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Science Review of the Centre for Environment, Fisheries and Aquaculture Science

Independent Review Panel Report

December 2012



Llywodraeth Cymru
Welsh Government

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Summary and Recommendations

1. A Science Review was undertaken in July 2012 to provide the Chief Scientific Adviser of the Department for Environment, Food and Rural Affairs (Defra) with an independent, external assessment of the relevance, sustainability, quality, and impact of the science and scientific programmes carried out by the Centre for Environment, Fisheries and Aquaculture Science (Cefas) over the period since the Science Audit in 2005.
2. The science at Cefas was evaluated under three Themes: Fisheries, Environment, and Health and Hygiene. Overall, the independent Panel concluded that Cefas is an excellent provider of essential statutory monitoring and inspection services, information and advice, and national emergency response capability supported by active researchers and good science.
3. **Relevance.** Cefas has strong relationships in place with its main government customers and provides them with high quality science. The creation of a High Level Agreement (HLA) for the provision of services by Cefas to Defra has established a clearer framework for delivery and financial commitments from which Cefas can plan for the future. However, the Panel felt that Defra could develop a more comprehensive and strategic view of services covered by the HLA and drive forward a more interactive approach to future evidence needs. There is also a divergence of policy approaches to marine planning across the Devolved Administrations and the implications for scientific coordination need to be actively managed by Cefas, Defra, the Welsh Government and other government customers.
4. Since the 2005 Science Audit Cefas has expanded and widened its customer base, particularly through European Union (EU) funding and private sector contracts. This makes Cefas a more resilient organisation with a wider portfolio of expertise. The Panel assessed the Cefas approach to management of the potential impacts of this wider portfolio of work on services to government (such as, data disclosure, regulatory impact assessments and emergency response capability). At this stage, the Panel concluded that appropriate procedures were in place. However, going forward, Cefas needs to anticipate any potential conflicts of interest which may arise from its commercial work and minimise the impact on delivery to public sector customers. Cefas's provision of critical emergency response capability to government must be maintained and, therefore, considered more strategically by its users.
5. The Cefas approach to management of performance is strongly aligned to successful delivery of five "measures of achievement" that make up Cefas's annual Ministerial Targets. Science Excellence is one of the five parameters that contribute to this annual evaluation of performance. The Panel considered that there should be an independent assessment of the measures of achievement to ensure that there is an ambitious programme for enhancing the quality of scientific services, expanding research partnerships and increasing the output of science journal publications.

6. Cefas has greatly improved its corporate approach to management of science since the 2005 Science Audit, including development of strategies and plans at various levels within the organisation and simplifying management structures, all resulting in a more professional organisation. However, whilst there has been some progress since the 2005 Science Audit, the IT-enabled corporate management systems could be more strongly aligned with the imperative to support the expansion of research capability and delivery of services. In particular, Cefas should accelerate development of management information systems that can provide accessible, useful and relevant data for Cefas to assess its scientific performance.
7. Cefas has a strategy for integrated development of business, science and people, including specific areas of science activities and links to the operational Division Plans. However, the Panel restates the view of the 2005 Science Audit that there should be a more forward-looking science strategy and more dynamic horizon-scanning across all sectors. This needs to convey the Cefas ambition to be a dynamic and interactive research organisation capable of attracting the best marine and freshwater scientists.
8. **Sustainability.** Cefas has improved its financial performance significantly since the 2005 Science Audit. Despite a reduction in Defra investment, Cefas has developed into an expanding and profitable business, largely through extending its customer base and range of science projects. There is a strong possibility that the business will continue to grow, although there is continued concern about how Defra funding, particularly for research and development, will impact on Cefas in the future.
9. The Panel concluded that the laboratory facilities at Cefas's Weymouth and Lowestoft sites and its sea-going capability were well managed, with an appropriate level of investment in scientific equipment. However, there is a clear need for the Lowestoft laboratory facilities to be replaced; in continuing to consider how to take this forward Defra and Cefas must drive to find a solution as soon as possible.
10. The quality of scientific and technical staff at all levels of the organisation is a key strength and Cefas has a cohort of scientists with international standing. As with many public sector organisations, there are challenges in managing retention and recruitment but these have not impacted on Cefas's capacity to deliver up to this point. Indeed, Cefas has been proactive in succession management. The Panel recommend that in the medium-term, Cefas should seek to align the pay and reward schemes with equivalent organisations and make further efforts in relation to achieving gender equality at senior grades.
11. The Cefas Seedcorn programme, which is self-funded through an operating surplus, is a noteworthy success in building capability for the future. The annual budget of around £1m has been invested in novel research projects, infrastructure to support science, collaboration with universities and exploitation of intellectual property. Going forward, it is important that the Seedcorn programme is managed strategically as it will be central in promoting innovation in the context of projected declines in government investment.

12. **Quality of Science.** The general level of science at Cefas is excellent and in several areas is leading at the European and global level. There is a cohort of research scientists and scientific advisers to government who have an international reputation. The management of scientific projects and quality assurance of evidence provided to support policy is suitably rigorous. Procedures have been put in place to ensure that the audit trail for advice is well documented and archived.
13. The Panel was impressed by the overall standard of the scientific presentations it received and noted that there had been significant improvements in those science areas highlighted for development by the 2005 Science Audit. The Panel's analysis of Cefas's data on scientific publications indicated that the number of papers in good quality journals and the level of citations are comparable with equivalent public sector institutes providing scientific services and research. Defra and Cefas should further develop external benchmarking to inform the Ministerial Targets set for Cefas in terms of journal publications in the future.
14. There were differences in publication rates across the three Science Themes at Cefas, with scientists in Health and Hygiene consistently exceeding the cross-Cefas targets agreed with Defra. In relation to the Fisheries and the Environment Themes, the Panel was concerned that pressures to support Defra's short-term policy requirements in terms of EU fisheries policy should not constrain innovation and development of new concepts and technologies. Cefas should review this situation, set internal metrics on which to evaluate scientific performance, incorporate these into the staff appraisal process and collect appropriate statistics for evaluation of corporate performance.
15. The Cefas Science Advisory Committee (CSAC) has influenced strategic thinking on cross-cutting science issues (such as climate change and ecosystem modelling) and focussed Cefas's attention on corporate activities (for instance, science quality and data management). The Panel concluded that CSAC should have an even more influential role and be strengthened by new appointments of senior scientists independent of Cefas and Defra.
16. **Impact.** Cefas is delivering high quality science and advice, impacting positively on policy decisions, regulations, public understanding, economics, human health and the environment. The key customers universally considered that the scientific resources and advice provided by Cefas were leading edge and cited numerous examples of beneficial impacts (for instance: influencing EU Common Fisheries Policy and the Marine Strategy Framework Directive; providing support for marine emergency responses; and mapping marine ecosystems for implementation of the Habitats Directive).
17. Cefas has considerable strength in population and epidemiological modelling that has underpinned policies on management of fisheries and fish diseases for some time. More recently, Cefas and the wider science community have been engaged in developing numerical models that forecast the effects of fisheries management and environmental change at the ecosystem level. The Panel concluded that Cefas needs

a clearer strategy for defining its contribution in this area and strengthening links with the academic community and relevant Natural Environment Research Council programmes.

18. Cefas holds significant national data sets. Managing these effectively and in the best public interest is hugely important - and will become more so with the implementation of the INSPIRE Directive, government openness and transparency agendas and Defra's Open Data Strategy. The Cefas website is crucial to raising public awareness of marine issues and the dissemination of data and information to customers and regulated businesses. Cefas should actively pursue an open data policy through the website and other means of communication.
19. Cefas has made considerable progress at developing and exploiting links with the wider research community, improving its ability to collaborate and identify new scientific opportunities. However, the Panel concluded that Cefas should increase customer awareness of the full spectrum of its activities (including commercial projects and exploitation of intellectual property) to maximise opportunities for future collaboration and partnerships.
20. The Panel makes a number of recommendations within the report to both Cefas and Defra, as listed below.

Recommendation 1. The Panel recommends that: (a) the main Defra stakeholders maintain a strategic approach to the provision of services and advice within the High Level Agreement (HLA) to provide continuity of evidence investment to Cefas; (b) the annual objectives in the HLA schedules should continue to be aligned to the relevant Defra Evidence Plans; (c) Cefas and Defra should increase their focus on anticipating future evidence needs through more active horizon scanning; and (d) there should be strengthened oversight and coordination of HLA evidence activities and reporting across all the Defra Programmes that commission evidence from Cefas through the HLA.

Recommendation 2. The Panel was impressed by the capacity and responsiveness of Cefas in recent marine and nuclear power station emergencies and recommends that the emergency response capability in Cefas should be sustained and underpinned by a specific R&D budget. While not wholly a Defra issue, Defra should develop a clear view of its role in terms of funding, responsibilities and requirements in marine aspects of emergency preparedness and produce a funded plan for delivering this capability.

Recommendation 3. The Panel recommends an evaluation by Defra of the relevance of Cefas's Ministerial Indicators given Cefas is increasingly operating as a commercial business with a wide customer base. In particular, there should be a greater degree of challenge in the targets for the 'Scientific Excellence' Ministerial Indicator. In addition, Defra should organise an independent evaluation of the annual science performance statistics provided by Cefas in support of their Ministerial Indicators.

Recommendation 4. The Panel recommends that Cefas ensures that it has a fit-for-purpose Management Information System for recording and managing project and

scientific output information and that Cefas develops a strategy for collecting, recording and reporting on scientific output data at appropriate organisational level. These data should be regularly reported on as a tool for science performance management at a range of levels (individuals, Science Teams and Science Divisions, etc.).

Recommendation 5. The Panel recommends that Cefas: (a) develops a five year cross-cutting Evidence Strategy (including commitments to expand staff skills in key areas and a forward-looking plan for internal investment in novel research and procurement of scientific equipment); and (b) the Cefas Science Advisory Committee should be actively engaged in the development of the Evidence Strategy.

Recommendation 6. Whilst feedback from customers was generally positive, the Panel recommends that Cefas should: (a) be more proactive in providing a dedicated relationship manager for key customers; (b) provide clarity to their government customers on their pricing policy; and (c) introduce more flexibility in funding models when bidding for strategic research with academic partners, in recognition of the extension in capability that such projects can deliver for Cefas.

Recommendation 7. The Panel were impressed by the financial resilience that had resulted from the expansion into wider markets beyond Defra but, having accepted the key importance of R&D activities to expanding future capability, the Panel recommends that Defra keeps the R&D funding at the present level in proportion with the support for statutory functions.

Recommendation 8. Given that there is potential for Cefas to grow income from expanding into new markets, the Panel recommends that an additional Business Plan is developed by Cefas that considers the various constraints on expansion of a government Agency (such as limitations of the current estate, caps on headcount and/or payroll, capital investment and underpinning R&D) so that these can be addressed through strategic discussions with Defra rather than the current case-by-case approach.

Recommendation 9. The Panel concluded that, in line with existing plans, there is a clear need in the near future to replace the Lowestoft Laboratory and recommends that Cefas and Defra place a priority on developing a costed plan for new, fit-for-purpose facilities which could be implemented rapidly as and when resources become available.

Recommendation 10. We recommend that Cefas: (a) fully recognises in its Risk Register the risks around the current Information and Communication Technology (ICT) strategy in terms of supporting the future expansion of science capability; (b) assesses the potential risks of any new cross-Defra ICT strategy on its scientific computing capability and requirements and, if necessary, develops a strategy for its scientific computing capability; and (c) incorporates feedback from computer users in a major review of its present ICT capability and future needs.

Recommendation 11. The Panel recommends that Cefas should be more proactive regarding gender issues, for example, by benchmarking gender balance with other science

organisations and setting goals to progress more rapidly towards equity amongst the senior grades.

Recommendation 12. As staff perceptions on the pay and reward package, corporate support services and retention issues in specific areas are a major concern, the Panel recommends that Cefas, working through Defra, should ensure that the future pay and reward package brings the consolidated pay scales more in line with other Defra Agencies and external benchmarks.

Recommendation 13. The Panel recommends that: (a) over time, a target of 150 ISI journal papers per annum should replace the existing criterion of 150 peer-reviewed papers in the Science Performance Ministerial Indicator; and (b) the Cefas Science Advisory Committee should advise on the rate at which this target should increase over the next review period in order to set an ambitious but achievable projection.

Recommendation 14. The Panel noted that there were differences in ISI journal publication rates across, and within, the three Themes (Fisheries, Environment, and Health and Hygiene). The Panel recommends that Cefas should: (a) examine more closely the reasons for the variation of ISI publications across the Teams with R&D funding, and provide this information to the Cefas Science Advisory Committee for external scrutiny; (b) adopt a minimum of 1.5 ISI journal publications per active research scientist as the internal metric and ensure that all teams across the organisation achieve this target by 2015; and (c) ensure that staff are aware of the measures of success in terms of science quality and impact and that these are assessed in annual Staff Appraisals.

Recommendation 15. The Panel has found value in using the UK Higher Education Institutions “Research Excellence Framework” approach for assessing research quality and impact, leading to the conclusion that Cefas has a cohort of leading scientists with an international standing in applied marine and freshwater sciences - comparable to some top research-led universities - and recommends that Cefas develops a simple, fit-for-purpose benchmarking process to evaluate the performance of staff in relation to scientific outputs.

Recommendation 16. Whilst the Panel recognises that all Cefas advisory scientists are required to keep their scientific credentials up-to-date by following the literature and best-practice, the Panel recommends that Cefas should promote and maintain the ability of staff to be active research scientists as well as involved in the provision of policy advice. Cefas should raise awareness amongst its scientific staff of individuals who represent exemplars of good practice in this context.

Recommendation 17. While the Panel recognises the value of numerical based customer feedback data (as provided by the Cefas administered Customer Satisfaction Questionnaires) in terms of providing quantitative trends in customer views, we also strongly encourage the collection of more qualitative free-form customer responses (for example, collected via telephone questionnaires) and independent validation of customer views. The Panel recommends that Cefas augments its Customer Satisfaction Questionnaire programme with an independent customer survey every 2-3 years to challenge and validate their own information.

Recommendation 18. The Panel recommends that: (a) it would be timely to refresh the Cefas Science Advisory Committee (CSAC), members of which, in addition to the present focus on scientists of high esteem, should also be independent of Cefas and Defra; (b) that recruitment to CSAC addresses the need for a better gender balance and international representation; and (c) CSAC develops a stronger role in strategic thinking, evaluation of the Seedcorn programme and assessment of Cefas's scientific performance indicators.

Recommendation 19. The Panel recommends that in the area of ecosystem modelling, Cefas: (a) develops a clearer strategy that defines its niche in this area; (b) demonstrates how the different modelling platforms used in Cefas are applied, for what purposes, and how they add to each other's strengths; and (c) both Defra and Cefas assess the potential synergies and efficiencies that could be achieved by coordinating this strategy with NERC's National Capability funding for marine ecosystem modelling, and with the NERC Earth System Modelling strategy (which includes University and NERC Centre partners, as well as the UK Met Office).

Recommendation 20. The Panel considers Cefas data resources to be a major national asset and recommends additional funding from Defra to ensure compliance with the INSPIRE Directive.

Recommendation 21. The Panel recommends that: (a) Cefas ensures that the implementation of a centralised approach to internal data management is completed and adopted across the organisation's data holdings so that Cefas can deliver an optimised data management and storage strategy within a two year time frame; and (b) the Panel is concerned that insufficient funding has been allocated to this task and encourages Cefas to look at the level of resources committed to data management by other equivalent organisations (for example, NERC Institutes) and re-evaluates its position.

Recommendation 22. The Panel recommends that Cefas: (a) makes a firm and public commitment to open access data and publishes a Data Policy comparable to that published by NERC, as soon as possible; (b) ensures that participation in data management and archiving networks are fully integrated; and (c) extends its recent participation in a wider network approach to data management to become a full and active member of initiatives such as the MAREMAP network.

Recommendation 23. The Panel was concerned that managing external perceptions will become more difficult as commercial income increases to the planned level of 25% of turnover by 2015. The Panel recommends that Cefas: (a) develops a communication strategy to make the commercial activities more transparent to its key stakeholders; and (b) issues arising in relation to conflicts of interest (in addition to specific complaints) are logged and reported to the Cefas Management Board on an annual basis.

Recommendation 24. The Panel noted that the arrangements whereby Cefas provides important services to the Welsh Government are evolving rapidly and the Panel recommends that: (a) there is an evaluation of the programme planning procedures by Defra to ensure that Welsh Government feels that its interests have been given full

consideration; and (b) Cefas establishes a formal agreement for the coordination of directly contracted services with the Welsh Government.

Recommendation 25. There are a number of UK initiatives between Defra and the Devolved Administrations to coordinate monitoring and research across national boundaries. However, the Panel recommends that Cefas and Defra takes the initiative at the institutional level to ensure comparability between the projects, initiatives and organisations of the Devolved Administrations and those of Cefas and Defra in the rapidly expanding marine environmental sectors.

Recommendation 26. The Panel recommends that: (a) Defra places a priority on supporting marine research through targeted co-funding of Research Council programmes even though there is pressure on evidence budgets; (b) Cefas undertakes greater collaboration with the academic sector; and (c) successes in grant applications to the Research Councils and the EU Framework Programmes are included in the Cefas Science Performance Ministerial Indicators.

Recommendation 27. The Panel commends Cefas on the quality of their external website and recommends that, as changes to Defra and government websites are implemented, the commercial value to Cefas of the present website is recognised and the current levels of functionality in any new solution are maintained by clear and unambiguous contractual arrangements.

Recommendation 28. The Panel commends Cefas on its commitment to exploiting Intellectual Property but recommends it takes a more ambitious approach to expansion of Cefas Technology Limited so that turnover is at least doubled over the next five years with more products moved out into joint ventures.

1. Introduction

- 1.1. This is the report of the independent Review Panel that considered the science conducted at the Centre for Environment, Fisheries and Aquaculture Science (Cefas) from 2006-2011. The Introduction provides an overview of Cefas, discusses the Terms of Reference for the Review and provides some background information about how the Review was conducted.

Overview of Cefas

- 1.2. Cefas is an Executive Agency of the Department for Environment, Food and Rural Affairs (Defra). Cefas employs over 500 people, with an annual turnover of approximately £53m. It operates from two main laboratory sites in Lowestoft and Weymouth, with small project offices elsewhere, and owns a Research Vessel. As an Executive Agency of Defra, Cefas is fully accountable to Parliament through Ministers.
- 1.3. As outlined in its Framework Document¹ Cefas's vision is "to make a real difference for society as recognised leaders in marine and aquatic science by supporting the long-term prosperity and well-being of industries, communities and individuals that enjoy and depend on the rich natural assets found in our marine and freshwater environments". Cefas's purpose is "to be the government's foremost source of evidence, applied science and impartial expert advice for marine and closely related environments". In delivering this Cefas "supports government decision making, provides long term assurance and responds to EU/UK legislation and international obligations". Government funding reinforces impartiality, maintains an emergency response capability, and supports the sustainability of specialised capability.
- 1.4. Cefas seeks to deliver its vision by undertaking Research and Development (R&D) projects, monitoring and surveillance and providing science services to promote economic growth and effective protection of the natural environment through:
 - Innovating to enhance the competitiveness, resilience and sustainability of the fishing and aquaculture industries. For example, working with Defra and industry to secure positive outcomes from Common Fisheries Policy (CFP) reform and sustaining effective aquatic animal disease controls.
 - Contributes to the national evidence base and expert scientific advice that supports sustainable management of marine and coastal environment. For example, contributing to the evidence base required for marine licensing and

¹ Cefas Framework Document 2012, [http://www.cefas.defra.gov.uk/publications-and-data/cefas-framework-document-\(2012\).aspx](http://www.cefas.defra.gov.uk/publications-and-data/cefas-framework-document-(2012).aspx), (December 2012).

planning decisions and effective implementation the EU's Marine Strategy Framework Directive (MSFD).

