Marine Scotland Science / Science Advisory Board

Annual Report to the Marine Scotland Board

2011 – 12

The Scottish Government
Riaghaltas na h-Alba

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MARINE SCOTLAND SCIENCE / SCIENCE ADVISORY BOARD

Annual Report to the Marine Scotland Board

2011-12

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INTERFLON

// STATEMENT BY THE HEAD OF SCIENCE

Marine Scotland came into existence in 2009 with the amalgamation of **Fisheries Research Services**, the **Scottish Fisheries Protection Agency** and the **Scottish Government Marine Directorate**. During the second year of Marine Scotland, a review of Marine Scotland Science was conducted and one of the recommendations was that an annual report from the Head of Science and the Chairman of the Science Advisory Board (established in April 2010) should be presented to the Marine Scotland Board. This report, covering the period 1 April 2011 to 31 March 2012 is the first of these reports. This period coincides with my appointment as Head of Science for Marine Scotland following the retirement of Professor Robin Cook. During this last year there have been some significant developments in our science delivery – the areas of marine renewable energy and marine spatial planning have been consolidated by the appointment of a Science Programme Manager for each of the two science programmes created as part of the matrix management system. At the same time, some of our more traditional areas of science – sea fisheries for example – have been impacted by staff moving to new areas, but new funding has permitted recruitment to ensure an appropriate level of fisheries science is still undertaken.

During times of fiscal constraint there has been a need to ensure that **Marine Scotland Science (MSS)** works as efficiently as possible. However, the demand for marine science has grown considerably in recent years – the **Marine Strategy Framework Directive**, review of the **Common Fisheries Policy**, plans for the further **development of the aquaculture industry**, the establishment of a successful **Scottish offshore renewables** industry and development of a **National Marine Plan**, which requires spatial planning at a variety of scales, have all demanded new science, both natural and social. As such, considerable effort was devoted to securing a reasonable headcount as part of the Workforce 2015 agreement. Staff are our most important asset and as we move to implement the **Scottish Government People Strategy**, there is a need to ensure that we genuinely manage our workloads, engage with our staff and provide them with the most appropriate working environment. Over the last year this has been a challenge. Achieving Practical Completion of the **Ellis Building** soaked up considerable staff resource and the delays impacted on both staff morale and science delivery. At the time of writing I am able to report that Practical Completion has been achieved, but this represents simply another step, albeit a significant step, in the delivery of this state-of-the-art facility. **Provision of a reliably-functioning IT system** has been a frustration for many staff.

Additional funding secured during the year has provided an improved infrastructure, but there remains some way to go in terms of delivery of a fit for purpose IT system. The data storage requirements of MSS are significant, especially given the need for seabed survey data. The consequence of such storage only being available in the **Off Scots Environment (OSE)** is significant and the revised scheme is built around the premise that the bulk of MSS data will have to be stored in the OSE.

MSS has continued to deliver high quality science and advice on a diverse range of marine issues as well as undertaking statutory and regulatory duties on behalf of Scottish Ministers. Prioritising where MSS devotes the available resources has resulted in a decline in research and development. That said, MSS has successfully maintained some of the long-term monitoring programmes that are so critical to marine assessment. The **Scottish Marine Science Strategy 2010–2015** prioritises understanding the functioning of marine and freshwater ecosystems and environmental change. Both require scientific data relating to the most important natural physical and chemical properties of aquatic ecosystems, especially those sensitive to climatic change. The continued monitoring at **Stonehaven** and **Loch Ewe**, across the **Faroe Shetland Channel** and along the **Jonsis line** have all provided further data points on our long-term time series. Equally relevant is the data gathered as part of the **UK Acid Waters Monitoring Network**, the **Clean Seas Environment Programme** and the **International Bottom Trawl Surveys**. The collection of such data is hugely reliant on the expertise of our scientists and engineers – our purpose designed equipment allows MSS to lead in several areas of marine science. At the same time, some of our science is supporting the daily work of the **Fish Health Inspectors**. MSS really is an eclectic mix of talent and expertise as befits an organisation with such a diverse range of activities, be it inspections, implementing regulation, undertaking field work such as market sampling, responding to marine emergencies, performing frontline research, replying to Freedom of Information enquiries, mending our nets, writing the weekly marine briefing, overseeing an extremely complex and hectic ships programme, briefing stakeholders, and so the list goes on. Ultimately, what is important is that all MSS staff genuinely see where their contribution is making a difference as well as helping deliver **Scotland's Marine Vision**.

All the work that MSS undertakes must be built on a sound business platform. The recruitment of a Business Manager has greatly facilitated an improvement in the business processes of MSS. The integration of core Scottish Government processes and procedures into the everyday working of MSS has required considerable time and resource. In some cases, however, MSS has acted as the 'guinea pig' for the development

and implementation of new SG processes. In a similar manner, our quality processes and data management are absolutely fundamental to the provision of high quality advice. Another successful **UKAS** visit was recorded with renewed accreditation of the 43 currently accredited MSS methods. At the same time, the implementation of the **laboratory information management system (LIMS)** is a welcome advancement in how we operate and I very much appreciate the effort of staff in respect of this development at MSS.

A close working relationship has developed between MSS and the **Science Advisory Board (SAB)** which is an essential component of an effective science programme. The SAB is now integral to the planning process and will undertake reviews of the quality of the science being conducted by MSS. Ensuring that MSS science is objective and impartial is essential, and the SAB can provide such assurance.

Scotland has an exceptional marine environment and MSS is charged with delivering the required science, often in collaboration with academic, national and international colleagues, that should ensure the efficient and effective sustainable management of our seas. As I look back over the last year I see a group of dedicated staff working hard to deliver robust science and timely and relevant scientific advice. We are at the forefront in many areas, we are leading in key scientific developments and we are making fundamentally important assessments of the status of our seas, the human pressures and, ultimately, the value of these seas to Scotland.

Prof Colin Moffat
Head of Science
30 August 2012

// STATEMENT BY THE CHAIRMAN, SCIENCE ADVISORY BOARD

The Science Advisory Board (SAB) has three principle functions:

- Ensure that the science undertaken my Marine Scotland Science is objective and impartial
- Oversee the quality of Marine Scotland Science
- Provide independent advice to Marine Scotland on science priorities

These oversight functions are a critical part of the delivery of robust science and advice to Marine Scotland, the wider Scottish Government and other Departments and organisations to which MSS provides advice. During this last year we have reviewed the proportion of spend on research versus monitoring / surveillance, advised on the science priorities, been involved in the science planning process, and commented on the quality and resourcing of the current six science programmes.

One of the key challenges for the SAB has been to better understand the complexity of tasks that MSS undertakes as well as the breadth of science covered by the various science programmes. I and fellow Board members have taken the opportunity to visit Aberdeen and Faskally and see, at first hand, the science being undertaken 'at the bench'. Hearing directly from the scientists and engineers has given us considerable insight into the work being undertaken by MSS as well as seeing at first hand the genuine enthusiasm that MSS staff have for their work.

Sustained scientific quality is critical, not only for MSS's national/ international reputation for science excellence but, fundamentally, in its ability to provide Scottish Ministers with the evidence on which to formulate sound policy and support rational decision-making. For SAB, this involves a critical appraisal of the outputs from MSS, as well as a detailed consideration of the resource prioritisation. As such, we have put in place a process to systematically review, over a 12-month period, each of the six science programmes. This will be an on-going process and I envisage a strong synergy between this process and the input that SAB will continue to make to the future planning and prioritisation of MSS.

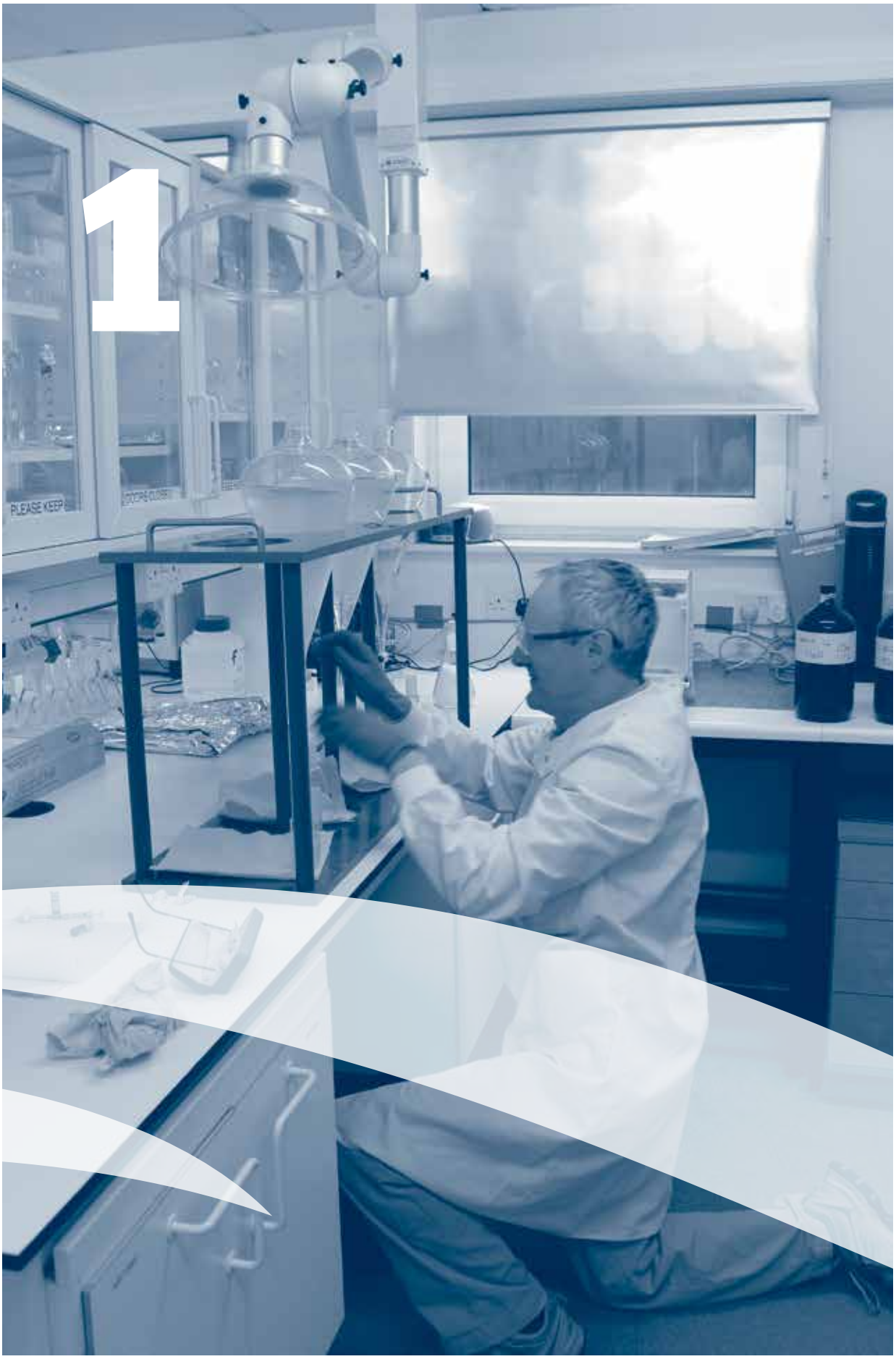
MSS operates in areas of science where scientific uncertainty can often arise and where there is the potential for scientific data to be interpreted in a variety of ways by different stakeholders. During this last year the SAB provided advice on the scientific quality, objectivity and impartiality of a specific project from the Freshwater Fisheries programme.

