 578-I (HC 1036)
Second Report	Strategic Science Provision in English Universities: A Follow–up	HC 1011 (HC 1382)
Third Report	Research Council Support for Knowledge Transfer	HC 995-I (HC 1653)
Fourth Report	Watching the Directives: Scientific Advice on the EU Physical Agents (Electromagnetic Fields) Directive	HC 1030 (HC 1654)
Fifth Report	Drug classification: making a hash of it?	HC 1031 (Cm 6941)
Sixth Report	Identity Card Technologies: Scientific Advice, Risk and Evidence	HC 1032 (Cm 6942)
Seventh Report	Scientific Advice, Risk and Evidence Based Policy Making	HC 900–I
First Special Report	Forensic Science on Trial: Government Response to the Committee's Seventh Report of Session 2004-05	HC 427
Second Special Report	Strategic Science Provision in English Universities: Government Response to the Committee's Eighth Report of Session 2004-05	HC 428