- Improving human health and food security through expertise on fish and shellfish. For example, supporting food safety by working closely with the Food Standards Agency and industry; and
- Supporting the UK energy policy through work relating to offshore renewables and leadership on adaptation to marine climate change.

1.5. More than 80% of Cefas's income is generated from UK government bodies with Defra, the main customer, providing more than £30m annual income (around 60% of total income). Other key government customers are the Food Standards Agency (FSA), the Marine Management Organisation (MMO) and the Environment Agency (EA). An increasing proportion of income is generated from wider markets with around 13% from industry and other sectors and about 5% from the European Union.

Terms of Reference of the Review

- 1.6. The Defra Chief Scientific Adviser (CSA) is responsible for independent challenge to the scope, content and quality of Defra's scientific activities, including investment plans for science, science programmes and specialist resources, and this remit extends to Defra's Laboratory Agencies. As part of this role, the Defra CSA and the Cefas Chief Executive agree to periodic independent science reviews of Cefas to assess and challenge the relevance and quality of Cefas's scientific activities. The last such review was undertaken in 2005 and covered the five year period to 2004/05. This Science Review covers the period 2006/07 to 2011/12.
- 1.7. The Terms of Reference for the Review were drawn up by the Defra CSA in consultation with Cefas and other stakeholders, with the broad aim of providing the CSA with an independent, external assessment of the **relevance, sustainability, quality and impact**, of the science and scientific programmes carried out by Cefas over the period since the 2005 Science Audit (the full Terms of Reference are given in **Appendix A**).
- 1.8. The Terms of Reference covering **Relevance** focus on assessing the extent to which Cefas is meeting the requirements of its government customers as well as the extent to which Cefas's science strategy supports delivery of its strategic objectives and is responsive to emerging scientific issues and the future needs of its key customers.
- 1.9. **Sustainability** relates to the quality of the resources in the form of the staff, equipment, Seedcorn investment and facilities that are available to Cefas, whether it can attract and retain internationally leading scientists and Cefas's ability and success at generating income for its scientific work.

- 1.10. **Quality of Science** is focused around an assessment of the national and international standing of the evidence activities undertaken by Cefas as well as the quality assurance processes in place and being progressed since the 2005 Science Audit.
- 1.11. **Impact** focuses on identifying key achievements and highlights and evaluating the impact that Cefas has in delivering evidence-based scientific advice and information to inform UK, EU and international policy development and delivery, as well as considering Cefas's interactions and collaborations with other organisations and knowledge transfer.

Review Background

- 1.12. Members of the Review Panel are listed in **Appendix B**. Members served in an individual capacity, rather than representing their employing institutions. Each member of the Panel made a declaration of interest and Panel members also signed agreements to respect any information given to them in confidence. Panel members were selected to cover the three thematic areas of Cefas work: Health and Hygiene; Environment; and Fisheries. A Chair was appointed to lead the Panel and Vice-chairs were appointed to lead each of the three Themes. Secretariat support was provided by Defra.
- 1.13. The Review visit took place from 2-6 July 2012 at the Cefas Lowestoft Laboratory. Prior to the Review, visit the Panel Chair and the Vice-chair for the Health and Hygiene Theme visited Cefas's Weymouth Laboratory to meet Cefas staff based there and to tour the facilities. One of the Health and Hygiene Theme Panel members also visited the Weymouth Laboratory after the main Review visit.
- 1.14. Prior to the Review visit Cefas prepared a self-assessment document, covering the period 2006-2011, based around the Terms of Reference and incorporating a number of metrics of science quality and impact, including research income, numbers of Institute for Scientific Information (ISI)² listed journal papers, scientific esteem measures and key outputs. The information presented by Cefas was organised according to the three Themes, which were each subdivided into three Sub-themes³, allowing more in-depth detail of the work undertaken to be presented. The three Themes broadly mapped onto existing management divisions within Cefas and were used for the Review as they provided a more balanced split of evidence activities. The Review Chair and the Secretariat provided comments to Cefas during the drafting of the self-assessment document, particularly in relation to

² Institute for Scientific Information (ISI) metrics for journals indexed in Thomson Reuters *Journal Citation Reports*, http://thomsonreuters.com/products_services/science/free/essays/impact_factor/ (December 2012).

³ Health & Hygiene Sub-themes: Aquatic Animal Disease; Environment & Health; Food Safety. Environment Sub-themes: Pressure, State & Impact; Current & Future Risks; Ecosystem Modelling & Processes. Fisheries Sub-themes: Evidence Collection & Monitoring; Ecosystem Approach to Fisheries; Assessment & Advice.

inclusion of appropriate performance indicators. The self-assessment document was supplemented with supporting material including information on governance, structures and organisation, Science and Divisional Plans, the 2012 Science Performance Report and the corporate strategy (Cefas Strategic Direction 2012-17).

- 1.15. Additionally, prior to the Review visit, the Panel Chair and Secretariat carried out a consultation with the key public sector stakeholders of Cefas to obtain some structured feedback on their interaction with Cefas. The Panel received responses from seven government organisations to the customer questionnaire and the Chair also held a teleconference interview with the Natural Environment Research Council (NERC). Our thanks go to all organisations that provided valuable feedback (**Appendix C**).
- 1.16. During the Review visit the Panel:
 - had presentations from Cefas Senior Management Team and scientists, describing work undertaken over the last five years and future plans;
 - had presentations from three of the key government customers of Cefas – Defra Marine Programme, the FSA and the MMO;
 - met with Cefas staff to discuss issues such as financial planning, customer relationship management, data and IT services, Human Resource issues, and with Trades Union representatives of Cefas staff;
 - toured the Benthos, Chemistry, Radiological Protection and Electronics Labs and the Tank facilities; and
 - had a number of informal opportunities to meet Cefas staff, including early career scientists.
- 1.17. The Panel was struck by the enthusiasm and engagement of the Cefas staff, and are grateful to them for the information they provided and for the way in which they contributed to the Review. We are also grateful to the Cefas Chief Scientist and his team for their support in providing information and in making practical arrangements for the Review.
- 1.18. This report of the Panel addresses each of the main areas of the Terms of Reference in turn (Relevance, Sustainability, Quality of Science and Impact). The reports from each Theme (Health and Hygiene, Environment and Fisheries) are at Appendix D, E, and F respectively.

2. Relevance – Meeting Defra and other objectives

Delivery to Government Customers

- 2.1. The Panel wished to establish whether there had been significant improvements since the 2005 Science Audit in the corporate approach to management of business, science and people. The Panel hoped to see a clear sense of purpose to supply government with evidence, applied science and impartial expert advice for marine and freshwater environments.
- 2.2. The first objective of the Panel was to establish a clear alignment between the Cefas Strategic Direction 2012-2017 and the Defra priorities covering enhancement of the environment and biodiversity, sustainable food production, promoting a green economy and supporting emergency responses.
- 2.3. Cefas is Defra's principal contractor for marine-related science. Defra and Cefas have developed a High Level Agreement (HLA) for the period 2007-2017. The HLA provides Cefas with a more secure, long-term funding stream and provides Defra with access to high quality scientific services to support policy development, maintain capability and scientific expertise and support for emergency response. The HLA includes indicative funding for research, monitoring and advice, for Defra's Marine, Aquatic Animal Health, Water Quality and Biodiversity Programmes and the Marine Management Organisation (MMO). These interactions are formalised through a variety of Service Level Agreements and Memoranda of Understanding. Defra also contracts Cefas to undertake research projects outside of the HLA through either single tender action or won through open competition, both for the Defra programmes which are signed up to the HLA and also other Defra programmes (for example, Chemicals and Nanotechnology). Recent establishment of the MMO has added to the complexity of the HLA.
- 2.4. The Panel concluded that the HLA operates effectively at a Defra Programme level, with external peer-review of research proposals and final reports where appropriate. However, the Panel had to put in some effort to obtain a coherent view of all aspects of the HLA and to obtain up-to-date information on the various funding lines. The Panel concluded that, for the main part, there were positive interactions between Cefas and the main government stakeholders. Implementation of the Defra 2006 Laboratory Strategy Review had provided a planned (but declining) indicative funding framework up to 2015 and Cefas continues to benefit from consolidated funding managed through HLA. The Defra Evidence Plans⁴ (dated April 2011)

⁴ <http://www.defra.gov.uk/evidence/strategy-evidence-plans/> (December 2012).

provide an important framework for developing robust evidence to support marine and freshwater policies and implement regulations and the Panel are pleased these will be updated regularly.

- 2.5. **The Panel recommends that: (a) the main Defra stakeholders maintain a strategic approach to the provision of services and advice within the High Level Agreement (HLA) to provide continuity of evidence investment to Cefas; (b) the annual objectives in the HLA schedules should continue to be aligned to the relevant Defra Evidence Plans; (c) Cefas and Defra should increase their focus on anticipating future evidence needs through more active horizon scanning; and (d) there should be strengthened oversight and coordination of HLA evidence activities and reporting across all the Defra Programmes that commission evidence from Cefas through the HLA. [Recommendation 1]**
- 2.6. The FSA commissions Cefas to provide surveillance, research and advice for the management of seafood safety in the UK. Cefas provides a critical mass of expertise in microbiology, analytical chemistry and radiochemistry to support surveillance and research on contaminants in seafood. Cefas is among the FSA's largest service providers and the relationship is managed through medium-term contracts that are subject to open competition. However, additionally, during environmental contamination incidents the FSA has also called on Cefas's capability to provide advice, emergency sampling and analysis.
- 2.7. Cefas needs to be responsive to government requirements as the marine sector is the focus for a number of high profile, and often conflicting, policy areas that require science/evidence support. Such areas include rapid expansion of the offshore renewable energy sector; designation of Marine Conservation Zones (MCZs); reform of the Common Fisheries Policy; implementation of the Marine Strategy Framework Directive by 2020 - when Good Environmental Status is to be achieved for UK seas; supporting integrated marine planning and streamlined licensing processes. The Panel noted that the manpower resources in core Defra, the MMO, Natural England and the Joint Nature Conservation Committee appeared to be at full stretch in dealing with these issues.
- 2.8. It was clear that the key government stakeholders rely heavily on specialists in Cefas to provide high quality science and evidence support, often at short notice. For example, Cefas organised a multi-million pound marine seabed survey in 2011/12 to address some gaps in the spatial marine databases on biodiversity. The Panel concluded that the Cefas capability is likely to become even more important to their key stakeholders in the marine sector in the coming years.
- 2.9. Cefas's capability has been built up over many years through a mix of applied science and strategic research (that is, with a time horizon over five years). However, a recent review by Defra of their Marine Fisheries Research between 2002 and 2012 (which primarily includes work commissioned from Cefas) concluded that over that period there had been a significant reduction in strategic

research and a greater focus on new approaches to fisheries management. It is important that Defra maintains a balance of funding to support both statutory functions and R&D – and that the latter contains a component of research with a longer term horizon.

- 2.10. Most public sector customers felt that Cefas was responsive to the forward strategies of their organisation, although sometimes this was restricted to certain areas where Cefas has traditional expertise and/or focused on meeting specific contract requirements. Some customers identified a tendency for Cefas to maintain existing teams and expertise, perhaps at the expense of being able to anticipate to emerging issues. Importantly, some key government customers felt that Cefas could be more proactive at horizon scanning and setting research direction themselves rather than responding to short-term policy agendas (particularly Defra policy).
- 2.11. There is a potential impact on Cefas of external pressures on their main government customers to use a wider range of service providers. However, there are both risks and opportunities for Cefas through increased competition. Coupled with declining government funding as a proportion of turnover, there is concern that a 'tipping point' might be reached beyond which Cefas will not be able to maintain science capability for government. The Panel noted that the main stakeholders were aware of the need to consider national capability as well as value for money. At this stage, the Panel did not identify any indications that Cefas was close to such a tipping point.

Emergency Response

- 2.12. Cefas provides a national emergency response capability for marine incidents (such as oil and chemical spills, and releases of radioactivity) and all aquatic fish disease outbreaks. These responses often require inputs from a range of senior specialists, supported by analytical and diagnostic skills and specialist aquarium facilities. The Panel were impressed by the wider advisory role played by Cefas for international incidents such as the potential impact of the 2011 Fukushima accident on UK citizens in Japan.
- 2.13. Whilst the Panel felt that there had been greater recognition of the role of government laboratories in emergency responses since the 2005 Science Audit, it considered the funding arrangements were not adequate. The continuity of funding under the HLA does provide Cefas with a platform to support rarely-used emergency response capacity. However, it is currently unclear across government where the responsibility lies for funding underpinning research to develop this capability. The Improving Future Disaster Anticipation and Resilience Foresight

project⁵, due to be published by the end of 2012, will be a key driver for improved coordination in this area.

- 2.14. **The Panel was impressed by the capacity and responsiveness of Cefas in recent marine and nuclear power station emergencies and recommends that the emergency response capability in Cefas should be sustained and underpinned by a specific R&D budget. While not wholly a Defra issue, Defra should develop a clear view of its role in terms of funding, responsibilities and requirements marine aspects of emergency preparedness and produce a funded plan for delivering this capability. [Recommendation 2]**

Widening the Customer Base

- 2.15. Cefas is aware that it is essential to widen its customer base as Defra evidence funding declines over the coming years from the present level of around 60% of turnover. Indeed, Cefas has been very effective in securing additional funds through competitive tendering across other government departments, the EU, Research Councils and commercial contracts from the private sector.
- 2.16. The relatively rapid changes in the customer base have led to a number of challenges. Most notably, income from the private sector - largely for impact assessment studies for large infrastructure projects (such as the British Energy Estuarine and Marine Study - BEEMS) has stretched resources, but ultimately enhanced the Cefas capacity to deliver large projects. Establishment of the MMO as a standalone Agency responsible for marine planning and licensing has also produced new challenges for Cefas in terms of developing novel modelling tools and coordinated approaches to data management.
- 2.17. Cefas has put in place management systems to deliver benefits to Defra from these wider market activities, to maintain pricing policies that achieve a fair balance between value for customers and a fair return to Cefas, and to anticipate and manage potential conflicts of interest. Efficiencies have been secured through streamlining corporate services supported by investment in financial and project management systems. The result is a more efficient and effective organisation run on profitable business lines and focused on delivering outcomes for the public sector and wider markets.

Defra Ministerial Indicators

- 2.18. The overall performance of Cefas has been evaluated each year by Defra against a set of Ministerial Indicators encompassing targets for financial performance, customer satisfaction, employee engagement, social responsibility and science

⁵ <http://www.bis.gov.uk/foresight/our-work/policy-futures/disasters> (December 2012).

excellence metrics⁶. A bonus for all staff of up to 4% of base pay is dependent upon satisfactory corporate performance against the Ministerial targets. There are a number of issues that arise in this area. The Panel noted that Cefas had achieved all the targets for the last five years (with one exception) and this raises the question as to whether these targets are sufficiently stretching. Cefas's Customer Satisfaction Survey is carried out in-house with infrequent independent evaluation. There has been a large increase in contracts from the private sector so the indicators should continue to include a representative assessment of the quality of this work.

- 2.19. The assessment of Science Excellence for the Ministerial Indicator is based on the annual Cefas Science Performance Report. This includes statistics on research outputs (numbers of peer-reviewed papers), popular (non-scientific) publications, self-investment by Cefas in scientists and underpinning R&D programmes, delivery of targeted initiatives and more qualitative feedback from the Customer Satisfaction Survey.
- 2.20. Up to 30% of the assessment of the Science Excellence Ministerial Indicator depends on an annual output of 150 peer-reviewed publications, with a rising baseline on journal impact factors. The Cefas Science Advisory Committee has urged Cefas to increase the number and impact factor of science journal publications and yet the target of 150 peer-reviewed publications has remained the same for at least five years. Up to 15% of the assessment is based on a score rating "science quality" in feedback from customers that is collated annually. As these individual targets set the objectives for the management of performance in Cefas, the Panel were not convinced that the parameters for science output and quality were appropriate – nor given sufficient weighting.
- 2.21. **The Panel recommends an evaluation by Defra of the relevance of Cefas's Ministerial Indicators given Cefas is increasingly operating as a commercial business with a wide customer base. In particular, there should be a greater degree of challenge in the targets for the 'Scientific Excellence' Ministerial Indicator. In addition, Defra should organise an independent evaluation of the annual science performance statistics provided by Cefas in support of their Ministerial Indicators. [Recommendation 3]**

Management Information System

- 2.22. The Panel heard that there were limitations to the current Management Information System used by Cefas in terms of being able to record, collate and extract data relating to projects and scientific outputs at a level of detail useful for monitoring, analysis and reporting on science outputs. For example, it was not straightforward

⁶ Cefas Performance Indicators 2011-12: <http://www.cefas.defra.gov.uk/about-us/governance/performance-indicators.aspx> (December 2012).

to identify which Cefas projects were R&D projects and to extract information on these. It was also not clear to the Panel whether information on science outputs (for example, ISI journal publication data, citation statistics, PhD level Full Time Equivalents and scientific esteem measures) were regularly broken down into useful management categories, such as by Science Division. It was also not clear that information other than those used in the Ministerial metrics were regularly recorded and collated in an accurate way that could be easily accessed for internal management purposes.

- 2.23. **The Panel recommends that Cefas ensures that it has a fit-for-purpose Management Information System for recording and managing project and scientific output information and that Cefas develops a strategy for collecting, recording and reporting on scientific output data at appropriate organisational level. These data should be regularly reported on as a tool for science performance management at a range of levels (individuals, Science Teams and Science Divisions, etc.). [Recommendation 4]**

Management of Science/Evidence

- 2.24. Management structures have been simplified since the 2005 Science Audit, with a stronger Cefas Management Board, four corporate Directors (including a Chief Scientist) and science teams brigaded into four Divisions: Fisheries; Environment and Ecosystems; Aquatic Health and Hygiene; and Monitoring and Programme Management. The Senior Management Team is operationally-focussed and consists of the Cefas Management Board executives and the Divisional Directors. The Panel concluded that these procedures and structures have worked effectively in emphasising customer focus, expanding the portfolio of science programmes and ensuring greater accountability in project management.
- 2.25. High level strategies for business, science and people over a five year time horizon are outlined in the internal document Cefas Strategic Direction 2012-17 developed by the Executive Team and approved by the Cefas Management Board. Science Plans have been produced for Cefas priority science areas identified in Cefas Strategic Direction 2012-17. Examples of the longer-term Cefas science priorities include remote monitoring technologies, laboratory diagnostics, modelling and forecasting as well as ecosystem goods and services.
- 2.26. Annual Plans had been developed at a Divisional level. The Divisions are customer-facing and the Science Leaders in each Division are central to coordination of science and identifying opportunities. Science Leaders also have a key role in coordinating cross-cutting science activities as well as broader responsibilities for staff mentoring and encouraging an ethos of innovation and a focus on scientific publications. Various mechanisms have been introduced to exploit cross-cutting opportunities such as marine renewable energy and climate change. Strategic plans are in place to exploit future opportunities in relation to

expanding commercial activity in areas such as the development of marine and coastal infrastructure, the oil and gas sector and aquaculture and food security.