Input from Marine Scotland's diverse group of stakeholders is an essential part of the process for determining science priorities and their resourcing. As such, during the past 12 months, I have met with many of these key stakeholders to hear directly from them about the quality and relevance of MSS.

As a co-author to this report, it has been my pleasure and privilege to have had the opportunity with my fellow SAB colleagues to work closely with the new Head of Science, Professor Colin Moffat and his team on reviewing the annual performance of MSS. The processes that we are initiating will permit balanced reflection and the systematic consideration of key issues and should, over time, permit improved planning and the determination of a strategic direction for future years.

The continued ability of MSS to provide a strong evidence base for the management of Scottish seas is critical if Scotland is to make best use of this resource such that it is developed sustainably for the benefit of current and future generations.

Dr George M Paterson, CBE
Chairman, Science Advisory Board
30 August 2012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// PURPOSE OF MARINE SCOTLAND SCIENCE

Marine Scotland Science (MSS) is a multi-site, multi-functional Division of Marine Scotland (Figure 1.1), the lead marine management organisation for Scotland with the mission:

To manage Scotland's seas for prosperity and environmental sustainability.

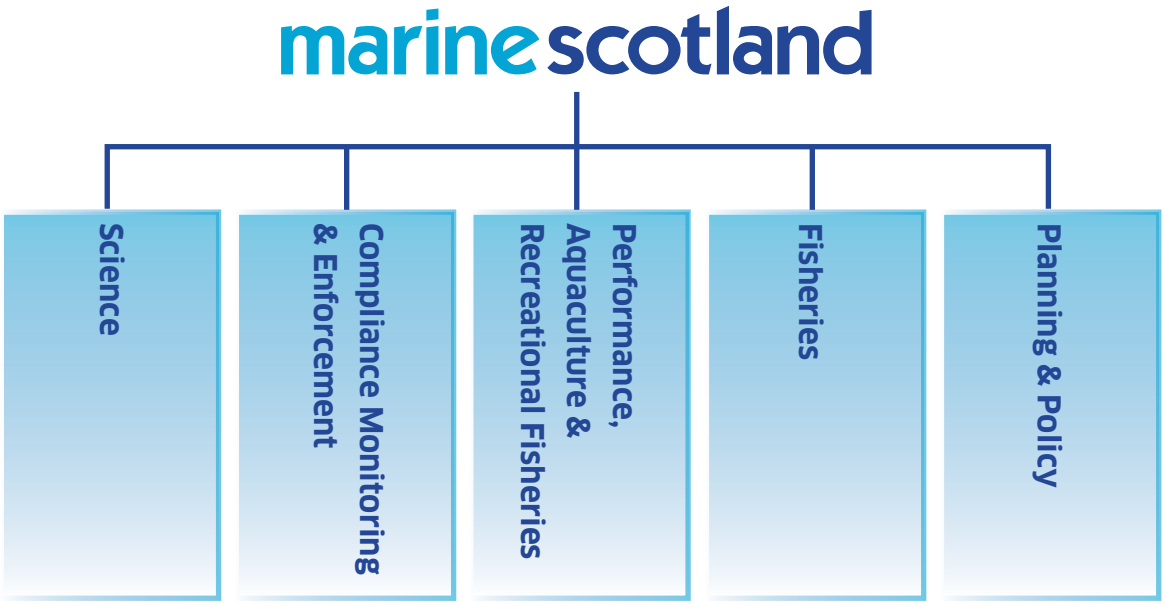

FIGURE 1.1
STRUCTURE OF MARINE SCOTLAND, WHICH COMPRISES THREE POLICY DIVISIONS (PERFORMANCE, AQUACULTURE & RECREATIONAL FISHERIES, FISHERIES AND PLANNING & POLICY), TOGETHER WITH COMPLIANCE MONITORING & ENFORCEMENT AND SCIENCE.

Marine Scotland Science is working closely with the other Divisions of Marine Scotland, as well as with stakeholders and partner bodies, towards a shared Marine Vision of:

'Clean, healthy, safe, productive, biologically diverse marine and coastal environments, managed to meet the long term needs of people and nature'

Thus, Marine Scotland Science, as a primary source of evidence and information, is key to delivery of both the mission and Marine Vision. MSS has a key role in the provision of integrated scientific information (both natural and socio-economic) to the relevant Policy Divisions across Marine Scotland, as well as other Scottish Government

MARINE LABORATORY – ABERDEEN

FRESHWATER LABORATORY – PITLOCHRY

FRESHWATER LABORATORY
FIELD STATION– MONTROSE

FRESHWATER LABORATORY
FIELD STATION– SHIELDAIG

MARINE ANALYTICAL UNIT – VICTORIA QUAY, EDINBURGH

FIGURE 1.2

LOCATIONS WHERE MSS STAFF ARE PERMANENTLY LOCATED.

Departments, UK Government Departments, the European Commission, and international bodies such as the International Council for the Exploration of the Sea (ICES), the OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic and the North Atlantic Salmon Conservation Organisation (NASCO). Staff are permanently located at a total of five sites (Figure 1.2). The MSS Marine Laboratory is in Aberdeen, while the MSS Freshwater Laboratory is located on the shores of Loch Faskally with field stations at Montrose and Shieldaig. The Marine Analytical Unit, which provides the socio-economic input, is situated in Victoria Quay, Edinburgh.

The science that MSS conducts is guided by:

- *The Scottish Government Business Strategy and associated National Outcomes*
- *National Regulations*
- *International Regulations (e.g. EU Directives) and agreements (e.g. OSPAR Decisions)*
- *The requirements of the Marine Scotland Policy Divisions*
- *The UK Marine Science Strategy*
- *The Scottish Marine Science Strategy 2010–2015* (Figure 1.3)
- *The Focus on Freshwater Science* (Figure 1.3)
- *Input from stakeholders*

FIGURE 1.3
THE SCOTTISH MARINE SCIENCE STRATEGY 2010-2015 AND THE FOCUS ON FRESHWATER SCIENCE.

At the same time, there is a need to ensure that the science which enables there to be an understanding of how marine ecosystems operate, how they are changing and how man is influencing these changes, is being done. This requires, amongst other science, the maintenance of long-term time series for which there is the appropriate storage of the data.

In order to ensure appropriate management of our seas, MSS must be able to access data and information generated by others undertaking research and monitoring in Scottish waters. In addition, MSS must ensure that there is good collaboration with organisations such as the Scottish Environment Protection Agency (SEPA), Scottish Natural Heritage (SNH) and the academic institutes within the Marine Alliance for Science & Technology Scotland (MASTS) as well as relevant UK and International bodies (Figure 1.4). Furthermore, it is fundamental that MSS works closely with stakeholders, including the many industries, communities and individuals for whom the seas are a source of living as well as for those for whom the seas give much enjoyment. Through appropriate planning and implementation of the science programme, together with relevant collaboration, Marine Scotland Science will deliver its overall purpose which is:

- *To provide integrated and well managed advice contributing to the management of Scotland's seas for prosperity and environmental sustainability*

- *To conduct an effectively managed programme of robust science (natural and social) that is respected, relevant and responsive.*

FIGURE 1.4
MSS MUST HAVE GOOD COLLABORATION WITH ORGANISATIONS INCLUDING MASTS, SNH AND SEPA.

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// FOCUSSING ON SCIENCE LEADERSHIP

The Matrix Approach

Marine Scotland Science is about generating evidence and delivering advice based on robust science. The marine science landscape is complex. As the ecosystem-based approach to marine management becomes more central to how we manage our seas, there is a need to respond to the changing landscape and to Policy driven demands. At the same time, we need to ensure that there is sufficient stability in programmes and line management to allow top quality science to emerge and staff to develop to their full potential. MSS has to be more flexible in its working arrangements and able to adapt to the changing demands whilst ensuring that core research and monitoring programmes are retained. As part of the process of making MSS more responsive, a matrix management system was adopted during 2011-12 (Figure 2.1). This approach provides clear scientific leadership of the six science programmes and allows for changes in the programme structure while keeping the team structure constant. The process is administered through the **Science Management Team (SMT)** and the **Science Programme Management Group (SPMG)**. The **SMT**, which comprises the **Science Team Leaders, Business Operations Team Leader** and the **Head of Science,** oversees resource management, business planning, budgets, line-management, staff reporting and staff development. The **SPMG**, which comprises the **Science Programme Managers, Science Teams Leaders** that are not programme managers, **Business Operations Team Leader** and the **Head of Science**, has a focus on science delivery, science strategy, science aims and objectives and science targets and milestones. A key aspect to the SPMG meetings is that each meeting has a focus on a specific science programme with the relevant Programme Manager leading presentations and demonstrations on the science being generated by the programme. This includes active laboratory demonstrations by staff and gives the SPMG an opportunity to interact with the staff conducting the science.

At the end of March 2011, a review of Marine Scotland Science and Policy Integration was published[1]; this Annual Report is one of the outcomes of this review. The 20 recommendations of the review were considered by the **Science Programme Management Group, the Science Advisory Board** and the **Marine Scotland Board**. Overall, aspects of all the recommendations have been implemented (see Appendix 1) as part of the process of ensuring improved policy/science integration, a stronger focus on science delivery, more effective resource allocation and development of more appropriate business management processes. Over the last year there has been a much closer working relationship between the various components of Marine Scotland; Science, Compliance and Policy. This process has been facilitated by presentations to staff and is yielding considerable benefits.

The Science Advisory Board

The Science Advisory Board (SAB) is an integral part of ensuring that the science undertaken by Marine Scotland Science is objective and impartial. Chaired by Dr George Paterson, the SAB membership reflects the breadth of the science being undertaken

[1] SINCLAIR, L. (2011) REVIEW OF MARINE SCOTLAND SCIENCE AND ASSOCIATED POLICY INTEGRATION: FINAL REPORT MARCH 2011, 21pp.

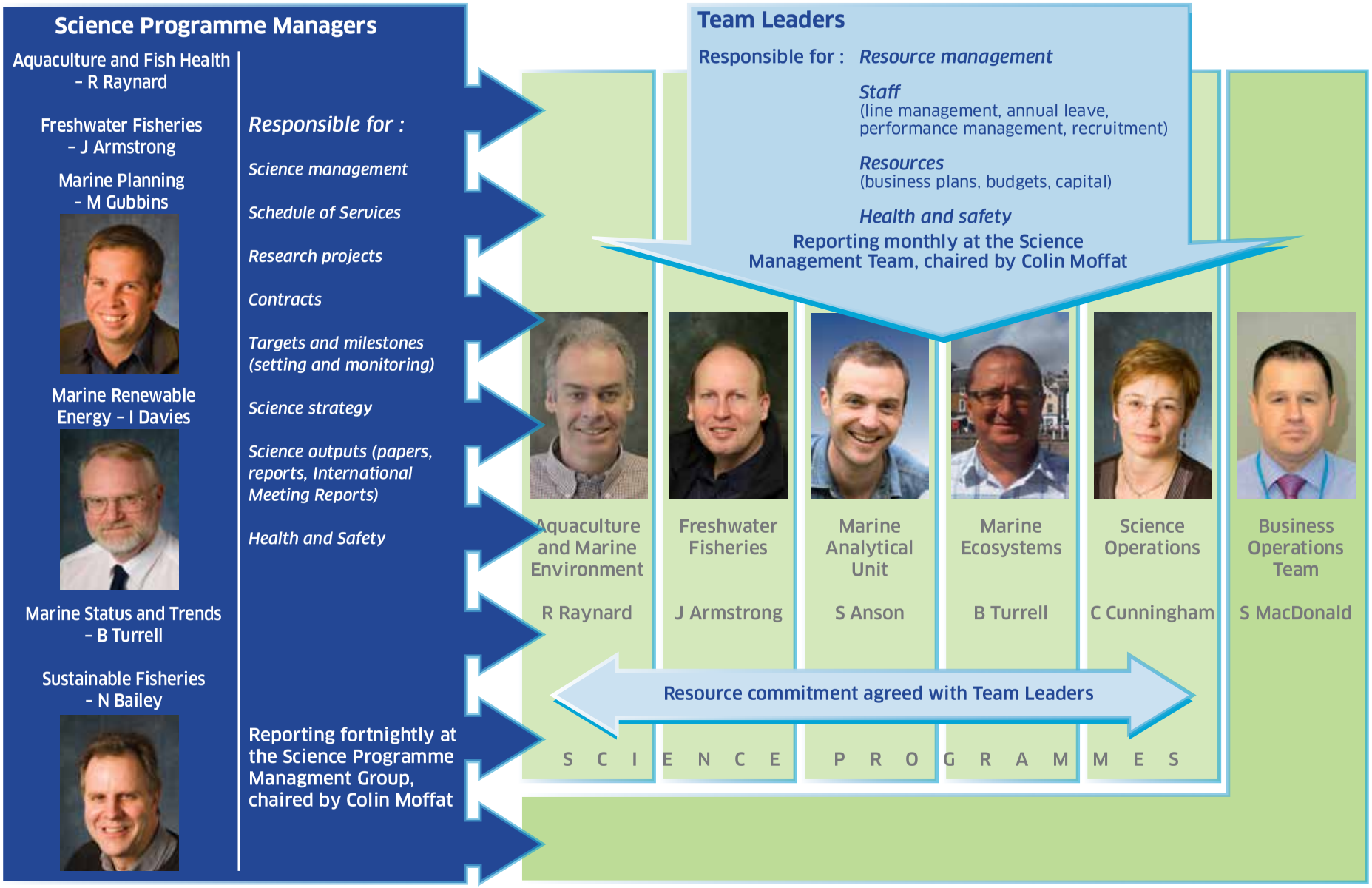


FIGURE 2.1
MSS MATRIX MANAGEMENT STRUCTURE IMPLEMENTED TO MAKE MSS MORE RESPONSIVE TO CHANGING DEMANDS AS WELL AS PROVIDING CLEAR SCIENCE LEADERSHIP.

by MSS. The SAB (Figure 2.2) met three times last year both with the members of the Science Programme Management Group and in private session. As highlighted in the Chairman's Statement, the SAB reviews the science programmes on a rolling basis, covering each science programme annually. The Chairman also attends meetings that constitute part of the science planning process as well as sitting on the Marine Scotland Board; this affords the Chairman direct access to the Director of Marine Scotland.

CHAIRMAN
DR GEORGE M PATERSON

In 2000 George set up the Scottish arm of the Food Standards Agency where he was responsible for the development and delivery of the Agency's programmes in Scotland. George was awarded the CBE for his services to the food sector in the New Year Honours in 2008.

PROF GEORGE GETTINBY

Prof George Gettinby is a statistician and mathematical modeller at the University of Strathclyde. His specialist marine interests have been in the control of sea lice infestations.

PROF FELICITY A HUNTINGFORD

Prof Felicity A Huntingford recently retired from the University of Glasgow. She has extensive experience of research into behaviour and life history patterns in fish and other aquatic organisms.

PROF SELINA STEAD

Prof Selina Stead from Newcastle University has 18 years experience in research, education and consultancy in marine resource management, specialising in coastal governance, socio-economics and scientific support for policy.

PROF WILLIAM RITCHIE

Prof William Ritchie is founding Director of the Aberdeen Institute for Coastal Science and Management (University of Aberdeen). He is currently involved with research in coastal geomorphology, oil spill response and coastal zone management.

PROF PAUL J B HART

Prof Paul J B Hart of the University of Leicester has an extensive background in Ocean Science and has submitted over 70 peer-reviewed papers in addition to co-authoring the following publications: The ecology and fisheries of seamounts, Handbook of fish biology and fisheries.

PROF PAUL THOMPSON

Prof Paul Thompson has a Personal Chair in Zoology in the University of Aberdeen's School of Biological Sciences, and is Director of the University's Lighthouse Field Station in Cromarty. His main interests are in the ecology and conservation of marine systems.

FIGURE 2.2
THE SCIENCE ADVISORY BOARD ENSURES THAT THE RESEARCH AND MONITORING UNDERTAKEN BY MSS IS OBJECTIVE AND IMPARTIAL.

An Outward Focus

Marine Scotland Science generates a vast amount of information, and as with any science institute, MSS scientists publish much of their work in the peer-reviewed scientific literature. However, it is increasingly important that we communicate in a more direct manner with as many of our peers as possible and also with our stakeholders and the wider public. During 2011-12, MSS staff gave around 60 presentations at both national and international meetings (see Appendix 2). In addition, staff provided input to 113 ICES Working Groups as well as to OSPAR Committees, STECF[2] working groups and plenary meetings and other inter-Governmental meetings. MSS also hosted a considerable number of meetings with representatives from the fishing industry, the renewable energy industry and the aquaculture industry. However, MSS also took the plunge into the uncharted waters of 'Science on a Plate' and GLOW, Scotland's national intranet for schools. Addressing over 1,500 primary school pupils located across Scotland generated over 600 questions on topics as diverse as whether or not a whale had a tummy button to the name of the smallest animal in the sea. Answering some of these questions live on-line was a challenge for John Dunn and Colin Moffat, but thanks to input from Ruth Allen, every question was answered over the following week. Rob Raynard and Nick Bailey went out for a meal with a difference when they attended an event on the RRS *Discovery* in Dundee. As scientists at the dinner table, they provided information to journalists and environmentalists on the sustainability of what they were eating. Matt Gubbins joined forces with the celebrity chef Nick Nairn at the Royal Botanic Gardens in Edinburgh where they presented four sessions on fish and shellfish from Scottish aquaculture with Matt providing the science and Nick Nairn cooking mussels and salmon for the audience to sample. Nick Bailey teamed up with Stephen Frost to demonstrate the value of wild fisheries as a food product. Finally, Colin Moffat joined the Aberdeen finalists in the Student Chef Challenge when he sampled the four sustainable Scottish menus, which were balanced, nutritious and healthy. Sustainability was the theme that influenced the design of the menu with the chefs providing an account of the basis for their menu selection and the source of their ingredients. Such events take the science to the public and it is intended that these activities will be expanded in future years.

SCIENTISTS AT THE GLOW EVENT

[2]STECF – SCIENTIFIC TECHNICAL AND ECONOMIC COMMITTEE FOR FISHERIES – PROVIDING ADVICE TO THE EU

An Insight to the Science Delivery

The six science programmes have responsibility for the delivery of all of our science activities through a mixture of programme-specific Schedules of Services, research projects and contracts. Both the Marine Analytical Unit and the Science Operations Team contribute actively to this delivery, as does the Business Operations Team. Key aspects of the work conducted by each of the science programmes are presented below together with some additional insight into the functioning of the Marine Analytical Unit, the Science Operations Team and the Business Operations Team.

Aquaculture and Fish Health – Fish Health Inspectorate

The Fish Health Inspectorate (FHI) are responsible for the completion of a programme of sampling and inspection visits of Scottish aquaculture production businesses. These visits ensure that aquaculture production sites are compliant with Scottish, British and European legislation or may be a follow-up to a previous disease event such as Infectious Salmon Anaemia (ISA). In respect of the routine operation of the FHI, 195 risk based inspections were completed, contributing to the maintenance, by the United Kingdom, of approved zone status for listed diseases. This allows the UK to limit where imports are sourced from, maintaining the UK's high health status, whilst allowing our businesses to trade freely with most other parts of the world. The Aquaculture and Fisheries (Scotland) Act 2007 requires businesses to take measures to control sea lice and minimise the risk of farmed fish escaping from containment. Two hundred and nine (209) containment inspections and 126 sea lice inspections were completed to ensure compliance with this legislation.

MSS offers a free diagnostic service to the Scottish aquaculture industry; the FHI are responsible for the collection of information and samples for the completion of these diagnostic investigations. Fifty diagnostic investigations were completed. No listed diseases were diagnosed, but several viral, bacterial and parasitic infections were recorded.

A FISH HEALTH INSPECTION UNDERWAY IN THE FIRTH OF LORN

The FHI undertake a contract on behalf of the Veterinary Medicines Directorate to collect samples for the National Surveillance Scheme, which involves the Food and Environment Research Agency screening fish muscle samples for veterinary medicines residues – 1,421 samples were collected in pursuance of this contract.

An outbreak of Infectious Salmon Anaemia (ISA) occurred in the Southwest Shetland Mainland area of Scotland in 2009. Work continued during 2011-12 to clean and disinfect sites affected, ensure that fallow periods were completed, that the fish used to repopulate the sites were from approved farms and that no re-emergence of the disease had occurred. All stocked sites in the area were visited during their growing period, with 450 fish from each site being tested for the presence of the ISA virus. Fish being moved out of the area for slaughter and processing were required to be certified, resulting in over 150 inspections being carried out. As a result of the work carried out, a submission to the European Commission seeking approval for freedom from ISA was made in late winter 2011, with the programme of work being approved soon thereafter. The whole of the United Kingdom is, once again, free of ISA and can recommence trade from the whole of the approved zone.

Freshwater Fisheries – *Environmental Monitoring*

As part of the UK Acid Water Monitoring Network, MSS Freshwater Laboratory has recorded water chemistry and associated salmon and trout population data at a geographically and environmentally diverse range of sites over several decades. Data from a complementary site in the Loch Ard area of south central Scotland has also been recorded to assess changes in water quality and fish populations associated with a range of forestry practices. Recently, analyses of these data have been published in order to inform debate on future forestry practices and revise environmental standards for acidity under the EU Water Framework Directive (WFD).