Seedcorn

- 2.27. Seedcorn is a budget used by Cefas to invest in training and R&D to develop capabilities to meet future government customer needs. Seedcorn is used for cross-Cefas science initiatives and the most innovative and relevant R&D that will produce science of international standing and high quality science outputs in areas of original research. Until 2009/10, the Seedcorn budget was provided by Defra but since then it has been generated from operating surplus from Cefas's competed activities, mostly commercial work.
- 2.28. The Panel commends Cefas for its internal investment to build capabilities and new opportunities. Seedcorn funding has increased year on year over the Review period from around £500k to more than £1m in current and future business plans. Seedcorn funding has been managed on an individual project basis, maintaining a balance of around 60% development to 40% research projects in the portfolio. In 2011, 32% was invested in research projects, including nearly £400k of PhD studentship funding, and 68% in development projects. However, the funding pot is now sufficiently large that a more strategic approach to project funding on a thematic basis can be adopted.
- 2.29. The Panel observed that Cefas's strategic planning document had not been refreshed for some time, until just prior to the initiation of the Science Review when the Cefas Strategic Direction 2012-2017 document was produced. Nevertheless, there was a reasonably strong integration between Division Annual Plans and the corporate strategy documents, but only in relation to short-term (less than 3 years) science/evidence issues. Some parts of Cefas had produced a more strategic assessment of future scientific challenges and opportunities but these had not led to any prioritisation of either areas for expansion, development of staff skills or capital investment. The Cefas Science Advisory Committee had discussed a number of strategic science issues. However, the management focus appeared to be on expansion of the business through competitive positioning in wider markets rather than developing an integrated Evidence Strategy. Much of the documentation was considered to be commercially sensitive and only released to the Panel on a limited basis.
- 2.30. **The Panel recommends that Cefas: (a) develops a five year cross-cutting Evidence Strategy (including commitments to expand staff skills in key areas and a forward-looking plan for internal investment in novel research and procurement of scientific equipment); and (b) the Cefas Science Advisory Committee should be actively engaged in the development of the Evidence Strategy. [Recommendation 5]**

Addressing Customer Feedback

- 2.31. There was a general consensus across the key government customers that the scientific quality of the evidence provided by Cefas was very high and customers cited a number of examples of the impact of Cefas's work for them. However, concerns were raised that innovation within the organisation was driven by a few dynamic individuals and the risk that this might present if these individuals leave Cefas. Nevertheless, the majority of the key customers indicated that the work commissioned from Cefas met their requirements, although some cited occasional instances where contracts did not deliver specified objectives for a variety of reasons. Most of the time these issues had been resolved through discussion and joint working.
- 2.32. Customers felt that they were not always aware of full spectrum of Cefas's work and therefore may be missing opportunities for collaboration. For example, there was a general comment from a number of customers that they were not aware of the wider capability that Cefas has through diversification into commercial work and so the potential wider benefits were not apparent. A compendium of Cefas projects/skills relevant to the NERC Biogeochemistry Research Programme that Cefas compiled was cited as a beneficial exercise in raising awareness of Cefas's capability in this area.
- 2.33. Capability gaps and succession planning for Cefas scientists was identified as a concern for some customers. For example, several customers were unsure whether Cefas has the social research capacity to engage with sustainable development agendas and also undertake socio-economic assessments. Cefas has only recently employed some economists despite this emerging as a priority area for Defra over recent years, although it was noted that Cefas is developing links with other institutes with expertise in economic research.
- 2.34. Customers also highlighted an apparent lack of join-up between different teams within Cefas sometimes resulting in mixed messages to customers and some variability in the quality of work delivered across different teams. The Panel felt that Cefas was responsive to customer concerns but that these issues could be dealt with more effectively through better structured customer relations management procedures.

Value for Money

- 2.35. The majority of customers considered Cefas work to be value for money most of the time and of a high quality. However, there were several comments relating to Cefas costs being considered high compared to some other contractors and the costing model used by Cefas was seen as a barrier to collaborative working in some instances. Given that Cefas pay scales are at the low end for government agencies there was a perception that a high overhead may be applied. Customers highlighted that there is currently a major driver to look for efficiencies and value for

money in the procurement of evidence, so these cost issues are likely to become more significant in the future.

- 2.36. We reviewed the Cefas Pricing Policy and concluded that it is well formulated and reviewed regularly by the Cefas Management Board and Defra. For government work within the HLA, Cefas applies a rate reflecting costs of delivery. Where government customers let contracts in competition, Cefas also includes charges associated with the competition itself plus an element of Seedcorn investment to ensure future capability and levels of contingency to manage risk. Clearly, Cefas must charge market rates when competing with the private sector. Nevertheless, the use of different overhead rates for different projects due to the charges identified above does appear to cause confusion for some customers. The position is further complicated by the fact that Cefas can work both as a partner and as a contractor to the other Agencies in the Defra network.
- 2.37. **Whilst feedback from customers was generally positive, the Panel recommends that Cefas should: (a) be more proactive in providing a dedicated relationship manager for key customers; (b) provide clarity to their government customers on their pricing policy; and (c) introduce more flexibility in funding models when bidding for strategic research with academic partners, in recognition of the extension in capability that such projects can deliver for Cefas. [Recommendation 6]**

3. Sustainability – Resources and Opportunity

Financial Sustainability

3.1. Overall, the Panel were impressed by the financial performance since the 2005 Science Audit, as indicated by the increase in turnover from £43m to £53m. The Cefas strategy of maintaining a high quality capability even though this has a high cost base has been successful in the expansion into wider markets. The business is now profitable and generates 5% of turnover that can be re-invested by Cefas in underpinning scientific projects, corporate infrastructure and capital programmes. Looking forward, Cefas’s Business Plan assumes that turnover will be sustained at around £55m as success in expanding wider markets more than offsets a decline in investment from Defra. **Figure 1** shows the turnover divided into Defra and commercial activities from 2006/07 to predicted figures up to 2016/17.



Figure 1. Cefas turnover (£m) split between Defra and commercial activities, past and predicted (data from Cefas, June 2012).

3.2. Cefas has been very successful in extending the portfolio of projects beyond Defra, going across other government departments and into the commercial sector (**Figure 2**). Defra income in 2011/12 was down to around 60% of turnover

compared to around 78% in 2006/07. Cefas income has increased by approximately £10m each five year period from 1997 to 2011. Projects for the private sector have had several positive consequences, including greater use of facilities that did not require permanent full capacity for government projects, expansion of the scientific capability in several key areas and generation of an investment budget. Cefas's strategy for the next five years is to aim for a stable turnover of around £55m and to manage any excess of demand over capacity through targeted outsourcing. The Panel felt that this was a credible strategy and there was a realistic prospect that turnover could be sustained.

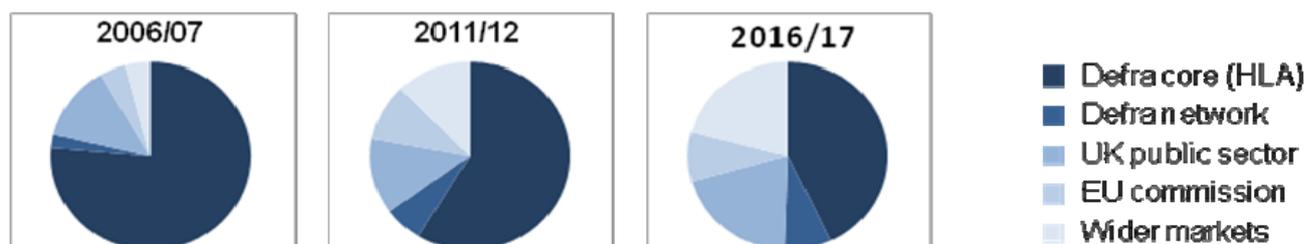


Figure 2. Diversifying Cefas's income, 2006/07 - 2016/17 (data from Cefas, June 2012).

- 3.3. However, there is increasing uncertainty about government funding that could undermine the stability provided by the commitment to long-term funding made by Defra after the Defra Laboratory Strategy Review in 2006. Cefas seemed concerned about the likely decrease in funding from Defra over the next few years and that the planning horizon in Defra seems to have shortened to only two years.
- 3.4. There were also particular concerns from Cefas around the decline in R&D funding as a proportion of turnover. Cefas has been able to maintain R&D funding from all sources in excess of £12m per annum over the review period. Excluding through-flow funds (external funding that Cefas passes on to sub-contractors) R&D funding is presently around 30% of Cefas delivered turnover. This will become increasingly difficult to sustain if Defra's R&D investment declines significantly over the next few years.
- 3.5. The Panel were impressed by Cefas's commitment to secure research funding through partnerships with universities, and other research institutes, plus a more proactive approach to the EU and Research Councils. The Panel recognises that there are constraints due to eligibility criteria and funding models but a joint approach between Defra and Cefas is needed to maximise income from these sources. Whilst the Panel concluded that the size of the reduction in R&D funding is highly unlikely to be anywhere near as large as seems feared by Cefas, it is clear that the reduction could still be significant. Consequently, the Panel judged that the Cefas plan to keep R&D funding above 20% of Cefas delivered turnover in the future is not sufficiently ambitious.
- 3.6. **The Panel were impressed by the financial resilience that had resulted from the expansion into wider markets beyond Defra but, having accepted the key**

importance of R&D activities to expanding future capability, the Panel recommends that Defra keeps the R&D funding at the present level in proportion with the support for statutory functions. [Recommendation 7]

- 3.7. The Panel was struck by the stresses that would arise if Cefas continued to grow at the recent trend of around £10m increase in turnover every 5 years. Central government restrictions on salary budgets and/or headcount would limit the ability of Cefas to respond to the growing opportunities in the commercial marine sector. The capacity to deliver could be created by outsourcing but only up to a point before there is a reputational risk. The Trade Union representatives claimed that recent delays in recruitment had resulted in delays in delivering on several contracts.
- 3.8. **Given that there is potential for Cefas to grow income from expanding into new markets, the Panel recommends that an additional Business Plan is developed by Cefas that considers the various constraints on expansion of a government Agency (such as limitations of the current estate, caps on headcount and/or payroll, capital investment and underpinning R&D) so that these can be addressed through strategic discussions with Defra rather than the current case-by-case approach. [Recommendation 8]**

Quality of Resources

Facilities

- 3.9. The Panel formed a positive view of staff capability and laboratory and operational facilities. Major assets include: the sea-going capability offered by the research vessel Cefas Endeavour; strong electronics capability for developing and supporting remote marine platforms and sensors (also leading to commercial exploitation); and extensive data repositories of international significance. In the main, these resources are being managed effectively.
- 3.10. There are issues around the ageing Estates, including increasingly limited work space. Concerns identified to the Panel during the Review included interruptions to work, increased management time for health and safety, reputation with customers, staff morale, the disposal of significant amounts of documents from the library, and reduction and fractionation of library space. Cefas ranks Estate Issues in their Risk Register as medium impact. However, discussion with scientific staff and Trade Union representatives suggests that this risk may be under-estimated. Clearly, the failure of recent initiatives to develop a new Laboratory complex on the Waveney site in Lowestoft has been a major set-back. The Panel was concerned that there was no structured project to deliver the aspiration for a new Laboratory by 2017.
- 3.11. **The Panel concluded that, in line with existing plans, there is a clear need in the near future to replace the Lowestoft Laboratory and recommends that Cefas and Defra place a priority on developing a costed plan for new, fit-for-**

purpose facilities which could be implemented rapidly as and when resources become available. [Recommendation 9]

Information and Communication Technology

- 3.12. The Cefas Senior Management Team signed off a new Information and Communication Technology (ICT) strategy in 2009, which anticipated the planned move to the Waveney Campus. It became necessary to revise this strategy following the publication of a new Defra ICT strategy in 2011. A presentation outlining a revised strategy was made to the Cefas Senior Management Team in March 2012 and this presentation, along with the 2009 ICT strategy, was provided to the Review Panel.
- 3.13. This revised strategy takes into account the availability of new options such as cloud based services, and recognises the need for mobile platforms. However, whilst the strategy does identify issues and business priorities, there is no clear mapping to the proposed solutions. Also, the material provided did not present a detailed analysis of the scientific computing needs, but rather focused on business issues. No costing information was provided to the Panel.
- 3.14. ICT only occurs on the Risk Register in terms of installation of back-up capacity. The Panel find it surprising that no significant risks on the capacity to deliver science activities had been identified given this is absolutely dependent on ICT.
- 3.15. Defra is investigating ICT solutions that may become requirements across the Defra network. Care should be taken to ensure that the drive across government to centralise ICT solutions - including web resources - should not adversely impact Cefas's ability to deliver to its customers (especially if the central funding from Defra is reducing).
- 3.16. Discussions with staff identified some issues with the currently operating ICT system, including:
- variable bandwidth to the external internet;
 - limited data storage capacity;
 - apparently universal disenchantment with the resource management software which, we were advised, is very difficult to use, and not fit for purpose in terms of managing projects; and
 - limited centralised support in terms of maintaining (and the acquisition of) scientific software and high performance computing capability for modelling.
- 3.17. The Panel recognise that similar problems, to some extent, may be identified in many scientific institutions. However, we were not provided with evidence by Cefas that the scientific computing requirements in terms of software and computing capacity had been considered in detail when formulating the ICT capacity.
- 3.18. **We recommend that Cefas: (a) fully recognises in its Risk Register the risks around the current Information and Communication Technology (ICT) strategy in terms of supporting the future expansion of science capability; (b)**

assesses the potential risks of any new cross-Defra ICT strategy on its scientific computing capability and requirements and, if necessary, develops a strategy for its scientific computing capability; and (c) incorporates feedback from computer users in a major review of its present ICT capability and future needs. [Recommendation 10]

Quality of Staff

- 3.19. The Panel formed a positive impression during the Review of the quality of scientific and technical staff at all levels. Internal procedures are in place to mentor new staff, encourage career progression and incentivise research staff to publish. Early career staff confirmed that Cefas was seen as providing a good environment to develop scientific careers. The investment in strategic partnerships with universities and the large increase in research studentships have contributed to a more dynamic and outward-facing approach.
- 3.20. Cefas has reduced corporate overheads by around 54% since 2006, saving over £1m per annum by downsizing corporate support teams, rationalising estates and introducing IT-enabled management information systems. Overall, it was recognised that Cefas had become a more competitive organisation. However, staff raised several concerns in this area. Middle managers felt under pressure to carry out support functions themselves. The functionality of IT-enabled systems left something to be desired. It seems that restructuring of the corporate systems is still 'work in progress' and would benefit from more open and regular feedback from staff.
- 3.21. Gender balance and equal opportunities are pro-actively managed by Cefas and these were not perceived as an issue by junior staff. However, senior scientists noted that there is still a strong gender imbalance in later career stages and across the senior management team. **The Panel recommends that Cefas should be more proactive regarding gender issues, for example, by benchmarking gender balance with other science organisations and setting goals to progress more rapidly towards equity amongst the senior grades. [Recommendation 11]**

Recruitment and Retention

- 3.22. Concerns were raised around recruitment and retention of staff. Whilst the Panel recognised that moving the Burnham Laboratory to Lowestoft had resulted in a more cohesive workforce, the Trade Union representatives claimed that recruitment has sometimes not kept pace with the rapid expansion of commercial contracts. In addition, recent government constraints on recruitment were claimed to have increased pressures on key staff. The Panel accepted that it has been challenging to maintain capacity to deliver an expanding programme of work with the current government wide recruitment freeze). The Panel concluded that Cefas needs more

flexibility to recruit replacements rapidly and prepare for additional contracted projects.

- 3.23. We note that staff turnover is currently running at an acceptable level of around 5%. Cefas are not experiencing significant difficulty in attracting applications for science posts, except those requiring mathematical modelling skills and senior specialist staff. However, we anticipate that Cefas will be seeking to recruit more staff in these areas as work for the commercial sector continues to expand.
- 3.24. Similar issues emerged in relation to staff with skills outside the traditional core Cefas profile - such as environmental economists - where Cefas needed to be very pro-active in attracting and retaining new staff. The Panel recognised that this was a difficult issue but the Cefas strategy of recruiting a few staff with special skills in this area and then forging partnerships with universities was the right approach. The Panel felt that more attention could be given to social sciences as well as to economics.
- 3.25. Another issue the Panel noted was around the retention of leading research scientists and senior advisors at Cefas. Several stakeholders commented that succession planning was a key concern to them, possibly stimulated by the recent loss of several key staff in Cefas's Fisheries Division. Cefas is aware of these concerns, has identified posts critical to its work and is providing mentoring for potential successors. Special arrangements had been made by Cefas to promote a few key scientific staff to the grades occupied largely by senior management staff and to invest in joint appointments with universities. The Panel felt external experts should be brought in to contribute to Promotion Boards for staff at this level to improve benchmarking with peers in academia and research institutes.

Pay

- 3.26. Staff in Cefas showed a relatively high level of engagement in the annual cross-government staff surveys. However, staff generally felt that the Cefas Reward package was poor. This issue surfaced several times during our discussions with staff and was raised by the Trade Union representatives. As an Executive Agency of Defra, Cefas currently has pay delegation and is able to retain flexibility for locally determined policies within an annual Pay Remit approved by Ministers. When compared to other science organisations within the Defra network, Cefas is 4-5% below the median across most pay bands. However, Cefas is unique across this same network in having the ability to pay up to an additional 4% of base salary extra, subject to satisfactory corporate performance in the achievement of Ministerial Indicators. In addition, there is an Individual Performance Related Pay system that enables a further 20% of staff to receive an additional 6% of base salary. Nevertheless, these bonuses are non-consolidated and do not contribute to pensionable earnings.

- 3.27. Clearly, government pay constraints for the public sector will continue to limit opportunities for Cefas to correct pay anomalies. Since 2010 Defra and Defra-network bodies including Cefas have been subject to a pay freeze, excepting earnings under £21,000, where staff received a £250 uplift. The next two years will likely see increases limited to an average of 1%. Cefas does not have contractual pay progression.
- 3.28. Cefas told the Panel it plans to work closely with Defra and the Cabinet Office “to prepare a 3 year Reward Strategy that is consistent with requirements for pay reform in the public sector and the relatively low pay for some posts in Cefas”. The strategy is to shorten pay ranges to ensure they benchmark favourably with the external market, not just within the Defra network, and retain flexibility with how they apply locally determined policies within the framework of pay delegation.
- 3.29. The Cefas Risk Register identifies that a major risk is insufficient resource capacity to generate and deliver new business. There are potential constraints around this relating to Cefas’s ability to rapidly employ new staff and its pay and reward package. **As staff perceptions on the pay and reward package, corporate support services and retention issues in specific areas are a major concern, the Panel recommends that Cefas, working through Defra, should ensure that the future pay and reward package brings the consolidated pay scales more in line with other Defra Agencies and external benchmarks. [Recommendation 12]**

4. Quality of Science – Including scrutiny and quality assurance

- 4.1. Around 75% of Cefas science is operational in nature and provides a range of services to several government departments which are often determined by statutory obligations and, increasingly, commercial work to private sector organisations. These activities include monitoring and surveillance, laboratory services, inspection services, data management, policy advice and emergency response capability. The customers usually define these services and regularly assess the outcomes in terms of scientific credibility, effective delivery and value for money.
- 4.2. The remaining 25% of the Cefas portfolio is applied and strategic research designed to meet the requirements of their policy customers. This may be supplemented by additional funding won in open competition from UK and EU sources or extended through joint research and studentships with university collaborators. For the applied and strategic research programmes undertaken by Cefas, research teams would be expected to publish widely in leading peer-reviewed international journals with high impact.