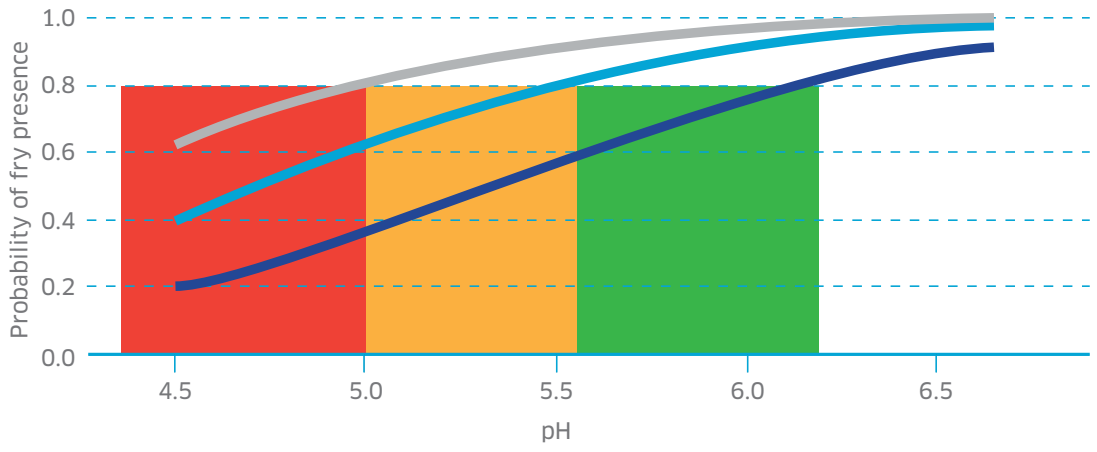


FIGURE 2.3

PROBABILITY OF FINDING TROUT FRY IN AT LEAST 1 (———), 2 (———) OR ALL 3 (———) SECTIONS OF A RIVER FOR A GIVEN pH, WHEN 3 SECTIONS ARE FISHED. GREEN-AMBER-RED BANDS INDICATE PROPOSED CHEMICAL BOUNDARY THRESHOLDS ASSOCIATED WITH HIGH/GOOD, GOOD/MODERATE, AND MODERATE/POOR CLASS BOUNDARIES FOR FISH POPULATION STATUS.

This process has provided objective manageable assessment criteria that directly relate the presence of fish to specific quality classification bands (Figure 2.3) and allows the relationships between pH and the probability of finding trout fry in a number of stream sections (reaches) in a given river to be investigated (Figure 2.3). This approach can be used to produce variably stringent environmental standards which can then be related to environmental status under the WFD. For example, the green-amber-red bands in Figure 2.3 were used to propose the pH that is associated with three status boundaries for fish population status: high/good, good/moderate and moderate/poor. The proposed thresholds are now being used to revise WFD environmental standards. Furthermore, the combination of revised standards and information on the effects of forestry on acidification and recovery is being used to inform debate on whether second phase forestry is advisable in areas where acidification pressures are preventing water bodies from achieving good ecological status under WFD. This work is an example of how appropriate long term data, coupled with an understanding of the underlying processes, can underpin sound management of Scotland's resources. The project has demonstrated that both the application of advanced statistical tools and focus on achieving high quality monitoring are required to develop sound management models.

Marine Renewable Energy – *Planning for Offshore Wind Farms*

The Scottish Government (SG) has set a range of challenging targets for renewable energy. These recognise the potential to take advantage of the extensive marine energy resources (wind, wave and tidal power) available in Scottish waters and include meeting at least 30% of our total energy demand from renewable sources by 2020. To assist in meeting these targets, SG has adopted a sectoral planning approach for offshore renewable energy, seeking to identify preferred development areas, and then move to a more formal Sectoral Development Plan through a process that includes Strategic Environmental Assessment.

A review of the process used to identify preferred development areas in the current Plan concluded that, as additional data and monitoring information, and improved data handling procedures, became available, these should be incorporated into the emerging iterative marine planning process, and extended into waters beyond the 12 mile limit.

WIND TURBINES AT ROBIN RIGG

A Scoping Report has been developed of the potential for offshore wind development in Scottish waters out to 200 nautical miles. Working with The Crown Estate and their spatial modelling tool Marine Resources System (MaRS), the exercise aimed to balance opportunities with many aspects of constraints on development both within Scottish Territorial Waters (STW; Figure 2.4) and Scottish seas outside STW.

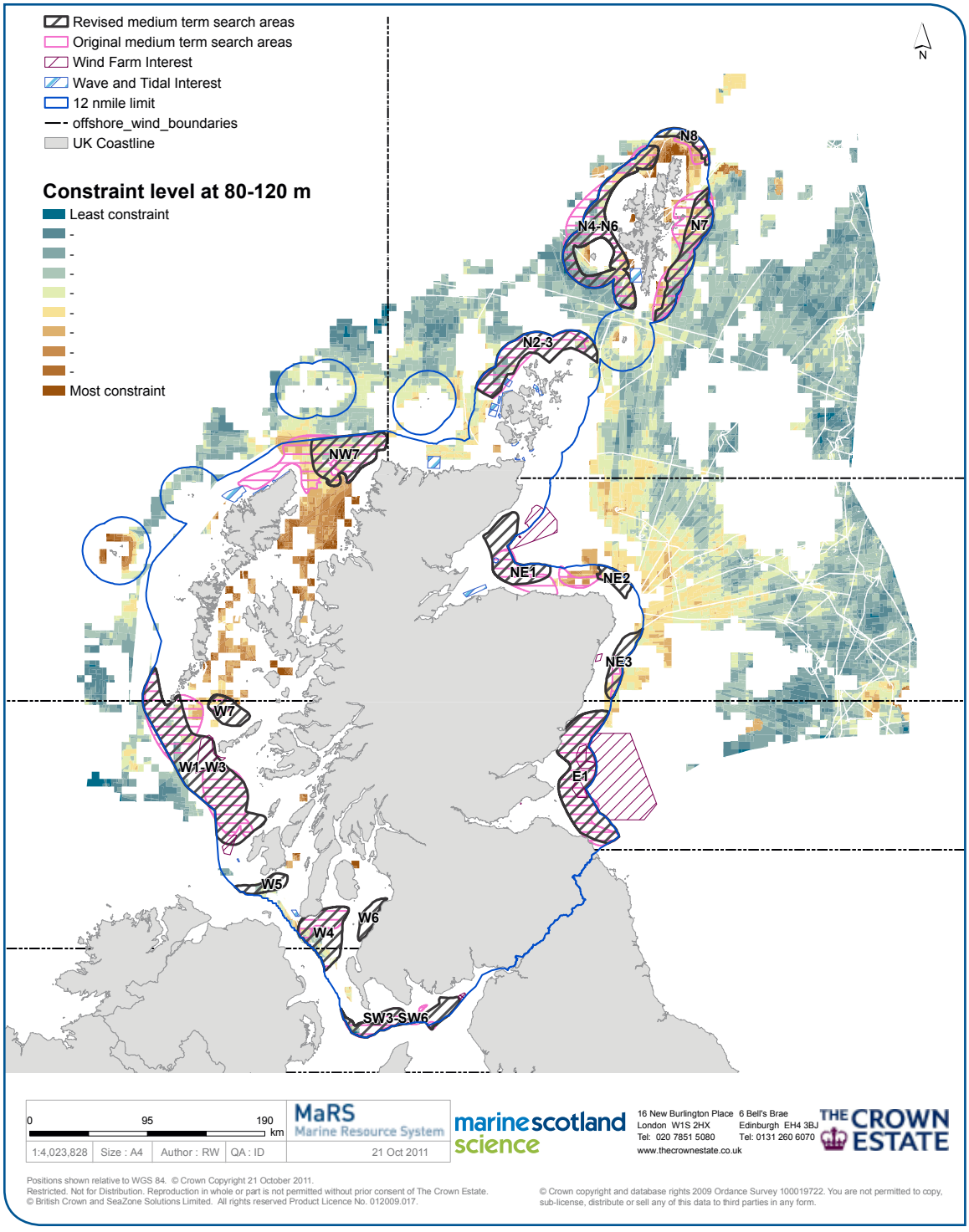


FIGURE 2.4

OFFSHORE WIND PLAN SEARCH AREAS WITHIN SCOTTISH TERRITORIAL WATERS (STW), EXISTING STW AND ROUND 3 OFFSHORE WIND SITES, THE 12 MILE LIMIT (BOUNDARY TO STW) AND THE EXTENSIVE AREAS OF WATERS OUTSIDE STW WITH 80-120 METRES WATER DEPTH AND OPPORTUNITY FOR FLOATING WIND FARM DEVELOPMENTS.

Sea areas outside STW generally have greater depths of water, and also generally lower levels of constraint. Potential search areas outside STW are therefore structured around depth zones. Particularly interesting are the large areas of water of 80 – 120 m depth. These areas are not currently amenable to fixed foundation wind turbine structures, but are suitable for the emerging generation of floating turbine systems. Very extensive areas in this depth range are found in the Scottish waters in the North Sea (green and yellow areas outside 12 nm in Figure 2.4).

The outputs from this study will inform the marine planning process by leading to the development of Regional Locational Guidelines for offshore wind development, which in turn will be the basis for a Sectoral Plan Review and SEA to cover wind farm development in Scottish waters.

Marine Spatial Planning – 2011-12 Survey work to support the selection of Scottish Marine Protected Areas

In order to support the Scottish Marine Protected Area (MPA) project, MSS provided the MPA Board, JNCC and SNH with scientific advice on the distribution of certain Priority Marine Feature (PMF) habitats and species, determined to be of conservation importance. These data formed part of an evidence base that was used to select 'search areas' for potential MPAs. Many of these search areas were than surveyed in more detail to provide information on the distribution of PMFs to further refine the boundaries of search areas and help decide whether they should be taken forward as proposed MPAs.

HORSE MUSSEL *(Modiolus modiolus)*, A SPECIES OF CONSERVATION IMPORTANCE © SUE SCOTT

MSS staff and vessels provided a platform to enable the surveys of many of the MPA Search Areas during May to October 2011 (Figure 2.5). Survey methods such as swathe bathymetry, towed underwater video, grab sampling and deployment of fish traps were used to record the presence of PMF habitats and species across search areas. MSS led five research cruises on board the MRV *Scotia* and MRV *Alba na Mara* with JNCC and SNH staff to search areas in the Minches, West of the Hebrides, Northern North Sea, Moray Firth and Solan Bank. These surveys have provided useful data on bathymetry and benthic habitats as well as the occurrence of a wide variety of PMF features, including the discovery of one of the most extensive horse mussel (*Modiolus modiolus*, a species of conservation importance) beds in the UK off Noss Head near Wick.

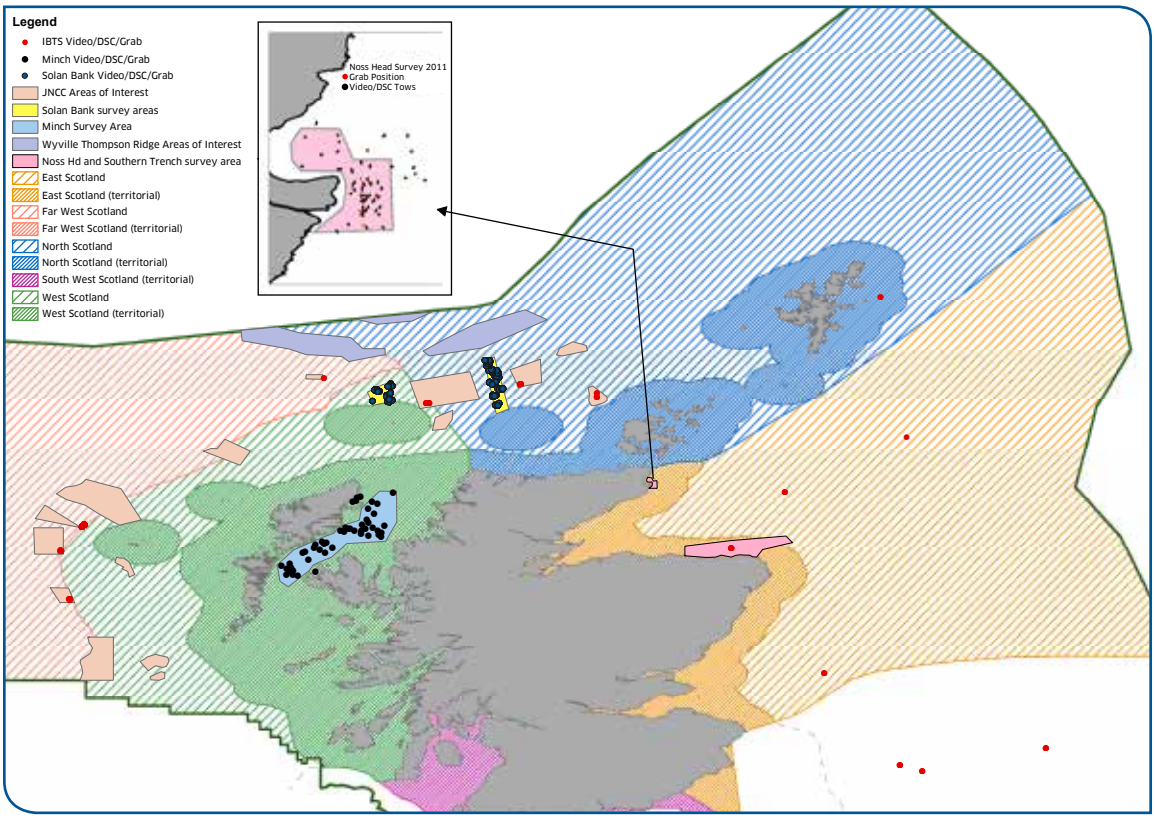


FIGURE 2.5

LOCATIONS OF THE MPA SEARCH AREAS (SHOWN WITHIN SHADED WIDER MPA REGIONS) SURVEYED USING MSS RESEARCH VESSELS DURING 2011. POINTS SHOW THE PRECISE LOCATIONS OF TV TOWS ETC AND THE INSET SHOWS THE LOCATIONS OF SURVEY WORK AROUND THE EXTENSIVE NOSS HEAD HORSE MUSSEL BEDS.

Sustainable Fisheries – Demersal fish market sampling

The MSS catch sampling schemes are designed to provide a sample of the main commercial fish and shellfish species landed into Scottish ports or discarded by the Scottish fleets. The market sampling component of the programme samples the landed fraction of the catch, the at-sea observer component samples the discarded component of the catch. The primary use of these data is to provide the estimates of the numbers at age (or length), and weight at age, that are submitted to the various ICES fish stock assessment working groups each year. These groups estimate stock size, and fishery induced mortality, which informs the setting of the total allowable catch (TAC) and other management measures. The observer and market sampling schemes are stratified into three species groups: demersal, pelagic and shellfish.

Focussing on the demersal market sampling scheme, this is stratified by port; Peterhead and Fraserburgh in the North East of Scotland, Kinlochbervie on the West Coast, and Lerwick and Scalloway in Shetland. Collectively these ports account for around 70% of the fishing trips landing demersal species into Scotland, and around 80% of demersal species landings by weight. The mainland ports are visited on 40 weeks of the year by two person teams operating from Aberdeen. The two Shetland ports are visited on 36 weeks of the year by teams from the NAFC Marine Centre based in Scalloway. Most demersal sampling is directed at the species of commercial importance; cod, haddock, whiting, saithe, megrim, monkfish and hake, all of which are subject to full analytical assessment each year. Other species, which may be of less commercial importance or are less frequently landed, are sampled according to a sampling plan submitted under the EU's Data Collection Framework (DCF).

Much of the practical work of market sampling involves measuring fish, either late at night or early in the morning, at one of the main fish markets. Typically all the vessels selling fish will lay out their landings, packed in boxes spread over the floor of the market. The landings from each vessel will have been sorted by the crew into species and, within the species, into different sizes of fish. Prices at auction will vary accordingly.

The selection of unbiased samples in such a situation presents many practical problems. Random selection sheets are used to pick which vessels to sample. The sampling team then run an experienced eye over the many rows of boxes, noting where each vessel's landing starts and ends, which species have been landed, where the size categories start and finish, and, crucially, that none of the categories of big prize fish have been sold privately and are now missing. Chalk marks on the floor, and a quick word with a busy crew member, are the only aids to getting this right.

Once the vessel and species are selected, all the fish from a selected box are measured on a centimetre (cm) measuring board. For the species subject to age based assessment,

FISH BOXES ON THE MARKET FLOOR

SAMPLING AT A FISH MARKET

one fish of each length has the otolith (ear bone) extracted and carefully stored in a brown paper envelope to be returned to the laboratory for age reading. Once all the fish in a box are measured, the box is carefully repacked and iced, and returned to its position in the market, ready to be sold at auction.

At the end of the morning, the samplers will come away from the market laden with forms detailing vessels, length frequencies, numbers of boxes landed and sampled, box weights, and species, and with numerous little brown paper packets each containing an otolith. A typical morning's work will yield samples from between 3 and 5 vessels each of which could include 2 or 3 species. It is quite common to have measured 700 different fish from 10 or 15 different boxes and to have collected 100 or more otoliths, all within 2-3 hours work following a 5 am start. This routine is repeated each morning of the sampling week, each of the different ports being visited according to the sampling plan. In 2011 the samples collected for the estimates of the landed component of the main demersal species required 131,000 fish to be measured, and 19,800 otoliths to be collected and read.

At the end of each year the data submitted for the ICES stock assessments, for each of the seven main species, will typically be based on sample sizes of around 200 trips from the fisheries operating in the North Sea, and around 40 trips for those fisheries operating on the West Coast. These are broken down to provide estimates by quarter and the EU's Scientific Technical and Economic Committee for Fisheries TR1 and TR2 gear types; these broadly correspond to vessels targeting demersal fish (TR1) and those targeting *Nephrops* (TR2). Estimates are submitted with 95% confidence intervals and precision levels on numbers at length that hopefully meet the stipulations of the DCF. Ensuring the data are as far as possible unbiased and representative of the landings is increasingly important, and underpins the whole basis of the stock assessment process. To that end, measures such as the validity of probability based sampling designs, sampling levels, spatial-temporal coverage, and refusal rates are the sorts of quality indicators that are increasingly becoming a required part of the standard data submissions.

AN OTOLITH (EAR BONE)

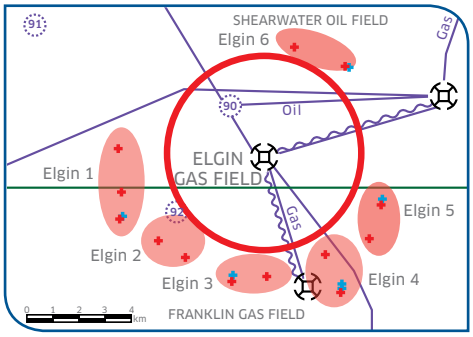
PLACING OF AN OTOLITH IN THE PAPER ENVELOPE

Challenges for the future within the market sampling include getting better estimates of the scale and characteristics of the fish sold privately (i.e. those consigned directly from vessels to private buyers and so not accessible on the markets). There is also a need to improve the selection of species sampled so that both the important commercial species and the dynamics of our ever changing fisheries are reflected in the samples obtained.

Marine Status and Trends – Responding to Incidents

On the 25 March 2012 an incident occurred on the Elgin/Rowan Viking installations operated by Total approximately 130 miles east of Aberdeen. A well control problem resulted in a gas and condensate release. Although the principal leaking hydrocarbon was the gas, and hence discharged into the atmosphere, there were concerns about marine pollution initially owing to the condensate falling out onto the surface of the sea.

Scientists from the Marine Status and Trends Programme sailed on MRV *Alba na Mara* from Fraserburgh on 6 April in order to carry out a sampling programme to assess if there were any environmental impacts on the fish, water and sediment from the leaking condensate. Samples were collected from 6 sites around the 2 nautical mile exclusion zone surrounding the Elgin platform complex (Figure 2.6). Samples were returned to the Marine Laboratory on 8 April.



ELGIN PLATFORM COMPLEX.

FIGURE 2.6

SAMPLING SITES FOR THE ENVIRONMENTAL SURVEY AT THE ELGIN PLATFORM, APRIL 2012. SIX SITES (ELGIN 1 – ELGIN 6) WERE SAMPLED OUTSIDE THE EXCLUSION ZONE (RED CIRCLE). THE RED CROSSES ARE THE SEDIMENT SITES AND THE BLUE CROSSES THE WATER SITES. SEDIMENT SAMPLES WERE COLLECTED AT THE START AND END OF THE TRAWL, WITH A MID TRAWL SEDIMENT ALSO COLLECTED FOR SITE 1.

Initially a sensory assessment was performed using samples of seven species of fish collected during the survey. This assessment used the Marine Scotland Sensory Assessment Panel; a unique facility to Marine Scotland Science consisting of trained panel members who taste fish and shellfish samples in order to detect taint from hydrocarbons. The sensory panel produces results much faster than any chemical analysis can provide, is sensitive to low concentrations and can be used to pre-screen large numbers of samples. No taint was detected in any of the sampled fish species from around the exclusion zone at the Elgin platform.

Subsequently, a suite of chemical analyses were applied to the water, sediment and and fish muscle samples. A set of five reports have so far been produced presenting all of the principle findings. Although some hydrocarbons were detected in the surface water samples collected around Elgin, careful interpretation of the results showed that these were not from the Elgin gas condensates but rather from another, unidentified, source (Figure 2.7).

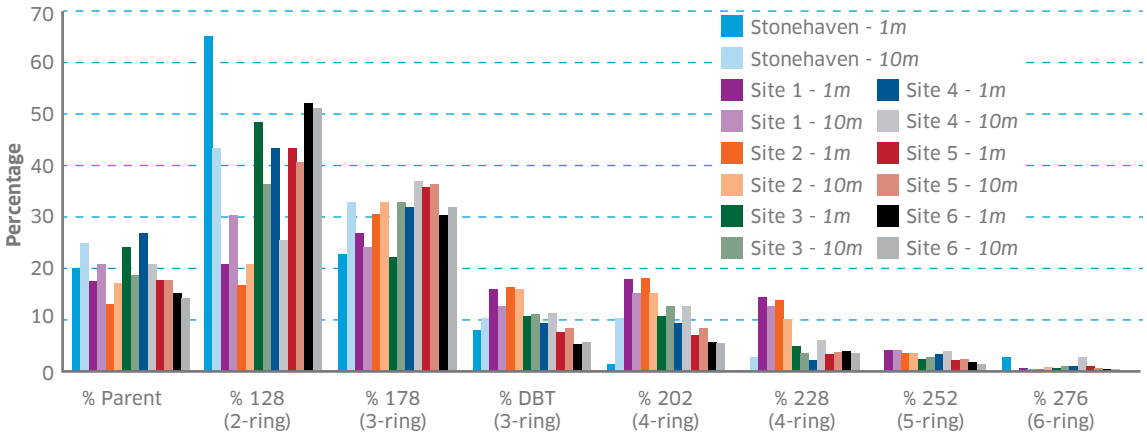


FIGURE 2.7

MEAN PAH PERCENTAGE COMPOSITION IN WATER SAMPLES COLLECTED FROM OUTWITH THE EXCLUSION ZONE PUT IN PLACE AROUND THE ELGIN INSTALLATION. SAMPLES WERE TAKEN FROM SITES ELGIN 1 (SITE 1 IN LEGEND) TO ELGIN 6 (SITE 6 IN LEGEND) AT TWO DEPTHS. (BLOCK COLOURS 1 METRE DEPTH, TINTED BLOCKS 10 METRE DEPTH) AND FROM A REFERENCE SITE AT STONEHAVEN WHICH IS SHOWN FOR COMPARISON.