Scientific Highlights

- 4.3. The Panel identified a number of scientific highlights, a selection of which are listed below:
 - Cefas international leadership in the development of size-based modelling approaches to understand the functioning of marine communities is recognised, despite recent staff losses. The underpinning science has benefited from excellent and essential collaborations with universities and other research centres. Cefas is beginning to realise the benefits of these modelling approaches for national and international policy development.
 - In the fisheries area a ‘data poor’ modelling project helped the UK secure significant changes from the European Commission’s proposals on Total Annual Catch settings. The assessment of data-limited stocks provided a good example of integrating evidence into advice. Cefas science influenced the development of ICES (International Council for the Exploration of the Sea) methodology for the production of advice for these stocks.
 - Cefas’s contributions to understanding circulation fluxes in the North Atlantic continue to be internationally recognised. The ‘Connections’ Programme has resulted in a thematic journal issue focussing on key topics such as open ocean oxygen depletion.
 - The elasmobranch assessment work provided a strong example of bringing together different disciplines and approaches (biology, biodiversity, tagging, and

stock assessment) to investigate declining and rare species. This study also illustrated effective use of the Fisheries Science Partnership to engage industry. It also demonstrated cross-cutting work linking biodiversity and fisheries.

- The work on jellyfish abundance in the Irish Sea is a good illustration of how data from different sources can be integrated to allow the best use of the data available.
- The European Reference Laboratory status for crustacean disease and microbial analyses of bivalve molluscs is evidence of an international reputation and high level inputs to the policy community. It is a central element in the Cefas profile characterised by excellent laboratory facilities, extensive accreditation networks and delivery of policy-relevant science.
- The work on 'ecosystem effects' monitoring, particularly the studies on liver cancer in fish, is world leading and producing excellent synthesis papers (e.g. on 'omics'), drawing the policy implications of work and publishing across a spectrum from pure science to policy relevant work in good journals.
- Research on aquatic animal diseases has been considerably strengthened since the 2005 Science Audit. Field investigations supported by laboratory diagnostics and epidemiological modelling have made several advances and influenced government policy. For example, a 2010 policy decision not to introduce an eradication programme for Koi Herpes Virus was based on evidence from several R&D projects carried out by Cefas for Defra Aquatic Animal Health.

Indicators of Science Quality

Publications

- 4.4. From 2005 to 2010 the target number of publications that Cefas used for its Science Excellence Ministerial Indicator was based on 1.5 peer-reviewed publications per full time employee engaged in research. Cefas estimated that this was equivalent to around 1.5 publications per £100k of research income and has adopted this as a simplified metric. This equates to roughly 150 peer-reviewed papers per annum across Cefas and this target has been exceeded since the 2005 Science Audit (although the total of 156 peer-reviewed publications in 2011 was the lowest since 2005). **Figure 3** shows the number of Cefas publications between 2006 and 2011.

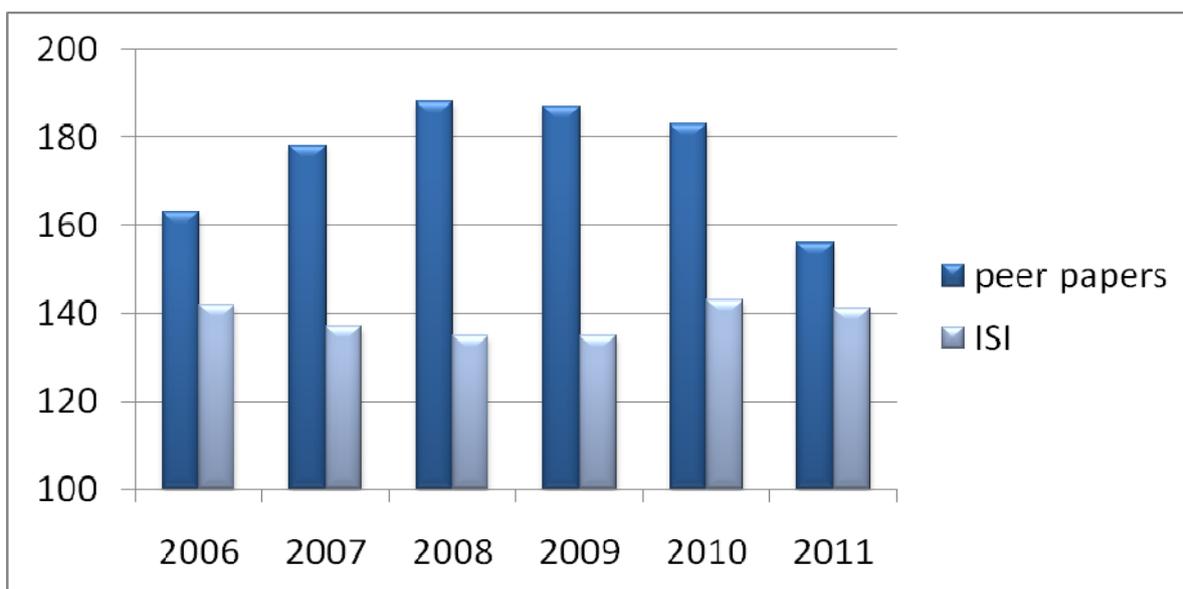


Figure 3. The number of scientific papers published by Cefas between 2006 and 2011 in all peer reviewed journals compared to ISI journals. ‘Peer papers’ refers to peer-reviewed papers and ‘ISI’ refers to ISI journal publications.

- 4.5. The Panel has examined the statistics since 2006 based on the output of Cefas publications in ISI listed journals. If the Science Excellence target were to be based on ISI journal publications (rather than the wider peer-reviewed publications criterion as is presently the case), the 150 paper target has almost been met, with ISI publications consistently in the 140’s per annum. Cefas also presented an upward trend in the average impact factor of journals where Cefas has published its peer-reviewed papers since 2006. However, the Panel saw evidence that the average impact factor of the top ranking marine and freshwater biology journals had also increased over this timeframe. The Panel concluded that, whilst the overall output and quality of journal publications has been sustained at a good level, and comparable with other institutes, there had not been an increase in the number of ISI journal publications since 2006, and the significance of the increase in impact factors was debatable.
- 4.6. The Panel considered whether the research output targets were appropriate, using information provided by Cefas and data presented in the recent publication, *Baseline Bibliographic Analysis of NERC-funded Research 2003-2010*⁷ (although it should be noted that this information only became available after the Review visit). Analysis of the Cefas data during the eight years from 2003 to 2010 showed that there had been around 1,000 publications (nearly 50% of these were with international authors) and the sum of citations over this period was nearly 16,000. The Panel considered bibliometric indicators for selected NERC-funded research centres alongside those for Cefas (**Table 1**). Cefas’s output of journal papers is slightly below NERC’s National Oceanographic Centre (NOC) and the citations are

⁷ <http://www.nerc.ac.uk/about/perform/documents/citations-study-2012.pdf>.

marginally higher. The citation impacts have been normalised in **Table 1** and values between 1 and 2 indicate that the research is 'influential at the national level'. A value of more than 10% for highly cited papers indicates that 'the research output is above the world average'.

Table 1. Summary bibliometric indicators for NERC-funded research 2003-2010 (for selected NERC Centres) and for Cefas⁸.

Centre	Number of papers	Sum of citations	Mean citation impact	% Highly-cited papers ⁹	% Uncited papers	% International papers ¹⁰
British Antarctic Survey	1791	22182	1.75	18.8	12.9	57.7
British Geological Survey	1056	8082	1.33	15.0	19.2	42.4
Centre for Ecology and Hydrology	2619	35939	1.84	21.5	12.4	43.6
National Centre for Atmospheric Sciences	764	9878	2.33	29.2	15.6	51.8
National Oceanographic Centre	1338	14700	1.62	16.7	14.3	53.1
Plymouth Marine Laboratory	781	10989	1.95	24.1	11.1	53.8
Cefas	1031	15926	1.71	23.6	5.4	49.5

4.7. For illustrative purposes, the number of papers has been plotted against the citation impact in **Figure 4**. The diagram also shows the percentage of highly-cited research papers at each Institute: these values vary from 15.0% at the British Geological Survey to 29.2% at the National Centre for Atmospheric Sciences - compared to 23.6% at Cefas. The diagram shows that Cefas sits between the Plymouth Marine Laboratory and the National Oceanographic Centre, although the comparison needs to be scaled according to the size of the Institutes. Cefas and NOC have a similar number of staff (just over 500) whereas Plymouth Marine Laboratory is below 150. It would be valuable to compare the level of R&D funding but this information was not available to the Panel. Nevertheless, the Panel concluded that the output at Cefas was similar to comparable Institutes. Consequently, while there were no firm guidelines, a target of 150 ISI journal publications per annum was reasonable as a starting point for the next five year period – as long as the R&D funding remained above £10m per annum (including Seedcorn funds).

⁸ Cefas data from Thomson Reuters analysis for Cefas, August 2012. NERC data from 'Baseline bibliometric analyses of NERC-funded research, 2003-2010' by Thomson Reuters, May 2012, <http://www.nerc.ac.uk/about/perform/documents/citations-study-2012.pdf>.

⁹ 'Highly-cited' refers to those articles and reviews belonging to the world's top decile of papers for journal category and year of publication. A percentage that is above 10 indicates above-average performance.

¹⁰ Refers to those papers with co-authors outside the UK.

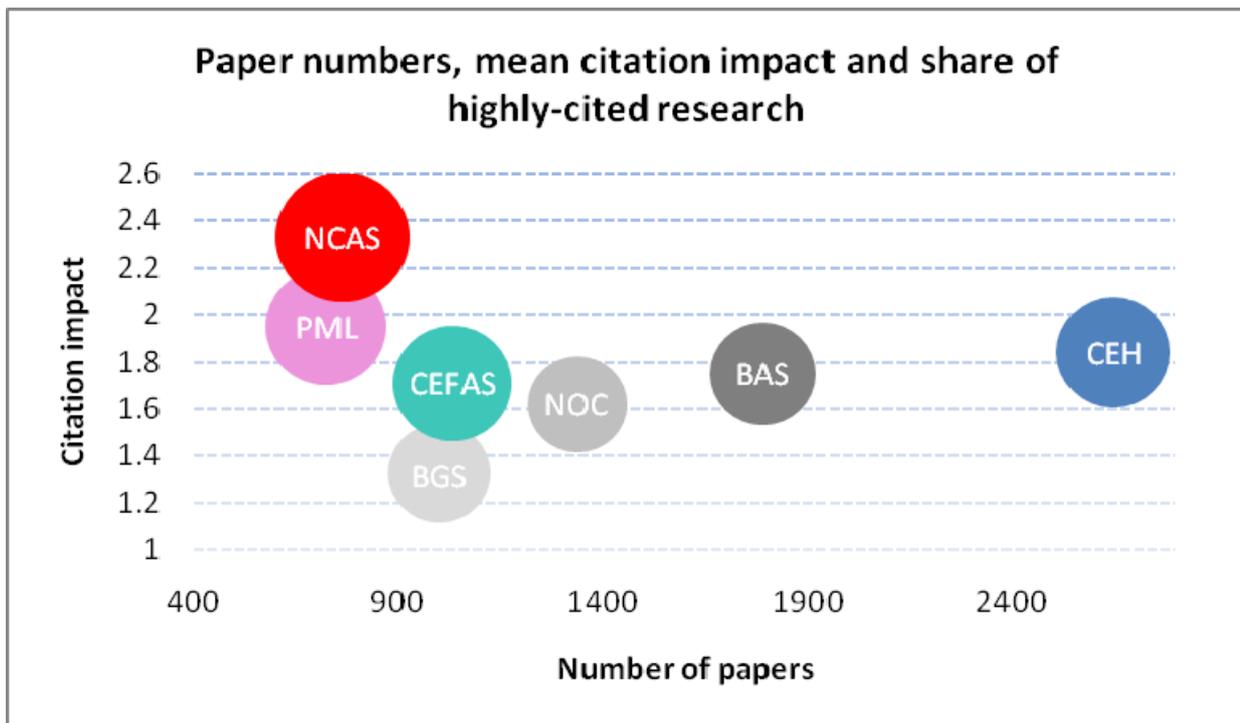


Figure 4. Comparison of the number of scientific papers, mean citation impact and percentage of highly-cited papers for Cefas and several NERC institutes. Data taken from analyses by Thomson Reuters (see footnotes 7 and 8) and diagram provided by Cefas. Acronyms: BAS - British Antarctic Survey; BGS - British Geological Survey; CEH - Centre for Ecology and Hydrology; NCAS - National Centre for Atmospheric Sciences; NOC - National Oceanographic Centre; PML - Plymouth Marine Laboratory.

- 4.8. **The Panel recommends that: (a) over time, a target of 150 ISI journal papers per annum should replace the existing criterion of 150 peer-reviewed papers in the Science Performance Ministerial Indicator; and (b) the Cefas Science Advisory Committee should advise on the rate at which this target should increase over the next review period in order to set an ambitious but achievable projection. [Recommendation 13]**
- 4.9. The 2005 Science Audit noted a heterogeneous pattern of journal publication across the Cefas Science Teams supported by R&D funding. Two reasons offered for this by Cefas were that (a) the time and effort of Cefas scientists should be directed principally to the provision of policy advice to government customers, and (b) papers reporting policy-driven data collection would not be appropriate for peer-reviewed journal publication. The 2012 Review Panel believes that the extensive monitoring data held by Cefas offer considerable scope for science insights and the examination of spatial and temporal trends. These are certainly publishable and most editors would welcome papers with clear policy relevance which would be likely to be cited well in subsequent contributions, thus, also improving the journal's impact factor.

4.10. The Panel examined the performance of the different science Theme areas of Cefas in terms of ISI journal publications against the value of R&D income in 2011 (**Table 2**). The data show that the Health and Hygiene Theme exceeded 1.5 ISI publications per £100K of R&D funding and had increased the output of publications since the 2005 Science Audit. Both the Environment and Fisheries Themes were below this level. The Fisheries Theme was well below the 1.5 ISI papers per £100k R&D funding level – with one ISI paper per £100k of R&D income at the Theme level. There may be particular reasons that partially explain this outcome. For example, sea-based research is expensive and in terms of allocation of ship time the fisheries teams have the major share of the costs allocated to their projects. In addition, the distribution of joint papers across the Environment and the Fisheries Themes may have distorted the comparison.

Table 2. Numbers of ISI publications in 2011 by Cefas Theme and Sub-theme.

	Number of PhD level staff 2011	Number of ISI journal papers 2011	ISI papers per PhD level staff	R&D income 2011 (£m)	Papers per £100K	% papers Cefas first author	% papers Cefas last author
Health and Hygiene Theme							
Food Safety	7	6	0.86	<0.1	6	50	67
Environment & Health	11	17	1.55	1.1	1.55	12	24
Aquatic Animal Disease	11	29	2.64	1.3	2.23	62	66
Theme Level	29	52	1.79	2.5	2.08	44	52
Environment Theme							
Ecosystem Modelling and Processes	22	20	0.91	2.2	0.91	45	45
Current & Future Risks	6	11	1.83	0.5	2.2	36	0
Pressure, State & Impact	24	23	0.96	2.0	1.15	48	57
Theme Level	52	54	1.04	4.7	1.15	44	41
Fisheries Theme							
Evidence, Collection and Monitoring	2	3	1.50	0.5	0.6	33	33
Ecosystem Approach to Fisheries	14	17	1.21	2.1	0.81	53	41
Assessment and Advice	12	16	1.33	0.9	1.78	31	38
Theme Level	28	36	1.29	3.5	1.03	42	39
Cefas							
Cefas Level	109	142	1.30	10.7	1.33	44	44

4.11. The Panel were not convinced that the number of papers per £100K of R&D funding was an appropriate indicator and gave further consideration to the initial target of 1.5 publications per FTE scientist. The Panel looked for external benchmarks of expectations on publications for different grades of staff. There are no specific requirements in equivalent research institutes in the UK but broad guidance is as follows:

- Band 6 to 5 (nearest equivalent to Higher Scientific Officer / Senior Scientific Officer – i.e. post doctoral level): expect an early career scientist to have in

excess of 10 papers after around 5 to 6 years - of which half might be first author, and

- Band 5 to 4 (Senior Scientific Officer / Grade 7 (Principal Scientist) – research leader equivalent): expect a greater level of output (perhaps 20-25+ papers) with an appropriate number of first and last author papers (perhaps 7- 12 depending on what and where published). Therefore 3-4 papers per year are expected of lead scientists.

In addition, some other government institutions use the 1.5 ISI papers per scientist as the benchmark. Overall, the Panel concluded that the target of 1.5 ISI publications per research FTE, although possibly lower than some full-time research institutes, was appropriate for a government laboratory with a range of scientific functions.

- 4.12. It is also crucial that key scientists are seen to have a leadership role and a significant national/international reputation. Examination of Cefas's publications showed that the number of first and last authors on publications was relatively high indicating that Cefas is, in general, playing a leading role in driving forward their science areas. However, it should be noted that a high proportion of these publications were attributable to a relatively small number of staff.
- 4.13. Examination of the 2011 statistics for publication outputs, in relation to the number of PhD level scientists in the Themes and Sub-themes at Cefas, showed that once again, the Health and Hygiene Theme exceeded the target whereas the two other Themes did not - and there were variations within the Themes (**Table 2**). Again, there are caveats around these observations as there may be differences, for example, in the number of PhD level scientists engaged in research. In spite of the limitations of the data, the Panel concluded that the scientists involved in the Health and Hygiene Theme (largely based at Weymouth) are commended for the improvement since the 2005 Science Audit.
- 4.14. In relation to the Fisheries Theme, and to a lesser extent the Environment Theme, the Panel concluded that Cefas should not allow the strong focus on Defra's policy needs to stifle ability to innovate and develop new concepts and technologies. There is room, in our view, for a more adventurous approach to thinking about future activities, unconstrained by the immediate demands of either Defra or the EU. If Cefas is to maintain international leadership in fisheries science, then it has to be thinking now about how the science will be advanced over the next 10 years and to develop international collaborations with other groups that are developing new thinking from which Cefas can gain. This thinking to the future has to be an ongoing activity with constant renewal. This approach should also result in a higher output of ISI journal publications even though the Defra contribution to R&D funding may be more limited in future.
- 4.15. We note that there is a Fisheries Division strategy (Influence on and Management of External Change) that reflects efforts to develop some forward thinking in this area. However, there is a need for the Division to identify scientific priorities in the

context of available resources in the medium term and set more challenging targets for journal publications. We strongly encourage those with leadership positions to create small working groups to identify areas that need new thinking and to then obtain the funding to carry out the necessary work.