Work continues on Elgin as the process to cap the well may not now be complete until October 2012. Other forms of release to the marine environment may take place during the process, and hence more environmental monitoring will be required after the well capping process is complete.

Marine Analytical Unit – Accessing Socio-economic Data

The remit of the Marine Analytical Unit (MAU) is to ensure that Marine Scotland is able to access the necessary socio-economic advice and analysis (integrated with natural science) to facilitate effective policy development and operational delivery. Amongst other priorities, it provides evidence that is used to develop policies which support the continued growth and future development of a range of existing and new key sectors, such as aquaculture, fisheries and renewable energy, which form part of Scotland's Growth Sectors. The MAU is involved in a number of projects. For example, the MAU produces an analysis on the value of the economic activity undertaken by Scotland's marine sector (Figure 2.8). This is to help inform assessment of the economic and social impact of marine planning decisions.

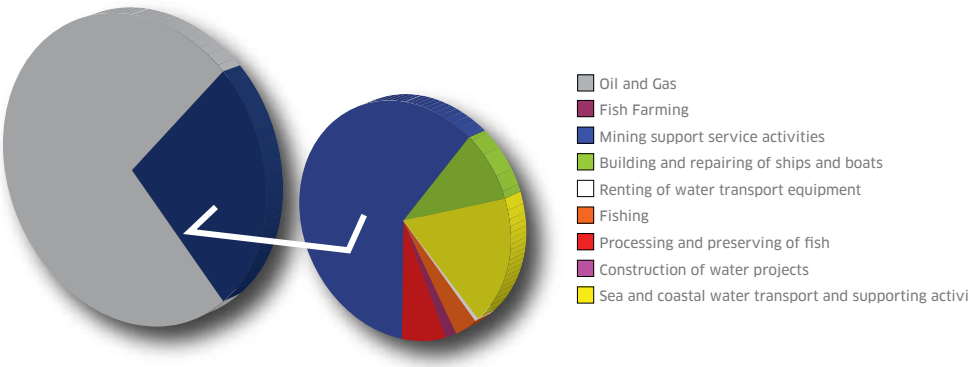


FIGURE 2.8

SHARE OF 'MARINE SECTOR' GROSS VALUE ADDED (GVA; A MEASURE OF THE VALUE OF GOODS AND SERVICES PRODUCED IN AN AREA, INDUSTRY OR SECTOR OF AN ECONOMY) BY INDUSTRY SECTOR 2009.

It is important that information is disseminated in an appropriate manner and the MAU produced and published a revamped Scottish Sea Fisheries Statistics Bulletin during 2011-12. This presents a detailed overview of landings of sea fish, the Scottish fishing fleet, and the number of sea fishermen employed. Research projects on the fully documented fisheries trial, socio-economic impacts of achieving maximum sustainable yield and a range of potential management options are part of the provision of economics to an integrated evidence base that promotes sustainable, profitable and well managed fisheries. Such research also contributes to ensuring Scottish interests and objectives, including the promotion of vibrant coastal communities, are maximised through the on-going process to reform the Common Fisheries Policy.

The MAU has worked closely this year with policy colleagues to maximise the value added to the Scottish economy via the European Fisheries Fund by facilitating the movement away from a demand led scheme towards one focussed on outcomes. This has helped ensure that funding is directed towards projects which most closely align with the SG Purpose and provide best value for money.

As well as providing valuable support on fishing, the MAU has supported the offshore renewables planning process through a series of economic and social assessments. In addition, provision of socio-economics guidance for the Marine Renewables Licensing Manual is helping to maximise the economic benefits to Scotland of offshore renewables development.

Science Operations Team – More effective use of our ships

The Science Operations Team contributes to many of the science programmes and wider delivery through providing expertise in engineering, statistics, quality management, data management, information services and ships logistics. The operation of the ship assets must be as effective as possible, maximising the opportunities for data collection. MSS, in conjunction with the wider marine community, are continually exploring ways of making our ship activities more efficient. One such way is to work across the range of users in Scotland, including SNH and SEPA. In summer 2011, as part of a research project that aims to map seafloor habitats, fish distribution and fishing activities at Rockall, a survey on MRV *Scotia* was undertaken in collaboration with SNH.

Rockall, a tiny island of just 10 metres across by 19 metres high, sits on the very extremity of Scotland's marine environment. Some 180 miles due west of St. Kilda, it is

SURFACE VIEW OF ROCKALL

Scotland's only truly offshore shallow water ecosystem. Rockall is a renowned fishing ground. It supports large stocks of haddock and monkfish and has a particular fish fauna quite distinct from elsewhere in Scotland.

In the deeper areas on the plateau it also supports some of the most extensive coldwater coral reefs in the north east Atlantic. Over the years Marine Scotland has been building up data on the fish and benthic ecosystems of the Rockall plateau. Until now, however, no detailed map of the shallow inshore areas around the Rock and the reef existed. To help with marine spatial planning and habitat protection measures, a detailed map is vital. One of the aims of the cruise was to map the shallow reef areas using a high resolution 'swathe' multibeam echosounder. This technology allows the seabed to be mapped to within a metre or two of spatial resolution. What emerged was truly spectacular. Numerous pinnacles, trenches, mounds, ridges and bedrock reefs were revealed.

The Rock itself turns out to be a minor pinnacle, compared with Helen's reef that extends in a great sweeping arc of fissures and ridges to the north west (Figure 2.9). Between the Rock and Helen's reef is a deeper trench which is frequented by fishermen targeting squid. Now that such a map is available, video imaging and more detailed analysis of the swathe data can be undertaken to identify the types of habitat and marine fauna present. This will build toward a better basis for the spatial management of the area for both fisheries and the conservation of vulnerable and unique marine habitats.

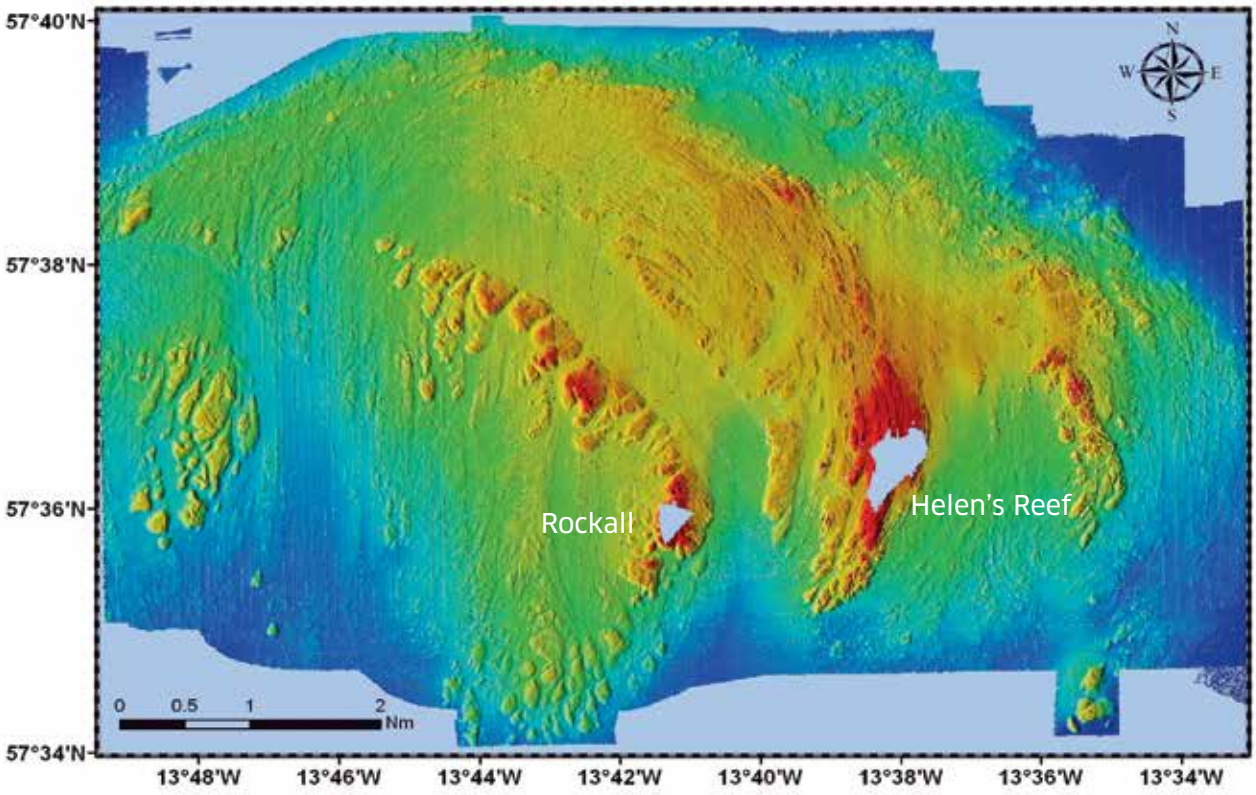


FIGURE 2.9
BATHEMETRY OF ROCKALL AND HELEN'S REEF.

Business Management Operations Team - Key Achievements for 2011-12

In support of science delivery the Business Management Operations Team have achieved a considerable amount during 2011-12. Covering a diverse range of topics, including Finance, Learning and Development, Business Support and Health &Safety, the pace of change has resulted in the team creating a quarterly update for staff. This helps keep people abreast of the work of the team and any emerging corporate requirements. It also provides clear information on the potential implications of the various developments for individuals and their teams. The specific developments within the areas have ensured that MSS is running on a more sound business footing within a safer working environment.

Finance – Improved management information and participation in the Release 12 Update for SEAS including piloting and leading on the development of the new SEAS Project Module. This involved working with a group of key users from MSS and ISIS colleagues in Edinburgh to ensure the resulting system would meet the needs of the business. The new Projects system was delivered on time which was a major achievement due to very short deadlines and the conflict with end of year activities.

Learning and Development – This role has really expanded, embracing the aspirations of the People Strategy. Several divisions within MS have benefited from the collaborative working culture which has made this role critical not just to MSS but the wider Directorate. The major success this year relates to the increased deployment and use of the Mobile Learning Centre, staff increasingly using other SG e-learning resources, delivery of efficiency savings and of course directing another successful Christmas Pantomime.

Business Support – Providing support for the matrix management approach adopted by MSS at the start of the year. New processes were developed for the work experience programme (with the support of John Dunn) and a new mentoring scheme for Science was created, potentially providing the blueprint for scientists of the future. Phase 1 of the MSS Accommodation Strategy has been implemented successfully and the requirements for Phase 2 have been mapped out.

Health and Safety – Extensive staff engagement has taken place to support the roll out of the Health and Safety management system as well as developing new policies and procedures to ensure a safe working environment for staff. In addition to this the ongoing requirements for Health and Safety training has continued to be delivered due to the proactive approach with our Learning and Development colleague.