- 4.16. **The Panel noted that there were differences in ISI journal publication rates across, and within, the three Themes (Fisheries, Environment, and Health and Hygiene). The Panel recommends that Cefas should: (a) examine more closely the reasons for the variation of ISI publications across the Teams with R&D funding, and provide this information to the Cefas Science Advisory Committee for external scrutiny; (b) adopt a minimum of 1.5 ISI journal publications per active research scientist as the internal metric and ensure that all teams across the organisation achieve this target by 2015; and (c) ensure that staff are aware of the measures of success in terms of science quality and impact and that these are assessed in annual Staff Appraisals. [Recommendation 14]**

Academic Standing

- 4.17. In evaluating Cefas's research, the Panel considered the criteria for assessing outputs of university research used in the "Research Excellence Framework" (REF) for assessing the quality of research in UK higher education institutions¹¹. In assessing whether the applied and strategic work carried out at Cefas would be in the "Excellence" category (that which is world leading in terms of originality, significance and rigour), the REF would expect to see evidence of research that is leading or at the forefront of the research area and/or is agenda-setting. Such work would have a major influence on a research theme or field.
- 4.18. The Panel assessments followed the procedures used in universities, where an evaluation of each paper is based on science judgement by senior staff, with the individual paper citation scores and the journal citation indices also taken into consideration as supplementary metrics. The publication 'h' index¹² for submitted staff is also a useful metric which combines both quantity and quality (the latter indexed by citation rates) of the publications authored by an individual. The UK REF assessment is focused solely on four submitted papers per researcher alone.
- 4.19. The senior university members of the Panel carried out a REF-style evaluation of between four and seven Cefas scientists - nominated by Cefas - for each of the three science Themes.
- 4.20. **Environment Theme.** All four staff evaluated in the Environment Theme were considered to meet the criteria of international excellence required by the Panel assessor's university, currently ranked in World top 100, to be entered for the REF

¹¹ Research Excellence Framework, <http://www.ref.ac.uk/> (December 2012).

¹² h index, http://images.webofknowledge.com/WOK45/help/WOS/h_citationrpt.html (December 2012).

2013. To clarify, the REF ranks the best four papers published over the REF period (five years) by an individual on a scale of 1* to 4* where 4* is the highest ranking. The policy in some UK universities is that staff will only be entered for the REF if the aggregate score for their top four papers is 11* or more. Effectively, this requires that at least 75% of the papers entered by an individual will achieve a 3* rank, which is research deemed to "make important contributions to the field at an international standard". The assessment of papers provided by Cefas led the assessor to conclude that the Cefas scientists considered would each achieve aggregate scores of 11* or more, and that in the Environment Theme, Cefas has staff who are internationally leading in their field.

- 4.21. **Health and Hygiene Theme.** From papers submitted for assessment for seven members in the Health and Hygiene Theme, all staff showed evidence of international impact and science contribution. This was suggested by: (i) the citation numbers of the submitted papers, which generally exceed the scaled impact factors for the submitted journals; and (ii) the international status and high level peer-review required by the journals in which the staff were publishing. This preliminary assessment is supported by the papers' content. A high proportion of the submitted papers would be graded at or above the 3* threshold so that the full list of seven staff would be submitted by a UK university making its REF submission.
- 4.22. **Fisheries Theme.** Four papers from each of five members of the Fisheries Theme were put forward for assessment. The evaluation was a little more complex than for the two other Themes, as there was some overlap between the submitted publications and the extent of collaboration with other institutions. Using the criteria described in the REF documents and the criteria used at the Panel assessor's university for inclusion of staff in the REF assessment, the initial judgement was that four of the five scientists would without doubt be included. For several of the papers submitted by these four scientists, the Cefas authors are names 'in the pack' on multi-authored publications, making it hard to discern individual contributions. The fifth Cefas scientist was first author on three out of his four submissions, indicating that he is likely to have been the originator of the work and primary author of the paper. The judgment that his papers are less significant than those of the other four is based on an assessment of the generality of the applied research and more limited scope for making significant conceptual advances. Nevertheless, this scientist had a good h factor for a fish ecologist. The final judgement was that the five Cefas scientists are all contributing to research of international quality and most would undoubtedly be included in a university based REF submission.
- 4.23. **The Panel has found value in using the UK Higher Education Institutions "Research Excellence Framework" approach for assessing research quality and impact, leading to the conclusion that Cefas has a cohort of leading scientists with an international standing in applied marine and freshwater sciences - comparable to some top research-led universities - and recommends that Cefas develops a simple, fit-for-purpose benchmarking**

**process to evaluate the performance of staff in relation to scientific outputs.
[Recommendation 15]**

- 4.24. Cefas's customers universally considered that the science and scientific resources provided by the Agency were leading edge at a European level at the very least. For example, in the radiological area the European Commission regularly asks Cefas for expert input. In the shellfish hygiene area the perception is that the scientific resources are state-of-the-art at an EU level, for example, Cefas work on shellfish biotoxins enabled the UK to take a lead in the EU regarding the introduction of new methods (developed through international research collaborations) of routine monitoring. Many Cefas scientists are recognised authorities in Europe as demonstrated by representation on OSPAR¹³ committees, taking the lead on many ICES¹⁴ working groups and having positions of responsibility in ICES which deal with aspects of marine monitoring and assessment. The Panel reviewed the current cohort of Cefas staff at Scientific Advisor level and confirmed that there was an appropriate level of scientific experience and international standing.
- 4.25. **Whilst the Panel recognises that all Cefas advisory scientists are required to keep their scientific credentials up-to-date by following the literature and best-practice, the Panel recommends that Cefas should promote and maintain the ability of staff to be active research scientists as well as involved in the provision of policy advice. Cefas should raise awareness amongst its scientific staff of individuals who represent exemplars of good practice in this context. [Recommendation 16]**

Science Management and Quality Assurance

- 4.26. Cefas has an established framework for quality assurance that operates at the strategic/corporate level and the programme and project level. The Panel were impressed by Cefas's overall approach to management of science.
- 4.27. Cefas subjects various corporate functions to external accreditation, including environmental management across Cefas (to ISO 14001) and occupational Health and Safety (to 18001 OHAS). The management systems in some Teams were accredited under ISO 9001. A range of analytical, diagnostic and microbiological services were accredited under ISO 17025. Commercial services were accredited under the Good Laboratory Practice Regulations and the MCERTS Diagnostic Toxicity Assessment scheme.

¹³ The OSPAR Convention is the current legal instrument guiding international cooperation on the protection of the marine environment of the North-East Atlantic.

http://www.ospar.org/content/content.asp?menu=01481200000000_000000_000000 (December 2012).

¹⁴ ICES, <http://www.ices.dk/indexfla.asp> (December 2012).

- 4.28. Defra has raised awareness of good practice guidelines for the gathering and use of evidence with all its network bodies, challenging network organisations to ensure their internal processes are robust and transparent. Cefas has recently revised its management systems to identify Chief Scientific Advisors for each key area for advice. An Electronic Records Management System (TRIM) is now used to record all information used in the advisory process.
- 4.29. The Cefas Programme Management Team oversees a range of multi-year programmes and provides a coordination service across Cefas for the HLA. The Health and Safety, Environment and Quality Team manages an extensive range of formal quality assurance procedures within Cefas. Management of a Cefas research project was independently audited in 2009 under Defra's audit of compliance of selected research projects against the Joint Code of Practice for Research.
- 4.30. Defra and the FSA conduct extensive external peer-review of the science proposals, R&D reports and policy-related advice provided to the UK policy clients by Cefas. The Panel considers this essential to maintain the credibility of the UK's policy evidence-base in the area.
- 4.31. The Panel did not identify any concerns regarding the quality assurance framework within which Cefas operates.

Cefas Customer Satisfaction Questionnaires

- 4.32. Cefas sends out Customer Satisfaction Questionnaires (CSQs) to get a project based assessment of "customer focus" and science quality. There are eight questions mostly relating to project management, which are scored on a scale 1-10 by the customer. The questions include whether project objectives were met, how the contract was managed, whether it was value for money. A science quality question was added to the questionnaire in 2007. Overall annual customer satisfaction scores across all projects form the basis for the "customer focus" annual target (one of Cefas's Ministerial Performance Targets). Additionally, the metric for science quality is also used as one of the six Science Performance metrics that Cefas reports on annually which together form the Cefas Ministerial Indicator for "Science Excellence".
- 4.33. In 2010 Cefas commissioned an independent, structured customer survey to look at financial reporting, project management and customer focus. Cefas followed this up in 2012 by undertaking a telephone survey of key customers - Defra, JNCC, NE, the MMO (IT provision only), the EA and some commercial customers. The key messages that Cefas synthesised from this exercise were that there had been a noticeable improvement in customer focus since 2010 and that customers were happy with the service they receive from Cefas, although a need was highlighted to provide greater evidence to Defra customers to confirm that they are getting value for money. Identified areas for improvement were:

- the need for greater quality assurance in the documentation produced for customers;
- the need to link science outputs directly to policy and in a form that can be easily understood by the customer; and
- the need for further training in customer focus in those areas of the organisation where this is not yet fully embedded.

4.34. **While the Panel recognises the value of numerical based customer feedback data (as provided by the Cefas administered Customer Satisfaction Questionnaires) in terms of providing quantitative trends in customer views, we also strongly encourage the collection of more qualitative free-form customer responses (for example, collected via telephone questionnaires) and independent validation of customer views. The Panel recommends that Cefas augments its Customer Satisfaction Questionnaire programme with an independent customer survey every 2-3 years to challenge and validate their own information. [Recommendation 17]**

Role of Cefas Science Advisory Committee

- 4.35. The Panel held a discussion with some members of the Cefas Scientific Advisory Committee (CSAC) (members are listed in Appendix G). The Panel observed that CSAC were engaged and committed to support Cefas senior management and had already influenced strategic thinking on science issues (for example, climate change and modelling) and stimulated action on data management and science quality. CSAC's overview was that Cefas had made progress in management, strategic direction and profitability but there were areas where further progress was necessary, - particularly data management and science outputs such as publications. Cefas is investing in these areas but it was not clear to CSAC how fast the culture of the organisation was changing. The overall CSAC impression was that progress was patchy – with some areas of excellence.
- 4.36. CSAC felt that external collaborations had improved significantly since the 2005 Science Audit but considered that funding models were still a barrier. There has been an improvement in joint research proposals to NERC but there is still some uncertainty about future relationships. Nevertheless, university partnerships had moved to a new and positive level – primarily as a result of Cefas initiatives.
- 4.37. Cefas staff felt that a positive contribution to the Cefas Diversity commitment would be to improve the gender balance on CSAC, which is exclusively male.
- 4.38. The Panel concluded that CSAC is an important resource for the Cefas Chief Executive and Management Board. However, CSAC should provide a greater challenge to Cefas management and the recent appointment of a new Chairman to CSAC is an opportunity to refresh the membership. It is questionable whether two meetings a year is sufficient to make full use of the CSAC and could be

supplemented with teleconference discussions. CSAC could also contribute to quality assurance for Defra but this potential has not been fully exploited.

- 4.39. **The Panel recommends that: (a) it would be timely to refresh the Cefas Science Advisory Committee (CSAC), members of which, in addition to the present focus on scientists of high esteem, should also be independent of Cefas and Defra; (b) that recruitment to CSAC addresses the need for a better gender balance and international representation; and (c) CSAC develops a stronger role in strategic thinking, evaluation of the Seedcorn programme and assessment of Cefas's scientific performance indicators. [Recommendation 18]**

5. Impact – Outcomes for Government, Partnerships and Knowledge Transfer

Highlights and Key Achievements

- 5.1. A selection of specific highlights identified following the reviews of the Fisheries, Environment, Health and Hygiene Themes and through the customer feedback are below:
- Cefas scientists have worked closely with Defra on a range of policy issues relating to reform of the Common Fisheries Policy, with the positive outcome that many of the draft proposals reflect the UK evidence-based position. Cefas has supported Defra in successful EU Fisheries Council negotiations and contributed to the international reviews of management plans for cod in the waters off northwest Europe.
 - The Panel were impressed with the strong alignment of the Marine Climate Change Impacts Partnership (MCCIP) activity to advisory needs in relation to climate change adaptation. A stronger link with emerging international networks on climate change adaptation such as the FAO-driven Global Partnership for Climate Fisheries and Aquaculture (PaCFA), and climate change science, for example through the ICES-PICES Strategic Initiative on Climate Change and Marine Ecosystems (SICCME), would further enhance MCCIP's exposure and impact outside the UK.
 - Cefas survey work for Natural England (NE) contributed to Cape Bank being designated as a Marine Special Area of Conservation.
 - Scientific advances on quantifying multiple impacts on the marine environment have been used by the Marine Management Organisation (MMO) to inform Marine Plans. A key outcome is improved understanding of recovery rates after anthropogenic disturbance.
 - Wavenet was established in 2002 with the intention of enabling long-term wave data recording in UK coastal waters. Currently data from buoys is freely available to non-commercial customers and this would be a good model for other data collected by Cefas. Wavenet data contributes to the UK Coastal Marine Forecasting Service and has an ever increasing range of applications, including the management of sea flooding, coastal erosion risks and marine construction projects. The utility would be further increased if the data archiving capability within Cefas was coordinated with other providers of wave information.
 - Cefas has a world-class radioactivity monitoring facility and this has been the first point of call for Defra for a number of recent emergencies, not just marine. The Cefas team has been commended for an excellent response to government endeavours to assess the risks to UK citizens of recent international concerns regarding release of radionuclides into the marine environment in Japan.

- Evidence provided to Defra Marine Environment on contaminants and eutrophication enables Defra to meet OSPAR international reporting commitments and has helped the UK successfully defend infraction cases brought against the UK by the European Commission.
- Fisheries scientists have developed tools to assess the causes of declining eel populations across Europe and contributed to the development of the UK Management Plan. Diagnostic tools being developed by Cefas have underpinned the monitoring of viral pathogens in eels by the Environment Agency (EA).
- The statutory functions delivered by the Health and Hygiene scientists – such as (i) the Fish Health Inspectorate, (ii) classification of shellfish growing areas, and (iii) sanitary profiles - offer considerable scientific benefits by providing access to data trends and emerging incidents, knowledge of key agency science needs, and early exposure to emerging policy questions.

5.2. The Panel saw evidence of impact in a range of scientific operational and research activities at Cefas, as below.

- Impacts on public policy and services: For example, policy decisions and changes to legislation, regulations or guidelines have been informed by research evidence on the effects of fisheries management and environmental change.
- Impacts on society, culture and creativity: The attitudes and understanding of stakeholder groups in sustainable fisheries management have been influenced.
- Economic impacts: Potential future losses have been mitigated by improved methods of risk assessment and emergency response capability.
- Health impacts: Public health and quality of the environment has been enhanced through, for example, enhanced public awareness of a health risk, enhanced disease prevention in fisheries and improved food and water quality.
- Impacts on the environment: New methods, models or monitoring techniques have been developed; the management or conservation of natural resources, including biodiversity and renewable energy has been influenced; direct intervention, based on research evidence, should lead to mitigation or adaptation to climate change; the management of an environmental risk, such as an oil pollution incident, has improved.

Environmental Modelling

5.3. The Panel formed a view that rapid development of ecosystem level modelling capability and expertise within Cefas is critical to meeting the future needs of Cefas's customers. The current focus on "sustainability" in the EU approach to the Common Fisheries Policy and the Marine Strategy Framework Directive has challenged the marine science community to develop new models to forecast the effects of fisheries management and environmental change on fish stocks and the ecosystems that support them.

- 5.4. Accurate forecasting at the oceanographic level, based on modelling at the hydrodynamic and ecosystem level, is required to understand the responses of marine ecosystems to management interventions. Cefas has strengths in numerical modelling capability that spans hydrodynamics models to study flow fields, biogeochemical models to predict the dynamics of major nutrients and population models that describe the size and distribution of marine fish, freshwater fish and shellfish. The Panel saw good examples of modelling applications in relation to understanding processes and system dynamics.
- 5.5. Within the modelling work aimed at understanding ecosystem processes, Cefas staff have applied a range of model structures and principles. However, whilst there were some valuable examples of advanced thinking, there is a need for a clearer vision for the ultimate goal of the work. Although the lack of strategy in this area is probably also found elsewhere, both in Defra and internationally, Cefas could take a lead and pioneer a more integrated approach. While the Panel acknowledged that there are benefits in developing a variety of models, the links between the current modelling developments within Cefas could be made more explicit.
- 5.6. In a more applied context, the science community is at a formative stage in developing numerical models to forecast the effects of fisheries management and environmental change at an ecosystem level. The Panel perceived that Cefas's applied ecosystem modelling work in support of policy needs has developed considerably since the 2005 Science Audit. For example, Cefas has made a significant contribution to scientific advances towards quantifying multiple impacts on the marine environment. In particular, its use of combined maps of human footprint and sensitivity to impact to assess multiple pressures is innovative, highly relevant, and supported by peer-review publications. A key recent outcome is an improved understanding of recovery rates of marine ecosystems after anthropogenic disturbance.
- 5.7. However, some applications of the ecosystem approach to meet short-term policy objectives could set unachievable demands on modelling and data gathering. In order to tackle this issue, one of the main innovations in fisheries science has been to develop marine strategy evaluation systems, which test the effectiveness of particular measures in the face of a variety of uncertainties. Cefas has an opportunity to establish a leading role in how such modelling approaches can be made operational. This should be done with external partners who would have complementary skills.
- 5.8. In addition, modelling ecosystems to produce worthwhile predictions of sustainability may be impossible. For example, contingent events that redirect the development of an ecosystem may not be predictable. Therefore, the Cefas strategy on ecosystem modelling needs to embrace some work on the limitations of an approach that assumes it is always going to be possible to construct an ecosystem model that encompasses the observed complexity and makes useful predictions.

- 5.9. **The Panel recommends that in the area of ecosystem modelling, Cefas: (a) develops a clearer strategy that defines its niche in this area; (b) demonstrates how the different modelling platforms used in Cefas are applied, for what purposes, and how they add to each other's strengths; and (c) both Defra and Cefas assess the potential synergies and efficiencies that could be achieved by coordinating this strategy with NERC's National Capability funding for marine ecosystem modelling, and with the NERC Earth System Modelling strategy (which includes University and NERC Centre partners, as well as the UK Met Office). [Recommendation 19]**

Data management

- 5.10. Cefas holds extensive datasets in the marine, coastal and freshwater sectors that are of international importance. These include data on:
- UK fisheries gathered by long-term monitoring programmes for Defra;
 - Cefas has provided data holding services for commercially sensitive datasets on fishing fleet activity on behalf of the MMO;
 - long-term environmental data on the trends in freshwater and marine invasive species and diseases and levels of eutrophication; and
 - chemical pollutants and radionuclides in seafood on behalf of the FSA.
- More recently, there has been a step-change increase in government funding for habitat mapping and spatial assessment of biodiversity to support the designation of areas of high conservation value. The need to define Good Environmental Status of UK waters will increase these activities still further over the next decade.
- 5.11. The Panel concluded that the Cefas role in management and dissemination of fisheries and environmental data will become even more significant in the future. The implementation of proper data management arrangements to secure Cefas valuable data resources were highlighted as priorities by Cefas customers. However, the establishment of effective data sharing with Cefas's delivery partners and the wider community needs to be coordinated by Defra and other owners of Cefas held datasets. **The Panel considers Cefas data resources to be a major national asset and recommends additional funding from Defra to ensure compliance with the INSPIRE Directive. [Recommendation 20]**
- 5.12. Such issues were also identified in the 2005 Science Audit. Cefas has made a relatively recent commitment to create a meta-data catalogue and implement a forward-looking data management strategy -Data Management in Cefas – (DMIC) with an associated roadmap. The Panel reviewed the main elements of the strategy and made the following operational observations:
- The instigation of requirements to produce Data Plans for each project involving data collection is welcomed, but they should include actions to be taken at the end of the project including procedures for final quality control, managing any subsequent requirements for updates (such as from changes in calibration parameters), and archiving within Cefas and/or elsewhere in an appropriate

Data Archive Centre. There should be a requirement for sign-off of the Data Plan before a project can be closed.

- The full costs of ensuring proper management, archiving and processing of datasets so they are accessible to third parties for re-use should be calculated and assigned in advance – either centrally and/or through an overhead on project costs.
- There is a recognised long term issue to consider how best to provide access to Cefas legacy data. This is probably best addressed by prioritisation based on key customer requirements.

- 5.13. The ongoing implementation of a centralised approach to data management was welcomed by the Panel as an important first step in addressing these requirements. However, these new arrangements are not yet fully in place.
- 5.14. **The Panel recommends that: (a) Cefas ensures that the implementation of a centralised approach to internal data management is completed and adopted across the organisation’s data holdings so that Cefas can deliver an optimised data management and storage strategy within a two year time frame; and (b) the Panel is concerned that insufficient funding has been allocated to this task and encourages Cefas to look at the level of resources committed to data management by other equivalent organisations (e.g. NERC Institutes) and re-evaluates its position. [Recommendation 21]**
- 5.15. In the past there has been a perception that Cefas has tended to take an independent approach to data resources, seeing them as an internal resource with potential for exploitation. We saw a more open approach to data issues, but feel that following the publication of the Defra Open Data Strategy in June 2012, to which Cefas contributed, Cefas need to make a public declaration of their intentions through a Data Policy. Issues around data collection, storage, access, charging policy and archiving should be covered by a Cefas Data Policy similar to that published by NERC. We understand that a Cefas Data Policy was being drafted for publication but has been delayed by issues around the possible merger of the Cefas website with a more centralised government website. We believe that despite this, a Data Policy should still be published as soon as possible.
- 5.16. Customers generally agreed that Cefas could do much more to make their data more widely available and in an accessible form. Customers were often unsighted as to what data Cefas might collect other than data generated in partnership or under contract with that particular customer. There were also cases where customers thought better coordination of some datasets generated across government departments (including Cefas) would increase awareness and promote data sharing. There were examples of good practice in this area – notably MEDIN (Marine Environmental Data and Information Network) where Cefas is beginning to make data available, and is contributing to the setting of standards. Additionally, the establishment of a Fisheries Data Archive Centre, recently accredited by MEDIN, will make data publically available and be co-hosted by Cefas.

- 5.17. Across the UK, data management is coordinated by MEDIN as a sub-group of the Marine Science Coordination Committee (MSCC). MEDIN coordinates data flows to Data Archive Centres to ensure long-term stewardship. The Panel considered whether Cefas should set up its own Environmental Data Centre to cover all Cefas's data holdings. However, it could be argued that it would be more efficient to make use of data management capability that exists elsewhere in the UK, in the various existing Data Archive Centres in the MEDIN network. The Panel concluded that Cefas should continue to establish close cooperation with existing data management and sharing initiatives.
- 5.18. The next step in data management is to bring all data sources together for assessment purposes. Cefas work on the Western Shelf Observatory has contributed to the establishment of the UK Integrated Marine Observing Network (UKIMON), which aims to integrate all the UK observations in the marine environment. UKIMON is a joint initiative with other UK marine organisations. At the EU level, Cefas has taken the lead on this via products such as the European Marine System Observatory (EMECO). The Panel noted the possibility of overlap and duplication and anticipated that Cefas would ensure compatibility across these initiatives.
- 5.19. The Panel was interested in ensuring that Cefas pursues proactive measures to become an associate member of MAREMAP (Marine Environmental Mapping Programme)¹⁵, and that as a result Cefas contributes its datasets on habitat mapping to this research initiative. It was noted that Cefas makes the data freely available to the Defra family, but not to other potential users at this stage.
- 5.20. **The Panel recommends that Cefas: (a) makes a firm and public commitment to open access data and publishes a Data Policy comparable to that published by NERC, as soon as possible; (b) ensures that participation in data management and archiving networks are fully integrated; and (c) extends its recent participation in a wider network approach to data management to become a full and active member of initiatives such as the MAREMAP network. [Recommendation 22]**

Wider Markets

- 5.21. Projects for the private sector have had several positive consequences for Cefas including greater use of facilities that were not required full-time for government projects, expansion of the scientific capacity in several key areas and broader skills in project management. The operational benefits to Defra include maintenance of a critical mass, greater interactions with marine commercial sectors and creating the potential to secure additional marine environmental monitoring data.

¹⁵ <http://www.maremap.ac.uk/index.html> (December 2012).

- 5.22. There was concern that Cefas's commercial work could lead to conflicts of interest in the delivery of contract work for public sector customers through: (a) diverting resources away from public sector customers' requirements; and (b) potentially limiting the information made available in government contract work due to commercial restrictions (such as in renewable energy and food safety areas).
- 5.23. The Panel established that Cefas have procedures in place to identify potential conflicts and to escalate the issues to senior management if necessary. The Programme Management team has so far been able to create "Chinese walls" between scientists where necessary. The Panel believe this issue needs to be kept under regular review, as we noted that some external perceptions differed from the position presented by Cefas.
- 5.24. The Panel explored the issues around potential conflicts that may arise if commercial work limits the ability of Cefas to respond to national emergencies. There were concerns around the impact of rising commercial income in increasing the utilisation rates for specialist facilities (for example, Weymouth aquarium facilities, chemistry laboratories and radiological facilities). This is a potential conflict as Cefas needs to keep flexibility in case these facilities are needed to deal with emergencies. Government customers accept that routine work for them will be put on hold if there is an emergency but this situation is more difficult to agree with commercial customers. Cefas has been able to protect its flexibility in several commercial contracts and to date there was no evidence of government work being squeezed out. The Panel felt this will be an increasing issue if commercial income increases to the planned level of 25% of turnover by 2015.
- 5.25. The Panel accepts that there are considerable benefits to Cefas and government stakeholders from commercial contracts and that the present arrangements for handling conflicts of interest are adequate. **The Panel was concerned that managing external perceptions will become more difficult as commercial income increases to the planned level of 25% of turnover by 2015. The Panel recommends that Cefas: (a) develops a communication strategy to make the commercial activities more transparent to its key stakeholders; and (b) issues arising in relation to conflicts of interest (in addition to specific complaints) are logged and reported to the Cefas Management Board on an annual basis. [Recommendation 23]**

Cooperation and Partnerships

Devolved Administrations

- 5.26. Cefas has an important role in delivering the pan-UK Marine Science Strategy that covers the period 2010 to 2025. Cefas also contributes to the Marine Science Co-ordination Committee (MSCC), composed of representatives from public-funded bodies who have a remit to undertake marine scientific research. There has been a

long history of coordinated activities by the governmental agencies responsible for the management of fisheries in UK waters. The MSCC also has oversight of MEDIN and the UK Underwater Sound Forum. The MSCC's work is overseen by a Ministerial Marine Science Group, representing UK and Devolved Administrations. However, there is increasing distance between policy leads and a need to manage the interface at the scientific level.

- 5.27. The Panel noted that the HLA covers services provided by Cefas to the Welsh Government where appropriate. To date, general evidence gathering for the Welsh Government has relied on Cefas offshore capability and the Environment Agency on inshore fisheries. However, this is changing with the formation of the new Welsh environment body. Some regulatory advice to the Welsh Government is paid for directly, and covers general licensing and appropriate assessments. Defra still cover (via the HLA) shellfish advice and fish health inspectors. An agreement is being negotiated by Cefas to formalise the above, but this has been delayed, pending clarification of the remit of the single environment body for Wales. Nevertheless, the Panel sensed that the Welsh Government has only a second order influence on the marine monitoring and cruise programmes implemented by Cefas.
- 5.28. **The Panel noted that the arrangements whereby Cefas provides important services to the Welsh Government are evolving rapidly and the Panel recommends that: (a) there is an evaluation of the programme planning procedures by Defra to ensure that Welsh Government feels that its interests have been given full consideration; and (b) Cefas establishes a formal agreement for the coordination of directly contracted services with the Welsh Government. [Recommendation 24]**
- 5.29. Cefas does not give advice directly to the Scottish Government; this role is covered by Marine Science Scotland. However, traditionally fish stock monitoring has been agreed internationally through ICES as a joint effort. Cefas does win wider markets work in Scottish waters and delivers the FSA programmes on shellfish microbiology and toxins for the whole of the UK.
- 5.30. UK level coordination of research, operational effort, and facilities between the government marine laboratories in Scotland, Northern Ireland and England is delivered through the Management Group of Directors. This brings the current Directors of the three laboratories (Marine Science Scotland, AFBI – the Agri-Food and Biosciences Institute and Cefas) together every six months. Current initiatives include better utilisation of research vessels. Contingency arrangements for emergency response (for example, fish disease or chemical/oil spills) are also in place between the three laboratories.
- 5.31. Nevertheless, the Panel was concerned over the level of engagement and relationship of research institutions in England and Scotland as a result of devolution – particularly in relation to the relatively rapid recent expansion of

mapping and modelling of biodiversity and other environmental parameters. The perception is that the resulting fragmentation in science and monitoring is not being addressed actively.

- 5.32. **There are a number of UK initiatives between Defra and the Devolved Administrations to coordinate monitoring and research across national boundaries. However, the Panel recommends that Cefas and Defra takes the initiative at the institutional level to ensure comparability between the projects, initiatives and organisations of the Devolved Administrations and those of Cefas and Defra in the rapidly expanding marine environmental sectors. [Recommendation 25]**

Research Councils and Universities

- 5.33. The Research Councils are placing increased emphasis on research 'impact' and consider that a successful model to achieve research impact is to involve the operational agencies such as the Met Office in the research. Cefas is therefore well placed to capitalise on this as an 'operational' organisation and this is recognised by NERC in particular.
- 5.34. Cefas does not have 'Independent Research Organisation' status (formerly 'Academic Analogue' status) with UK Research Councils. It cannot apply in its own right for standard Research Council grants but can participate in Research Council Programmes as a sub-contractor. Nevertheless, there has been increased engagement between NERC and Defra, with Defra putting in funding to NERC's Marine Programmes in order to influence setting the research framework. This has resulted in increased opportunities for Cefas to secure research funding from these specific NERC Programmes. There are still barriers to collaboration, for example due to financial mechanisms, and cuts in funding from Defra budgets may limit flexibility for future collaboration.
- 5.35. Historically Cefas struggled to win funding from NERC due in part to poor coordination of funding proposals and weak collaboration. However, the perception now is that Cefas are putting in stronger proposals and have engaged more with partners. For example, Cefas have linked with NERC Centres, the Met Office, Plymouth Marine Laboratory, National Oceanographic Centre, British Geological Survey and Scottish Association for Marine Science, and are working more collaboratively on projects such as UKIMON and MAREMAP (see paragraphs 139 and 140).
- 5.36. The wider academic community has not always been aware of the breadth of work being undertaken by Cefas, nor who to approach within the organisation as a way into possible collaboration. But better communications work between Defra, NERC and Cefas has improved collaboration opportunities. In the case of the NERC's Shelf Seas Biogeochemistry Research Programme, Cefas produced an information document that outlined relevant work and projects and the key contacts within

Cefas. This was identified by academic scientists as a valuable exercise for raising awareness of Cefas and its work within the area of the NERC call.

- 5.37. The 2005 Science Audit suggested that Cefas was in an excellent position to initiate and develop collaborative links with the academic community and other Defra agencies. The former could offer early access to new science initiatives and technologies in addition to involvement with a potential pool of PhD and MSc students who could benefit from exposure to Cefas expertise in policy support and data.
- 5.38. The Panel concluded that good progress has been made with developing external research links. Three strategic alliances have been established with the Universities of East Anglia, Bangor, and Exeter, funded internally from the Seedcorn fund. Numerous other links have been established, mainly via CASE PhD sponsorship with other universities.
- 5.39. **The Panel recommends that: (a) Defra places a priority on supporting marine research through targeted co-funding of Research Council programmes even though there is pressure on evidence budgets; (b) Cefas undertakes greater collaboration with the academic sector; and (c) successes in grant applications to the Research Councils and the EU Framework Programmes are included in the Cefas Science Performance Ministerial Indicators. [Recommendation 26]**

Public Awareness

- 5.40. Cefas makes a concerted effort to disseminate information on marine science and evidence to a wide audience. The Communications staff handle high profile media interest, respond to requests for scientific and technical information and actively engage with communities, non-governmental organisations and regulated industries. Media statistics and papers for lay audiences contribute to the Ministerial Science Performance Indicator and the 2011/12 output of over 800 articles was well above the target.
- 5.41. Cefas also has a well organised and actively managed website. The Cefas website is seen as a crucial dissemination route for clients, regulated businesses and the public interested in the work of Cefas. The Panel members also found that much key information was available on the website. As this is a main route for wider dissemination, it is surprising that relevant website usage statistics have not been incorporated into the Ministerial Science Performance Indicators.
- 5.42. Cefas expressed concern that it may lose direct control of its website through the central integration of all government websites. However we understand that organisations will continue to have control over their corporate and specialist content in the new website. **The Panel commends Cefas on the quality of their external website and recommends that, as changes to Defra and government**

websites are implemented, the commercial value to Cefas of the present website is recognised and the current levels of functionality in any new solution are maintained by clear and unambiguous contractual arrangements. [Recommendation 27]

Intellectual Property Exploitation

- 5.43. Cefas has an active policy to meet government objectives for technology transfer and exploitation of Intellectual Property (IP). There have been two main streams relating to the large data resource and products/systems that owe their origin to Cefas research activities. Cefas has collaborated with other government science Agencies in securing significant funding from the Department of Business Innovation and Skills to identify and exploit joint commercial opportunities. The Panel reviewed the procedures for protection of IP and evaluation of marketing opportunities and concluded that these were working effectively.
- 5.44. Following the publication of the Cabinet Office Open Data White Paper¹⁶ and the Defra Open Data Strategy¹⁷ in June 2012 it is clear that data produced from public funding should be made available to the public, either free of charge or at marginal cost. Cefas is now focussed on expanding commercial work through value-added services based on its data resource. None of the opportunities have yet led to an appropriate business model as there are a number of barriers to data exploitation. The Panel recognised the sensitivities around data exploitation and expects Cefas to deliver an open approach to the wider dissemination of data for non-commercial purposes.
- 5.45. The exploitation of products and services is through the wholly owned subsidiary, Cefas Technology Limited. The company produces and markets products such as data storage tags, water-samplers and mooring-position systems, it provides access to laboratory-based testing services and sells certified reference materials for laboratory use. Cefas also has one joint venture to promote advanced fish-bait attractants.
- 5.46. Cefas Technology Limited employs three staff directly and has an annual turnover of under £1m – largely based on the manufacture and sale of data storage tags. The company operates in sectors that are familiar to Cefas and the risks and liabilities are recognised and managed effectively. Several new products have been launched recently but the Panel felt that the opportunities for IP exploitation were not being fully realised. As a consequence, growth in turnover and profitability were rather modest.

¹⁶ <http://www.cabinetoffice.gov.uk/resource-library/open-data-white-paper-unleashing-potential> (December 2012).

¹⁷ <http://www.data.gov.uk/sites/default/files/Defra%20Open%20Data%20Strategy.pdf> (December 2012).

- 5.47. **The Panel commends Cefas on its commitment to exploiting Intellectual Property but recommends it takes a more ambitious approach to expansion of Cefas Technology Limited so that turnover is at least doubled over the next five years with more products moved out into joint ventures. [Recommendation 28]**

6. Conclusions

- 6.1. Cefas has made considerable progress since the 2005 Science Audit and overall the Panel were very impressed with Cefas, its science, management and staff.
- 6.2. Cefas has addressed sustainability issues by consolidating its relationship with Defra through the development of a High Level Agreement. It has also successfully expanded into wider markets; this will provide some resilience over the next few years as government funding is likely to decline further.
- 6.3. The Cefas Chief Executive presented a clear and achievable strategy for the integrated development of business, science and people, including how this links with specific areas of science development and annual Divisional Plans. However, the Panel still highlights a need for a more forward-looking (5 year) science strategy and more dynamic horizon scanning. In addition, the ICT strategy lacks clear mapping to solutions, risk management and scientific computing capability.
- 6.4. The Panel concluded that there had been considerable progress in the quality of publications and Cefas now has a cohort of leading scientists with an international profile. However, the Panel also noted that the overall number of publications had not increased and there were still some disparities in publication rates across the organisation.
- 6.5. The Panel reiterates a recommendation from the 2005 Science Audit to regularly collect, collate and report on research output metrics such as publications by Theme, esteem measures (for example, chairs of national and international committees, editorship of ISI journals and grants awarded) and encourages Cefas to develop and undertake regular benchmarking exercises to evaluate research excellence.
- 6.6. The 2005 Science Audit suggested that Cefas was in an excellent position to initiate and develop collaborative links with the academic community and other Defra agencies. The Panel concluded that good progress has been made with developing external research links. Three strategic alliances have been established (using internally generated Seedcorn investment) with the Universities of East Anglia, Bangor, and Exeter. Numerous other links have been established, mainly via CASE PhD sponsorship with other Universities.
- 6.7. The 2005 Science Audit drew attention to resourcing emergency capability as an ongoing issue. Cefas demonstrated that a much more coordinated approach was now in place across government. However, the Panel still observed a central expectation of capability by customers without it being fully supported.

- 6.8. Reports of each Theme (Health and Hygiene, Environment and Fisheries) are provided in Appendix D, E, and F respectively. These reports go in to more detail of the specific issues within each Theme.
- 6.9. The Panel have made a number of recommendations through the report and these are presented in a compiled list in the summary at the beginning of the report.

APPENDICES

Appendix A – Terms of Reference for Science Review of Cefas 2012

To provide the Chief Scientific Adviser of the Department for Environment, Food and Rural Affairs with an independent, external assessment of the relevance, sustainability, quality, and impact, of the science and scientific programmes carried out by the Centre for Environment, Fisheries and Aquaculture Science (Cefas) over the period since the 2005 science audit.

Relevance - Meeting Defra and other Objectives

1. To assess the extent to which Cefas meets the requirements of Government, and wider benefits for industry and society, by providing evidence, scientific support services, surveillance, policy and regulatory functions, advice and emergency response capability in the marine and freshwater environment;
2. To assess Cefas' science strategy including how it supports delivery of Cefas' strategic objectives and its capacity to identify emerging scientific issues and deliver the future needs of its major customers, including Defra, the Marine Management Organisation and other Government Departments and Agencies.