3

// THE SCIENCE OUTPUTS

Marine Scotland Science performs a number of functions including research, monitoring, inspections/regulation and the provision of advice. Key to our activities is the provision of robust scientific evidence and consequently the science outputs are fundamental to assessing the overall delivery of MSS. During this last year, the Science Advisory Board, in conjunction with the members of the Science Programme Management Group, has been considering the most appropriate way of reporting delivery and the most relevant set of Key Performance Indicators (KPIs). A set of KPIs were agreed and are reported on below. Many of them stem from when MSS was an Agency. As such, it has been possible to compare the outputs for 2011-12 with that of previous years. There are four primary headings under which sit the specific KPIs:

A. Delivery of Service

1. Plan, execute and report a programme of science to meet the needs of Scottish Government
2. Plan and conduct an annual programme to achieve the most efficient use of available days on research vessels

B. Quality of Science Output

1. Number of peer-reviewed publications per scientist
2. Number of non-peer-reviewed publications, topic sheets etc. produced
3. Results of external and internal audits

C. Collaboration

1. Value of externally funded work in total and for strategic science projects
2. Communications with stakeholders
3. Integration of natural and socioeconomic sciences with policy

D. Balance Between Strategic Science and Routine Activities

1. Proportion of the science programme allocated to strategic science and routine activities
2. Proportion of in-year resource reallocation between strategic science and routine activities

The Science Advisory Board undertakes a review of the KPIs and provides comment to the Science Programme Management Group on performance. The Chair of the SAB also has the opportunity to report to the Marine Scotland Board on any aspect of the KPIs.

A. Delivery of service

1. *Plan, execute and report a programme of science to meet the needs of Scottish Government*

An ambitious programme of scientific services and research projects was planned for 2011-12 in conjunction with relevant policy colleagues in Marine Scotland. The science programme was presented to, and endorsed by, the Science Advisory Board and the achievement of milestones and targets for each project was monitored and reported to it.

Percentage of project targets achieved 2011-12

Science Programme	Schedule of Services	Research Projects
Aquaculture & Fish Health (AFH)	97.1	83.3
Sustainable Fisheries (SF)	94.8	54.2
Freshwater Fisheries (FF)	100.0	34.6
Marine Renewable Energy (MRE)	69.6	77.8
Marine Spatial Planning (MSP)	85.7	65.4
Marine Status & Trends (MST)	89.3	51.0
Overall	**90.4**	**59.3**

TABLE 3.1
SUMMARY OF THE PROJECT TARGETS ACHIEVED BY THE VARIOUS SCIENCE PROGRAMMES, EACH OF WHICH IS LED BY A SCIENCE PROGRAMME MANAGER.

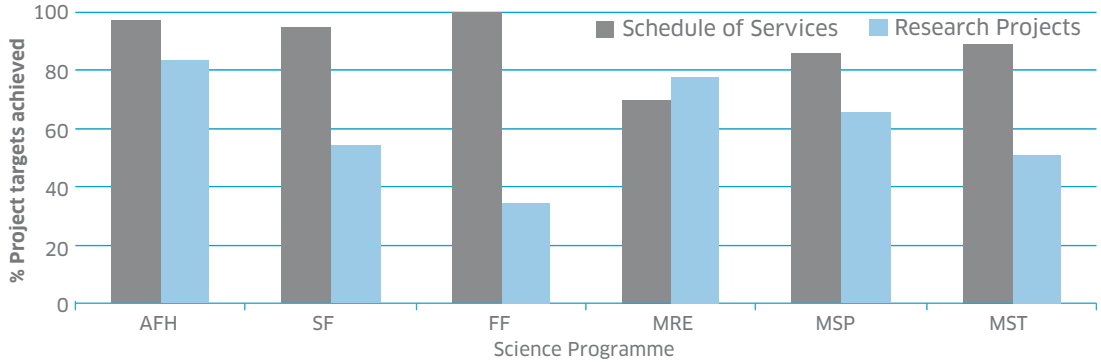


FIGURE 3.1
SUMMARY OF DELIVERY FOR BOTH THE SCHEDULE OF SERVICES AND RESEARCH AND DEVELOPMENT (R&D) PROJECTS BY SCIENCE PROGRAMME. THE PROGRAMME ABBREVIATIONS ARE PRESENTED IN TABLE 3.1.

Achievement of targets under the Schedule of Services for 2011-12 is high (Table 3.1 and Figure 3.1), particularly for well-established programmes such as Freshwater Fisheries, Aquaculture and Fish Health, and Sustainable Fisheries. In these programmes, activities such as monitoring and inspections have been ongoing, with minor modifications, for

several years. In the new programmes, particularly Marine Renewable Energy, new activities have been planned and staff levels have not yet reached the intended, number. As such, levels of achievement were lower.

Research project achievements have typically been lower than those for the Schedule of Services. This is largely due to the diversion of resources from research to urgent advice or other Schedule of Services activity during the year. However, the outturn figures for 2011-12, particularly for Freshwater Fisheries, give cause for concern when compared with previous years (Figure 3.2).

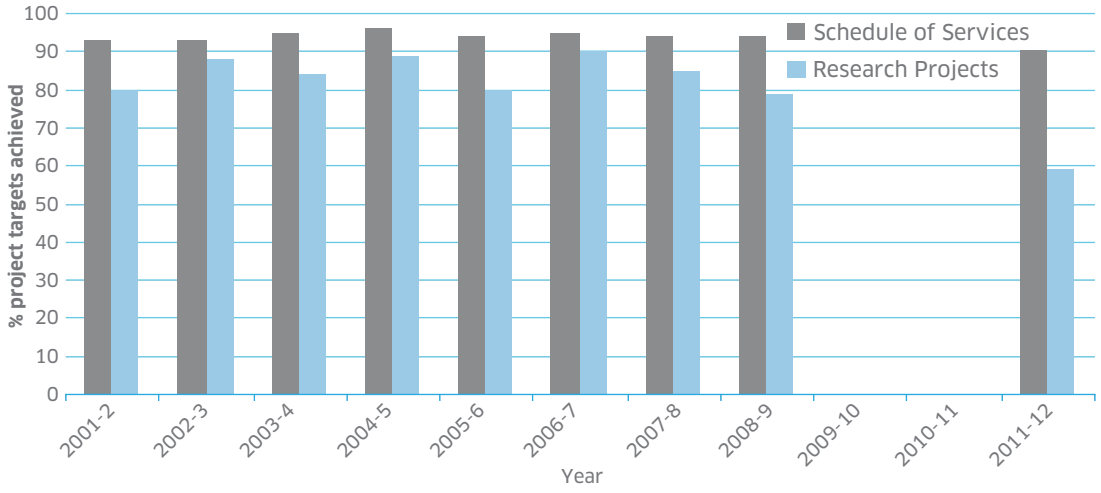


FIGURE 3.2

PERCENTAGE PROJECT TARGETS ACHIEVED FROM 2001–2 TO 2011–12. DATA FOR 2009-10 AND 2010-11 IS BEING SOURCED AND WILL BE INCLUDED IN SUBSEQUENT REPORTS.

The data is not complete for 2009-10 and 2010-11, when Marine Scotland had been formed but, KPIs were not reported. MSS did, however, collect most of the necessary data and this information will be collated during this year to update the time series so that it is continuous.

As an Agency, prior to 2009, Fisheries Research Services had Key Targets that were reported annually. These targets included two based on delivery of service:

- To achieve 96% of the Schedule of Services milestones
- To achieve 85% of Research Project milestones

MSS continued a high level of achievement for the Schedule of Services activity, where there is high pressure to deliver advice, regulatory activity and statutory services. The large drop in achievements for research projects last year compared to previous years may have several contributory factors:

- *There were significant staff vacancies and churn over the last 2 years, which had a more severe impact on research activity than the Schedule of Services, with the loss of several experienced researchers and movement of staff into areas such as renewables, where research activity may be lower*

- *Reorganisation of the science programme into new programmes has led to reduced outputs during the period of change*
- *Increased pressure to deliver Schedule of Services at the expense of research.*

The balance of budget allocation and actual outturn figures detailed under KPI D below provides further information on this matter.

A. Delivery of service

2. *Plan and conduct an annual programme to achieve the most efficient use of available days on research vessels*

Marine Scotland Science operates two primary ships; MRV *Scotia* and MRV *Alba na Mara.* MSS also operates the MRV *Temora*, based in Stonehaven, and a number of other small boats. The research vessel programme was planned, taking account of priorities from Scottish Natural Heritage (SNH), the Joint Nature Conservation Committee (JNCC) and others, and in conjunction with other research vessel operators in Scotland, notably the Scottish Environment Protection Agency (SEPA). Both *Scotia* and *Alba na Mara* are planned to be at sea for the maximum number of days possible (Table 3.2), with cruises serving multiple purposes and working as many hours per day as possible. Non-productive time spent travelling e.g. from west to east coast, has been minimised by reducing the number of times each vessel has to travel between coasts, and bartering ship time with other organisations (notably SEPA). The effort and knowledge of our Ships' Liaison Officer has enabled MSS to operate the busiest and most efficient programme of any of the Scottish research vessels (Table 3.2).

Vessel	Programmed days	Operational days	Refit days
MRV *Scotia*	291	290	20
MRV *Alba na Mara*	270	268	21
MRV *Temora*	n/a	53	16

TABLE 3.2
SUMMARY OF THE OPERATIONAL DAYS FOR MSS VESSELS.

B. Quality of science output

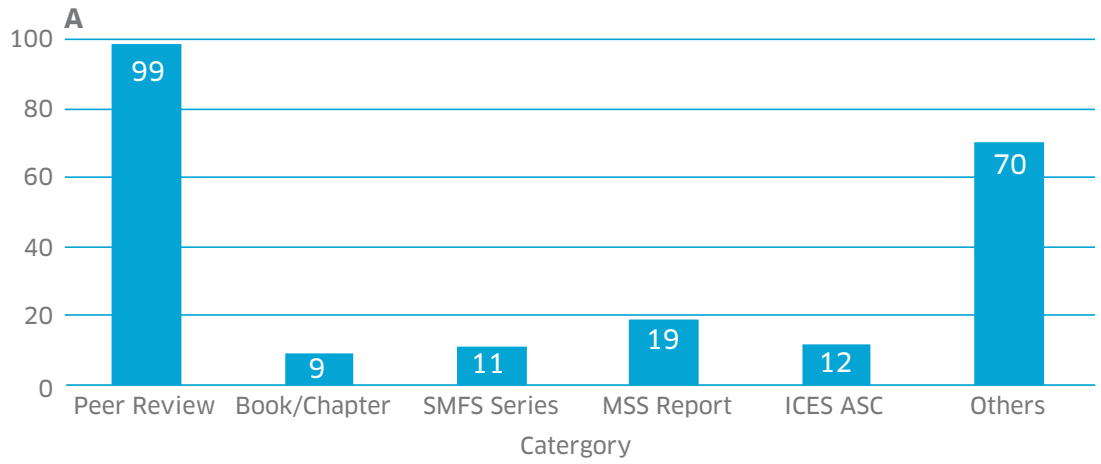
1. Number of peer-reviewed publications per scientist
2. Number of non-peer-reviewed publications, topic sheets etc. produced

Marine Scotland Science endeavours to publish as much of its science and information as is practicable. There are a number of publications options. These include:

- peer-reviewed papers in scientific journals
- book chapters
- internal reports of which there are two types, namely the Scottish Marine and Freshwater Science (SMFS) series and Marine Scotland Science Reports
- presentations made at the ICES Annual Science Conference. This is highlighted as a separate category due to the fact this conference enables dissemination to one of the key audiences for MSS
- platform presentations and posters at conferences

During 2011-12, MSS publications totalled 220 (Appendix 2). The breakdown across the various categories is shown in Figure 3.3A where a comparison is made with the number of peer reviewed publications from the previous 6 years. The number of peer reviewed publications (99) represents a significant scientific output and also reverses the trend of previous years when there has been a decline in peer reviewed publications (Figure 3.3B). The 7 year average is 101.