Sustainability – Resources and Opportunities

3. To consider the quality and suitability of the resources available to Cefas (including staff, Seedcorn investment, equipment and facilities) and whether the organisation and management of science are appropriate to achieve Government requirements.
4. To assess Cefas' ability to attract exceptional scientists and to develop and utilise the skills of its scientists, retain them, and manage succession of key senior scientists.
5. Assess Cefas' ability and success at generating income and attracting funding for its science from external customers, and how external funds complement and enhance the science capability for Government.

Quality of science – Including Scrutiny and Quality Assurance

6. To assess whether the evidence activities undertaken by Cefas, including both research and other underpinning scientific services including laboratory and seagoing infrastructure, data management etc. are appropriate-to-purpose, reflect up-to-date scientific thinking and are of suitable quality to meet the objectives of their customers - in particular as the Government's foremost source of marine and aquatic evidence, applied science and impartial expert advice.
7. To consider the strategic management of science, and quality management systems. In particular, assessing the role of the Cefas Science Advisory Committee

for ensuring that science delivered by Cefas is of high quality and relevant; reviewing measures of science quality and performance including benchmarking against similar organisations; considering the accreditation and other proficiency assessment processes in place at Cefas; evaluating progress made and actions taken in response to the recommendations of the 2005 science audit.

Impact – Outcomes for Government, Partnerships and Knowledge Transfer

8. To identify science outputs, highlights and key achievements since the last review and evaluate the impact that Cefas has in delivering evidence-based scientific advice and information to inform UK, EU and International policy development and delivery in marine and aquatic science.
9. To consider co-operation and interaction with other organisations in the UK and overseas, such as UK Government departments and regulatory bodies, including the devolved administrations, other executive agencies and NDPBs, research institutes, universities, non-governmental organisations and industry, and an assessment of the effectiveness of these partnerships (including cost-effectiveness) in meeting customer needs.
10. To consider whether the mechanisms used by Cefas to transfer results of publicly funded research and other scientific activity to internal (Defra) and external (non-Defra) users, including scientific advice, scientific publications and exploitation of Intellectual Property (IP) including access to data, are timely, effective and appropriate in meeting customers objectives.

Overall

11. To comment and make specific recommendations for the future development of Cefas science programmes, as appropriate, and to draw an overall conclusion on the relevance, sustainability, quality and impact of its evidence activities.

In recognition that Welsh Government has an interest in the Science Review of Cefas, the Terms of Reference have been agreed with Welsh Government's Chief Scientific Adviser (CSA) and the final report of the review will be copied to the Welsh Government's CSA for information.

Appendix B – Cefas Science Review 2012 Panel Members

Name	Review role	Institution
Dr Michael Roberts CBE	Panel Chair	Formerly Chief Executive of Central Science Laboratory and Director of NERC's Centre for Ecology and Hydrology. Now T-Mar (personal company)
Fisheries Theme		
Professor Paul Hart	Vice-Chair Fisheries Theme	Department of Biology, University of Leicester, UK
Dr Marie-Joelle Rochet	Fisheries Theme Panel Member	Institut Français de Recherche pour l'Exploitation de la Mer (Ifremer), France
Dr Bjarte Bogstad	Fisheries Theme Panel Member	Institute of Marine Research, Bergen, Norway
Dr Bill Turrell	Fisheries Theme Panel Member	Marine Scotland, UK
Health and Hygiene Theme		
Professor David Kay	Vice-Chair Health and Hygiene Theme	Institute of Geography & Earth Sciences, Aberystwyth University, UK
Professor Michael Kent	Health and Hygiene Theme Panel Member	Department of Microbiology, Oregon State University, USA
Professor Helmut Segner	Health and Hygiene Theme Panel Member	Institute of Animal Pathology, University of Bern, Switzerland
Environment Theme		
Professor Manuel Barange	Vice-Chair Environment Theme	Plymouth Marine Laboratory, UK
Dr David Cotton	Environment Theme Panel Member	MEDIN, c/o British Oceanographic Data Centre, Liverpool, UK
Professor Stuart Harrad	Environment Theme Panel Member	Division of Environmental Health & Risk Management, University of Birmingham, UK
Professor Graham Shimmiel	Environment Theme Panel Member	Bigelow Laboratory for Ocean Sciences, USA
Ex-officio Member		
Professor Nick Owens		Representing the Cefas Science Advisory Committee

Appendix C – Consultation with Cefas Public Sector Stakeholders

Prior to the Review visit, a consultation was carried out by the Panel with the key public sector stakeholders of Cefas to obtain some structured feedback on their interaction with Cefas. We received responses from seven government organisations and also held a teleconference interview with the NERC. The government organisations who responded are listed below.

Department for Energy and Climate Change

Department for Environment Food and Rural Affairs (Defra)

(Responses from different teams within Defra: Aquatic Animal Health R&D; Aquatic Animal Health non-R&D; Marine Environment; Salmon and Freshwater Fisheries; Sustainable Marine Fisheries.)

Environment Agency

Food Standards Agency

Marine Management Organisation

Natural England

Natural Environment Research Council (via telephone)

Welsh Government

Appendix D – Report of the Health and Hygiene Theme

Overview

D1. This Theme was presented under three headings:

- Aquatic Animal Disease;
- Environment and Health; and
- Food Safety.

The scientific activities are broad-based covering field sampling and biosecurity assessment; disease diagnosis and risk assessment of endemic and emerging diseases and imports; assessment of the impact of environmental contamination and diseases on aquatic ecosystems; surveillance, research and risk management of pathogens, algal toxins and other pollutants contaminating seafood and/or the aquatic environment. These activities are largely based at the Weymouth Laboratory and have been supported principally by Defra's Aquatic Health Division, the Food Standards Agency (FSA) and the European Union (EU). Much of this work has been won in open competition and has been supplemented recently by a growing portfolio of contracts from the private sector.

D2. The income has grown from £7.2m in 2006/07 to £11.5m in 2011/12 (supporting 112 staff), due largely to growth in the monitoring work. Close alignment with policy units in Defra, FSA and the EU is reflected in a high level of participation in expert working groups and committees. R&D income has been sustained at around 25% of turnover but there has been a recent diversification of income streams (including commercial work) to compensate for a decline in Defra funding. In spite of these funding pressures, the ISI journal output has increased by nearly 25% over the period (to around 50 papers) and the average Impact Factor in 2011 was a creditable 2.7. There is also evidence of significant contributions to journal editorships and collaborations with university partners.

D3. Importantly, the team working on this Theme is producing a range of papers using a spectrum of data from the classical science paper reporting (for example, methods development) through to papers exploring the science policy interface. These are published in a range of journals including the leading international outlets in the field. This reinforces the complementarity of the policy-driven monitoring, classical R&D and related advice work-streams and acts as a form of independent quality assurance on all three areas of activity.

D4. Laboratory facilities across this Theme were seen as world class and, in many cases, unique; offering novel challenge testing facilities for fish and shellfish, and microcosm scenario testing to investigate shellfish contamination and oceanic acidification. The uniformly high levels of laboratory accreditation were noted and

considered an essential element of quality assurance of the Cefas work for government. This was further reinforced by the Cefas role as an International Reference Laboratory in this area, which is indicative of the high level of international recognition of diagnostic quality of work delivered by these Cefas teams.

- D5. Whilst there is no formal forward-looking science strategy covering these activities, the Annual Plan does identify scientific opportunities in areas such as pathogen ecology, molecular indicators of crustacean disease susceptibility, Norovirus epidemiology and risks associated with chemical mixtures. The Fisheries Annual Plan also identifies that these developments need to be supported by further investment in bioinformatics capability, IT solutions and epidemiological modelling. The Panel considers developments in these fields to be essential for future competitiveness of the Health and Hygiene Theme and encourages these activities.

Science/Evidence Highlights

- i. This Theme exemplifies the benefits of an integrated working environment in which a cross disciplinary team has delivered excellent science demonstrated by international-class publications and leading scientists in emerging agendas. This is used to generate a credible policy evidence-base supporting targeted and valued policy support to the UK, EU and international agencies (e.g. World Health Organisation and International Organization for Standardization (ISO)). This is seen in:
 - the Cefas role as part of an international effort to deliver replacement of the mouse bioassay in toxicity testing of shellfish flesh samples;
 - OECD incorporation of the stickleback bioassay;
 - EU leadership and European Union Reference Laboratory (EURL) status in the development of molecular methods for Norovirus;
 - EURL status for crustaceans and bivalve molluscs; and
 - The Cefas role as leading contributor to the development of OSPAR marine monitoring methodologies.
- ii. The development work to replace the mouse assay with chemical testing of toxins in shellfish flesh illustrates excellent science, international collaboration, high impact and a significant level of societal and policy contribution.
- iii. The EURL status for crustacean disease and microbial analyses of bivalve molluscs is evidence of international reputation and high level inputs to the policy community. It is a central element in the Cefas profile characterised by excellent laboratory facilities, extensive accreditation networks and delivery of policy-relevant science.
- iv. The Cefas survey role offers a rare opportunity to offer the policy community ecosystem assessment based on empirical data describing 'ecological

effects' (such as liver cancer in Dab) rather than less useful water quality proxies, and these offer considerable potential for the Marine Strategy Framework Directive (MSFD).

- v. The work on 'ecosystem effects' monitoring, particularly the studies on liver cancer in fish, is world leading producing excellent synthesis papers (e.g. on 'omics'), drawing the policy implications of work and publishing across a spectrum from pure science to policy relevant work in good quality journals. At the same time, these activities provide most valuable input into the OSPAR-related monitoring activities, and will be also of high value for the implementation of the new EU MSFD.
- vi. The statutory functions delivered by this Theme (the Fish Health Inspectorate, classification of shellfish growing areas, and sanitary profiles) offer considerable scientific benefits by providing access to data trends and emerging incidents, knowledge of key agency science needs and early exposure to emerging policy questions.

Key Issues

- D6. *Funding acquisition.* The resource for this Theme is dominated by competitively won funding. Its sustainability is dependent in a clear strategy and management of staff time to facilitate successful competitive funding bids. This is difficult in a dynamic funding environment but staff development, succession planning and time management to facilitate funding acquisition will be increasingly imperative. The immediate track record of successful funding acquisition is excellent and encouraging, but this cannot be guaranteed in the medium term (3-5 years). Defra and Cefas should be aware that access to the world class resource and emergency response capacity contained within this Theme is jeopardized by the current funding model and one or both organisations may wish to address this concern. Thus, a management strategy document outlining how this will be achieved should be prepared and agreed within the Theme personnel and with senior management.
- D7. *Molecular microbiology and regulation.* Cefas has one of the few groups with science and operational experience of the utility of molecular microbial methods within regulatory systems. This area is very likely to expand in microbial standards for recreational and shellfish harvesting waters, with potential applications in the potable water area - in addition to the present food hygiene work. The group should review opportunities in general to ensure they maximise the utility of existing expertise.
- D8. *Extending the stickleback model research.* The program has developed a unique model with the stickleback, particularly for investigating endocrine disruption in male fish. Given the expertise and facilities within the group, there is considerable potential in extending the stickleback assay to other fish models when they are more appropriate for the particular area of research (for example, the zebra fish).

This would be most effectively achieved by collaboration with the existing academic contacts and would provide a potentially fruitful avenue for future R&D funding.

- D9. *Staff benchmarks.* The early career scientists and PhD students working in this area are able, enthusiastic and committed to the corporate aims of Cefas and its clients. However, a significant salary gap appears to be evident between, for example, Cefas post-doctoral scientists and comparable university researchers.
- D10. *External Communications.* The Cefas website is seen as a crucial dissemination route for the customers, regulated businesses and the public interested in the work of this Theme. Concern was expressed that Cefas may lose direct control of this resource and, if website organisational change is planned we would advise that current levels of functionality are maintained by clear and unambiguous contractual arrangements.

Health & Hygiene Sub-theme Reports

- D11. Health and Hygiene areas of activity were presented under three Sub-themes:
- i. Aquatic Animal Diseases;
 - ii. Environment and Health; and
 - iii. Food Safety.

Aquatic Animal Disease Sub-theme Report

Summary

D12. This Sub-theme contains several internationally recognised scientists conducting world class research in aquatic animal health. The scientists come from several areas of expertise, covering all important research areas needed for a comprehensive aquatic animal health program. They conduct research from basic molecular biology, through field investigations, leading to significant influence on policy. The latter is clearly demonstrated by specific changes in policies directly related to their research findings. They serve on several international boards that influence science policy in their field. Their research facilities in Weymouth are world class, and their laboratory for in vivo studies with exotic aquatic pathogens, particularly with marine pathogens, is unique.

D13. The Sub-theme shows a good balance of R&D and monitoring which produces a diverse research portfolio. These two factors place them in a good position for future funding acquisition even in the adverse funding environment projected for the next five years. Monitoring activity is conducted within the Fish Health Inspectorate (FHI) where continued R&D in aquatic animal health is an important benefit because it provides cutting edge diagnostic methods for the regulator. Indeed, the FHI would be less effective if cuts in R&D funding from Defra result in significant reductions in R&D to the Sub-theme, particularly in the area of development, evaluation, and implementation of new diagnostic

tests. Generally, the Aquatic Animal Diseases Sub-theme has an outstanding culture in integrating the diverse expertise being available within the group.

Observations

- D14. The Panel noted that the applied focus of the work has not been a constraint to publishing in high quality peer-reviewed science journals and there was also a good track record in publishing policy analysis focused papers. The interdisciplinary focus of the work, reflected in the team's expertise and its internal links within Cefas, was a significant strength.
- D15. The FHI, in particular, links strongly into a broad range of work in other teams contributing in this Theme. FHI is also a very valuable intelligence and empirical data source for work across this Theme (for example, of specific relevance to epidemiological studies). This results in cost effective and efficient sharing of skills, knowledge and resources and provides a standing pool of expertise to react to new emergencies. In addition, the FHI has an important education and information dissemination role. For example: (i) the FHI disseminates policy messages to the public through direct contact with trade and public stakeholders; and (ii) disseminates Defra policy to fish farmers via presentations at stakeholder meetings.
- D16. High international scientific standing is demonstrated by the valuable EURL for crustacean diseases, which is responsible for the provision of reference materials, advice and support to EU laboratories. This group has unique laboratory facilities at Weymouth for in vivo testing of exotic pathogens, which underpins the potential for innovative R&D and sets a strong platform for agenda setting research and publication. This facility reinforces the impression of world-class facilities and expertise in the Aquatic Animal Diseases Sub-theme which underpins their monitoring and research functions.
- D17. Aquatic Animal Diseases is outward-looking, committed to effective science communication and brings together wider groups of external experts. This brings substantial benefits to Cefas's reputation and influence.

Concerns

- D18. Basic R&D funding from Defra allows headroom to underpin FHI statutory functions and gives critical mass to approach issues effectively. If Defra R&D investment continues to fall, this may no longer be sustainable. FHI would be a less effective regulatory body without the science support of Cefas R&D; also the regulatory functions help keep research aligned with the policy community needs.

Environment and Health Sub-theme Report

Summary

- D19. The Environment and Health Sub-theme takes a health-focused approach to environmental assessment: i.e. it starts from observed environmental impairment and wildlife disease, and then works to understand the processes leading to impairment. This 'disease first' approach includes the development and implementation of methods and concepts to assess and predict environmental change. It also enables the Environment and Health group to fit very well into the broader Health and Hygiene Theme as it opens numerous possibilities of interactions within the Theme (and these interactions indeed take place). Further, the health-based approach positions the Environment and Health group well to acquire funding for R&D as well as evidence work under new environmental regulations which are already or about to be implemented. Whilst the research focus is on the impact of human activities, the group clearly recognises and addresses the role of stressor interactions and cumulative effects, an area that will dominate the environmental research agenda in the coming years.
- D20. The group contains a number of scientists of international standing and has published research which is agenda-setting in marine environmental science. Examples of science highlights include:
- exploring and establishing the value of the stickleback as a fish model used to assess biological effects of endocrine-disrupting compounds;
 - integrated understanding of the role of toxic contaminants, in the context of other stressors, in causing environmental change;
 - revealing the aetiology of complex environmental diseases; and
 - exploiting cutting-edge technologies for environmental monitoring.
- D21. The research of the Environment and Health Sub-theme has a strong regulatory focus and impact. Examples include:
- the EU MSFD as well as the Clean Seas Environmental Monitoring Programme, where EH make major contributions from their long-term health monitoring on marine fish populations (work done in collaboration with the Aquatic Animal Diseases sub-theme)
 - their prominent role and function in ICES and OSPAR activities, including their capability to integrate advanced technologies into existing assessment methodologies;
 - the development of OECD test guidelines for the hazard assessment of endocrine disruptors.

Observations

- D22. The strong R&D and policy contribution of the Environment and Health group comes from the international standing of key scientists in environmental monitoring and assessment as well as from commitment to interdisciplinary approaches,

ranging from molecular to ecological methods for environmental monitoring and assessment. The group integrates several disciplines, including ecology, toxicology and genetics.

- D23. There is clear evidence of strong science underpinning advice. For example, the excellent synthesis papers on metabolomics of fish cancers, drawing out the policy implications of work and publishing across a spectrum from pure science to policy-related interpretations in good quality journals.
- D24. The Environment and Health Sub-theme shows international leadership. The research work feeds directly into work of international authorities and organisations (e.g. EU, OSPAR, ICES, and OECD). There is evidence of international leadership in EU Analytical Quality Control (AQC) programmes and co-authorship of related guidelines.
- D25. The group has the strategic vision further to develop its R&D capabilities. It was successful in winning Defra funding to develop in-house molecular biology skills, and it made targeted use of Seedcorn investment in projects and in studentships via links with universities to build up new expertise in emerging research areas. The Seedcorn funding is also strategically used to underpin university partnerships.
- D26. As in the other Health and Hygiene Sub-themes, there is strong evidence of staff commitment, drive and talent. Poster presentation sessions demonstrated a strong PhD culture and very enthusiastic, articulate, engaged students. Early career scientists also appreciated the value of superb facilities and the group's cross-collaborative culture together with access to well-funded policy relevant research data and understanding of policy agendas.

Concerns

- D27. The Sub-theme has little core funding for R&D work, compared to the other two Sub-themes in Health and Hygiene. Although this highlights the competitiveness of the group in R&D, it is also a risk, as success in obtaining R&D funding can vary markedly over time. This may affect the stability of the group and its capability to maintain the current level of scientific expertise, although the Panel expects that, with increasing implementations of regulations for environmental health assessment, the opportunities for the group to increase its funding for policy related evidence work will increase. However, the reliance on R&D funding should be reviewed and if possible reduced and complemented by other funding streams.
- D28. The group should make more of their extensive data resource. Given the number of scientists and the sound research projects, publication rates appear comparatively low. However, it should be noted that the group has published several papers in top rank journals in environmental and aquatic sciences, but the average impact factor is lower than might be expected given the overall quality of the research. An increase in the number of in-house PhDs could improve the publication rate. In the longer term, the EH group might consider reducing the diversity of research topics.

The current situation probably reflects the diversity in funding as well as the diversity in background of the individual scientists. However, gradually re-focusing the research topics will help to sustain a competitive group.

Food Safety Sub-theme Report

Summary

- D29. The Food Safety Sub-theme centres on science and regulation of UK shellfisheries. This unit is working closely with UK governments, food and water regulators (FSA/FSA-Scotland and EA), water undertakers and shellfish growers to deliver appropriate regulation of shellfish food safety to UK clients.
- D30. They have scientists leading international agendas and importantly, a proven international track record in science delivery which is evidenced by:
- their publication history of well cited papers in top journals in the field;
 - the acquisition of competitively won funding;
 - their hosting of the EU reference laboratory for Norovirus determination; and
 - their delivery of operational testing for algal toxins in shellfish flesh to replace the earlier mouse bioassay.
- D31. There is evidence of synergy between the group's semi-regulatory functions, including monitoring activities, and its publications. Here, the policy development process has been aided by science advances needed to deliver new regulatory tools. This input to the policy cycle forms the core of the group's published work and represents its principal impact.

Observations

- D32. Cefas personnel lead the European Committee for Standardization (CEN) group on standardisation of detection methods for viruses in shellfish flesh and the Weymouth facility has EURL status in this area. This role has resulted in excellent EU-wide networks with the provision of inter-laboratory quality assurance schemes, training and associated reference materials all contributing to community-wide methods harmonisation and equivalence in environmental regulation and public health protection.
- D33. The Cefas activity in this area proves a high level of laboratory management and operational competence, producing an internationally leading position in a rapidly developing area of direct relevance to the regulation of shellfish, but with wider potential significance through the Cefas lead in the development of molecular microbial methods for pathogen determination in environmental matrices. Wider regulatory potential in, for example, bathing waters is becoming evident (initially in the USA) and this offers the potential to contribute to key international agencies such as the EU and World Health Organisation as the policy debate develops.

D34. The work to move from the previous mouse bioassay to direct toxicity assessment of shellfish flesh samples is of particular policy benefit. It removes the ethical problems in using the mouse bioassay and provides a chemical assay better suited to the wide variability in sample throughput which is common where algal bloom incidents are identified. This development represents a significant international effort centred in Aberdeen, Canada and the Netherlands which is now being operationalised by Cefas in Weymouth where the team have developed a new suite of automated mass spectrometry equipment to deliver toxicity monitoring to the policy community. The Cefas monitoring role represents a new, technology led, market where the Cefas experience in management of accredited facilities and inter-laboratory harmonisation is important as seen in the development of new reference materials in Weymouth (for example, the first certified oyster material due for release in the summer 2012 period; arising from internal Seedcorn R&D funding).

Concerns

- D35. The Cefas website is seen as an essential communication tool which is consistently updated to serve the needs of the policy community and other clients wishing to procure testing and consultancy services. There is a possibility that Cefas may lose direct control of this facility in the near future with adverse impacts. This was particularly important for the Cefas role as an EURL, and this is perceived as a potential threat to science delivery.
- D36. The recent balance of funding has tended to move away from R&D towards monitoring with a regulatory focus. The synergism between R&D and innovative regulation has been important to the success of this unit in the past and restoration of a significant R&D proportion in the funding balance will be important. The university collaborations are useful in this regard as is the potential for Seedcorn funding from internal Cefas resources. However, research delivery by the team should be seen as a key element in the unit's sustainability.

Appendix E – Report of the Environment Theme

Overview

- E1. This Theme covers research, monitoring, assessment and advice to manage and adapt to human and environmental impacts on marine ecosystems (including assessment of the biological effects of chemicals). Since the last Science Audit, scientists in the Environment Theme have been directed to support the development and implementation of the 2008 EU Marine Strategy and Framework Directive (MSFD) and the 2009 UK's Marine and Coastal Access Act. This work supports the Marine Management Organisation and the statutory nature-conservation bodies in marine conservation and marine spatial planning. This includes high profile advice on Marine Protected Areas, the development of integrated resource management and management of aggregate extraction, dredging-material emplacement and offshore renewable energy. This Theme also includes large commercial contracts supporting inter-disciplinary studies of major potential infrastructure developments (such as the British Energy Estuarine and Marine Studies).
- E2. The Theme has significant capability in marine monitoring, numerical modelling and risk assessment. The income in 2011 was £13.5m and the staff complement was 141 Full-Time Equivalent (FTE). The Theme was divided into three Sub-themes:
- Pressure, State and Impact (62 FTE, ca £2m R&D budget),
 - Ecosystem Modelling and Processes (30 FTE, £2.2m R&D budget), and
 - Current and Future Risks (49 FTE, ca. £0.5m R&D budget).
- Whilst funding in some areas has declined, there has been a recent step change in funding to map marine habitats and assess the sensitivity to pressures at a range of scales. Taking 2011 as representative of the review period, publications in ISI journals numbered just under 55 papers for the year, with the average impact factor of the journals in which papers were published being 2.4. Representation on expert working groups and committees did increase over the Review period, whilst editorships of scientific journals increased from a relatively low base. Our recommendations are combined for the whole Theme, but reference to Sub-themes is made when appropriate.
- E3. The sessions included 22 presentations and 6 poster/interactive presentations. The Panel recognised and confirmed the international excellence of some areas of the environmental research portfolio; in other areas the research presented was well aligned to the mission of Cefas and was fit for purpose in fulfilling regulatory advice and preparedness for emergency response capability. However, Cefas should ensure it prioritises innovation in order to continue to compare favourably with other European research institutions that provide regulatory advice.

- E4. The Panel recognises that Cefas has taken significant steps to improve collaborations with Natural Environment Research Council (NERC) centres and Universities. This will continue to be key to Cefas's success and the Panel welcomes this positive response to the recommendations of the 2005 Science Audit. Given the different business models from government and business-led opportunities, it is recommended that Cefas remains flexible so as to further attract academic collaborations.
- E5. The Environment Division Annual Plan provides a good framework for setting short-term objectives for business development, scientific initiatives and management of staff resources. However, this is a dynamic and expanding area. Defining Good Environmental Status for UK waters and protecting areas of high conservation value requires a step change in assessment of biodiversity and environmental quality indicators. Accurate forecasting at the oceanographic level, based on modelling at the hydrodynamic and ecosystem level, is required to understand the responses of marine ecosystems to management interventions. The costs and benefits of alternative management options needs support by analysis of the social and economic implications. Therefore, this Theme would benefit from a longer-term assessment of both scientific, social and economic evidence and research needs and opportunities.

Science/Evidence Highlights

- i. Scientific advances on quantifying multiple impacts on the marine environment. In particular the use of combined maps of human footprint and sensitivity to impact to assess multiple pressures is innovative, highly relevant, and supported by peer-reviewed publications. A key recent outcome is an improved understanding of recovery rates of marine ecosystems after anthropogenic disturbance.
- ii. Cefas international leadership in the development of size-based modelling approaches to understand the functioning of marine communities is recognised, despite recent staff losses. The underpinning science has benefited from excellent and essential collaborations with universities and other research centres. The benefits of these modelling approaches for national and international policy development are starting to develop.
- iii. Cefas contributions to understanding circulation fluxes in the North Atlantic continue to be internationally recognised. The "Connections" Programme has resulted in a thematic journal issue focussing on key topics such as open ocean oxygen depletion.
- iv. Work presented on the marine mammal strandings programme – exemplified by the excellent work linking Polychlorinated biphenyls (PCBs) with adverse effects in harbour porpoises; coupled with monitoring of responses to

measures to reduce contamination (e.g. bans on use, industry voluntary programmes etc.).

- v. The Panel was impressed with Cefas's work to gain efficiency in conducting monitoring in support of the MFSD – both in terms of sea-time usage (reduction of 10 days per year) and cost (20% drop). Cefas is well prepared for future challenges and ahead of game within the EU.
- vi. Cefas's world-class radioactivity monitoring facility is the first point of call for Defra for all programmes (not just marine). The Panel noted Cefas's excellent response to recent international concerns regarding release of radionuclides into the marine environment in Japan.
- vii. Cefas's emergency response capability remains crucial to the UK, and the Pollution Response in Emergencies Marine Impact Assessment and Monitoring (PREMIAM) project provides guidance for protocols for responding to major incidents.
- viii. Finally, the Panel was shown evidence of internationally-leading emerging work on marine litter, that characterises (via modelling and monitoring) the scale and spatial distribution of the problem.

Key Issues

- E6. Cefas should be proactive in clarifying when they are acting as an Executive Agency of Defra and when are they providing independent advice. Cefas do not appear to perceive this as an issue but some stakeholders do not share the same view.
- E7. The Panel was concerned over the level of engagement and relationship of research institutions in England and Scotland as a result of devolution – particularly in relation to the mapping and modelling of biodiversity and other environmental parameters. The perception is that the resulting fragmentation in science and monitoring is not being addressed actively. There are a number of national and international initiatives to coordinate monitoring and research across national boundaries but there is a need for Cefas to take the initiative at the institutional level.
- E8. Similarly, cuts in Defra's High Level Agreement (HLA) and the subsequent re-balance with increased commercial activity could potentially affect the ability of Cefas to maintain an effective emergency response capability. While this was not perceived as an issue currently, a potential tipping point could be reached where the balance between Defra and commercial work would inhibit a full interdisciplinary response to an incident which has the potential to impact the marine environment.

- E9. The Panel was keen that Cefas establishes proactive measures to become an associate partner of the Marine Environment Mapping Programme (MAREMAP) network, and that Cefas contributes its datasets on habitat mapping to this research initiative. It was noted that Cefas makes the data freely available to the Defra family, but not to other potential users.
- E10. The UK Integrated Marine Observing Network (UKIMON) provides a good opportunity for Cefas to work with other Marine Science Coordinating Committee (MSCC) partners in bringing together observatory visions and coordinating/integrating datasets. However, in leading this initiative Cefas needs to be aware of capabilities developed by relevant ongoing activities and build on these, rather than duplicate them.
- E11. Wavenet – the current situation where data from buoys is freely available to non-commercial customers is a good model for other Cefas-collected data. However, in the long term, Government open data access requirements may mean that the data should be provided even for commercial purposes. Data archiving capability within Cefas should be coordinated with other providers of wave information.
- E12. The Panel perceived that the ecosystem modelling work in Cefas has developed considerably since the 2005 Science Audit and is at a stage where it could benefit from a clearer strategy defining Cefas's niche in this area, how the different modelling platforms used in Cefas are applied, for what purposes, and how they add to each other's strengths. Significant additional synergies and efficiencies could be achieved by ensuring that this strategy is coordinated with NERC's National Capability funding for marine ecosystem modelling, and with the NERC Earth System Modelling strategy, which includes university and centre partners, as well as the UK Met Office.
- E13. Northern Seas ocean circulation and climate work is a key national science priority – for this work to remain viable in the longer term it needs to link better with NERC Centres and particularly the providers of NERC long-term observation capability. The development of collaborative links may also need to consider combining outflow assessments with changes in inflows.
- E14. The Panel appreciated the strong alignment of the Marine Climate Change Impacts Partnerships (MCCIP) activity to advisory needs in relation to climate change adaptation. A stronger link with emerging international networks on climate change adaptation (for example, FAO-driven Global Partnership for Climate Fisheries and Aquaculture - PaCFA) and climate change science (e.g. ICES-PICES Strategic Initiative on Climate Change and Marine Ecosystems - SICCME) would enhance MCCIP's exposure and impact outside the UK.
- E15. Eutrophication was seen as an area of static/declining research investment. It is recommended that Cefas refocuses work in this area towards research on 'nutrient management' and resulting environmental degradation such as increasing pathogens or vibrio infections.

- E16. The Panel perceived a risk in terms of future funding for work on emerging contaminants in light of reduced Defra R&D spend. Management needs to develop a clear strategy in this area.
- E17. In relation to research on contaminants in marine mammals the Panel considered that Cefas could better exploit links with the NERC/University of St Andrews' Sea Mammal Research Unit, and related academic institutes, to combine their expertise with cetacean ecology and population dynamics.
- E18. Noise research appeared promising but needed further development to yield a solid science base for meeting potential regulatory frameworks.
- E19. The evolving relationship between Cefas and the MMO was highlighted. Cefas's view was that the working relationship with the MMO was very good – from both side's perspective. The MMO considered Cefas Regulatory Advice Team work for the MMO licensing team to be high quality. However, the MMO raised some issues relating to the quality of evidence and delivery of project outputs in other areas (including fisheries and the Marine Planning Tool) and Cefas's responsiveness to the need for strategic science reviews. The relationship with MMO would benefit from a more comprehensive approach to customer relationship management.
- E20. The Panel suggested that Cefas takes a stronger role in the provision of effective advice to customers by ensuring that they do not just deliver products for customers to interpret the results themselves. This was particularly of concern in relation to tools for the assessment of multiple impacts of human activity on marine ecosystems and on marine decommissioning, where customers may have too much leeway to extract their own preferred outcomes from delivered products. There was also a wider point around Cefas being more proactive in setting research and monitoring agendas and horizon scanning, and driving these forward rather than expecting Defra and other customers to tell them what they need.
- E21. The Panel recognised that Cefas has recruited environmental economists to support the need for a broader approach to assessment of alternative management strategies. Retention of staff in this area will continue to be difficult until Cefas has established a critical mass of staff (including social scientists) and established effective networks with universities and specialists in Defra.

Appendix F – Report of the Fisheries Theme

Overview

F1. The Fisheries Theme was presented in three parts:

- Evidence Collection and Monitoring;
- Ecosystem Approach to Fisheries; and
- Assessment and Advice.

The Review covered both freshwater and marine fish and fisheries and under each of the three headings there were a total of 18 separate presentations. It was clear from the presentations that there was considerable overlap with the Environment Theme, particularly with respect to the Ecosystem Approach to Fisheries.

F2. Much of the work in this Theme provided evidence for statutory monitoring and stock assessment, activities dictated by the European Union by way of Defra. The total income of £10.3m in 2011 supported 125 staff. The R&D income of £3.5m in 2011 resulted in the publication of around 40 ISI journal papers (unchanged over the Review period) with an average Impact Factor of 3.8 (increasing over the Review period). There was heavy representation on international committees reflecting the high level of advisory support to Defra Marine and the EU but a more modest level of contribution to the editing of scientific journals.

F3. The general impression obtained was of a competent, well managed, thoroughly informed and strongly motivated group of people who are producing well integrated science and advice. The quality of both the science and the advice puts the Theme amongst the leaders in Europe. We were particularly impressed by the quality checks applied to the data collection methodology, the way in which fishing discards were being studied and the work being done to deal with the assessment of data limited fisheries. Much of the work was supported by a group of skilled technicians and they need to be encouraged, nurtured and retained as the work of the fisheries scientists depends crucially on them.

F4. The presentations gave us the impression that thinking in Cefas is constrained by the relationship with Defra. As one of the main customers for Cefas's output the view was expressed that if Defra had no interest in a topic then it would not be considered further. There is room, in our view, for a more adventurous approach to thinking about future activities unconstrained by the immediate demands of either Defra or the EU. If Cefas is to maintain international leadership in fisheries science then it has to be thinking now about how the science will be advanced over the next 10 years and to develop international collaborations with other groups that are developing new thinking. Thinking of the future has to be an ongoing activity with constant renewal. This approach should also result in a higher output of ISI journal

publications even though the Defra contribution to R&D funding may be more limited in future.

- F5. We note that there is a Fisheries Division strategy (Influence on and Management of External Change) that reflects efforts to develop some forward thinking in this area. However, there is a need for the Division to identify scientific priorities in the context of available resources in the medium term and set more challenging targets for journal publications.

Science/Evidence Highlights

- i. The elasmobranch assessment work provided a strong example of bringing together different disciplines and approaches (biology, biodiversity, tagging, and stock assessment) and a good use of Fisheries Science Partnership to engage industry. It also demonstrated cross-cutting work linking biodiversity and fisheries.
- ii. The assessment of data-limited stocks provided a good example of integrating evidence into advice. The Cefas science influenced the development of ICES methodology for the production of advice for these stocks.
- iii. The work on jellyfish abundance in the Irish Sea is a good illustration of how data from different sources can be integrated to allow the best use of the data available.
- iv. The tagging work has produced some very interesting results, particularly with regard to cod movements and the migration of eels out into the Atlantic.
- v. The monitoring and analysis of discarding practices provided a good example of the efficient integration of evidence and advice.
- vi. It was pleasing to see an integration of marine and freshwater stock assessment.
- vii. The Fisheries Theme is strongly supported by skilled technicians. There appears to be very strong support from technical staff and there are plans in place to recruit additional staff (e.g. two new geographic information system –GIS - staff).
- viii. Evidence was presented to demonstrate that a well-integrated data analysis and processing system was under construction.
- ix. Cefas has valuable historical data which was being put to productive use in establishing long term trends. There is a strong need to keep supporting this work to digitise and utilise these data to ensure they continue to be available for use in the future.

- x. We were encouraged to see the maintenance of long term monitoring of fish stocks, including work done under the Fisheries Science Partnership.

Key Issues

- F6. Some applications of the ecosystem approach could set unachievable demands on modelling and data gathering. There is a need for clear and creative thinking as to how the ecosystem approach can be made operational. This should be done with external partners who would have complementary skills.
- F7. Within this work on the ecosystem approach to fisheries management there are some valuable examples of advanced thinking but there is a need for a clearer vision for the ultimate goal of the work. Although the lack of strategy in this area is probably found elsewhere, both in Defra and internationally, Cefas could take a lead and pioneer new approaches. To start with, the links between the current developments within Cefas could be made more explicit.
- F8. Evidence presented to us showed that 50% of the value of landings by the English fleet comes from shellfisheries, yet spend on their management is not in proportion. There could be greater collaboration with the Inshore Fisheries and Conservation Authorities. It should also be noted that many of the methods developed for the inshore fishery sector could be better integrated with other areas of Cefas's work.
- F9. The data gathering and assessment procedures are predicated on a standard approach to managing single species. Whilst the quality of this work is excellent, it assumes that the system will continue for the foreseeable future. There is a need for more horizon scanning which could be funded by Seedcorn money.
- F10. There was some evidence of the involvement of fishers in the scientific enterprise, for example, achieved through the Fisheries Science Partnership. We would like to see more involvement of English fishers in Cefas's science.
- F11. The tagging work has produced some excellent results but now that the technology is producing a wide range of tag types it would be good to see well defined hypotheses steering further tag developments.
- F12. Cefas should be clearer about the range of collaborative activities in which they are engaged. They should demonstrate more proactively how work is coordinated across different institutions.
- F13. We were concerned that several key staff have left the Fisheries Division over the last few years. This raises questions concerning staff retention and succession planning.

Appendix G – Members of the Cefas Science Advisory Committee

Professor Kevin Chipman	University of Birmingham
Professor Nick Owens (Chair)	Sir Alistair Hardy Foundation (as of 1 August 2012) previously British Antarctic Survey
Dr Miles Parker	Director of Science and Deputy Chief Scientific Adviser, Defra
Professor John Rees	Natural Environment Research Council
Dr Alex Scott	Fisheries and Wildlife Department, Michigan State University (and Cefas Emeritus Fellow)
Professor John Shepherd FRS	National Oceanography Centre, University of Southampton
Professor Andrew Watkinson	Director, Living With Environmental Change