The objective for future years will be to at least maintain the approximately 100 peer reviewed publications per year if not increase this number. However, an important aspect of the output from MSS is that the various audiences are receiving what is required. MSS has a wide stakeholder base and so MSS needs to maintain a variety of means by which it publishes its data and information.



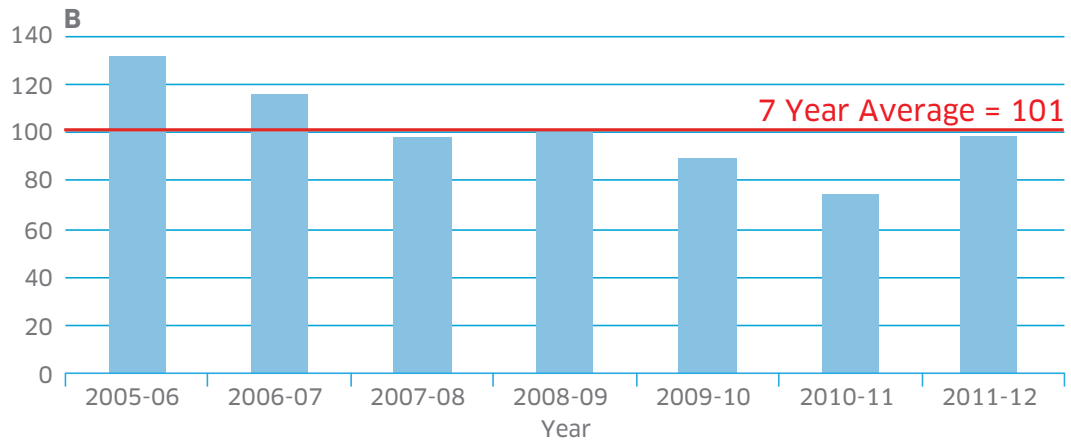


FIGURE 3.3

SUMMARY OF A) MSS PUBLICATIONS DURING 2011-12 AND B) THE NUMBER OF PEER-REVIEWED PUBLICATIONS BY YEAR, 2005–06 TO 2011–12. THE 7 YEAR AVERAGE IS 101.

Presentations at conferences remains an important means of information dissemination as it also enables networking and should facilitate future collaborations. The internal report series, the Scottish Marine and Freshwater Science series and the Marine Scotland Science Reports, do provide an opportunity for rapid dissemination of information where greater detail is required. It is intended that the Scottish Marine and Freshwater Science series become at recognised series of reports, hence this series has an International Standard Serial Number (ISSN).

The category of 'Others' includes several substantial and regularly published documents such as the:

- Scottish Sea Fisheries Statistics 2010
- Scottish Shellfish Farm Production Survey, 2010 Report
- Scottish Fish Farm Production Survey, 2010 Report
- Fish and Shellfish Stocks 2011

These publications (Figures 3.4) serve critical functions and during this last year the Scottish Sea Fisheries Statistics report was refreshed by the Marine Analytical Unit.

FIGURE 3.4

EXAMPLES OF THE REGULAR (ANNUAL) REPORTS PRODUCED BY MARINE SCOTLAND SCIENCE.

Other long-term reports have also been revised. For example, the Scottish Salmon and Sea Trout Fisheries Statistics are now presented as a Topic Sheet (Figure 3.5) with much of the data being available from the Scottish Government website. Topic sheets are suitable for outreach and a wide, non-specialist audience. They are suitable for communicating information on single issues to a wide audience and are being used extensively by several Divisions of Marine Scotland. The bulk of the, approximately 110, Marine Scotland Topic Sheets originate from Marine Scotland Science and together with the website pages and the Blog represent a significant output. The challenge is to appropriately develop the web-based systems for information dissemination while, at the same time, ensuring that an appropriate number of publications are being delivered through the peer-reviewed literature.

FIGURE 3.5

TYPICAL WEB PAGES FROM THE SCOTTISH GOVERNMENT WEBSITE INCLUDING, THE MARINE ECOSYSTEM MONITORING BLOG, AND EXAMPLES OF THE TOPIC SHEETS.

B. Quality of science output

3. Results of external and internal audits

Accreditation was maintained following external United Kingdom Accreditation Service (UKAS) audit against standards ISO17025 (General Requirements for the Competence of Testing and Calibration Laboratories) and 17020 (Conformity Assessment – Requirements for the operation of Various Types of Bodies Performing Inspections). During their visit, UKAS assessed 19 of the 43 methods currently accredited at MSS. The auditors did take account of the time required to develop and implement the Laboratory Information Management System (LIMS) last year and recognised that this had diverted time and effort from some of the usual quality systems.

Box 3.1 Quotes from the Annual UKAS Audit

'This was another very positive visit. The quality and technical systems in place in both the testing laboratory and the inspection body are very impressive and demonstrate the competence and high level of knowledge present in all areas.'

'There is extensive, appropriate quality control measures applied in all assessed areas giving confidence that there are consistent and accurate results produced.'

'Technical records are extremely well detailed and all stages of testing are fully documented and verified.'

Quotes from the February 2012 UKAS Inspection Report

Ninety per cent of quality and sampler internal audits were completed within the agreed timescales. The number of internal auditors has been a concern in the past and although there are currently sufficient numbers of staff acting as auditors, this will have to be kept under review during 2012-13.

The benefits of working within an accredited system are considerable. The positive feedback (Box 3.1) boosts staff while working within an accredited system ensures that there are robust audit trails and a well documented archive. Furthermore, staff find it a very useful way of working as well as appreciating the wider benefits of undertaking their science within a quality assurance system.

C. Collaboration

1. Value of externally-funded work in total and for strategic science projects

The total value of contract income over the period 2006–07 to 2011-12 is shown in Figure 3.6. This value is broken down into EU income from the Data Collection Framework (DCF), other EU income and wider commercial income. The latter includes funding from other Government Departments as well as some industrial income. The percentage of the three categories relative to the total are also presented. With the exception of 2010-11, when there was a spike in commercial income, there has been a progressive decline of contract income since 2006-07. The DCF income has remained more or less constant and is a relatively predictable and stable income as long as the MSS fisheries sampling programme continues at the same level – this has proved challenging as the headcount fell, but should improve as staff are recruited back to this area of work. Commercial income decreased from approximately £1.4 million to about £500,000 over the same period. In contrast, other EU income showed a modest increase during the period 2007-08 to 2010-11 after which it fell back to only £125,000 in the most recent year.

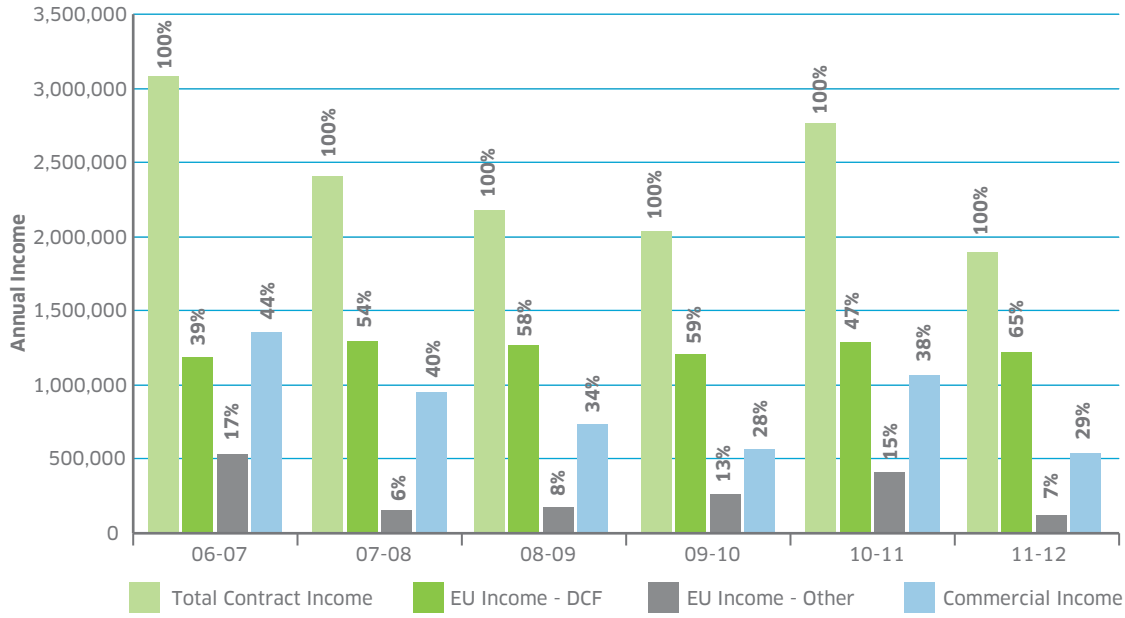


FIGURE 3.6

TOTAL CONTRACT INCOME AND THE DIVISION OF THIS INCOME ACROSS THE DATA COLLECTION FRAMEWORK, OTHER EU-INCOME AND WIDER COMMERCIAL INCOME OVER THE PERIOD 2006-07 TO 2011-12.

External income is important for MSS as it provides added value to the science programme through collaborative projects, and results in improved networking and knowledge transfer, particularly in the European context. As part of the Spending Review, MSS is required to increase its external funding. As such, the Business Operations Team Leader will be taking forward an initiative to expand the external income by 25% during 2012-13.

C. Collaboration

2. Communications with stakeholders

In addition to day to day staff interaction with stakeholders, such as contact with fish farmers, Fisheries Trusts and work carried out with sea fishermen, MSS has carried out specific activities to communicate with the industries, public bodies and others who are affected by or use the results of MSS work.

Formal collaborations have been set up in individual projects with aquaculture businesses. The sea fishing industry has been involved in projects under the Scottish Industry-Science Partnership and is particularly involved in gear trials and joint surveys. Fieldwork is carried out with sea angling and Scottish Fishermen's Federation assistance. Industry, science and policy joint bodies have been set up in relation to Inshore Fisheries Groups, the Fisheries Management & Conservation Group and Regional Advisory Councils. MSS is also involved in the development of the Centre of Expertise on Fisheries Management. In terms of marine renewable energy, MSS is involved in a range of research projects including with both academic and industrial partners. Membership of national science coordination groups has enabled MSS to influence the directions of funding initiatives and to integrate MSS internal science into national efforts, and to ensure that the best use is made of Marine Scotland's capacity to fund external research projects.

Two major surveys of aquaculture production, including biological and socioeconomic data are published each year (*see* page 35). The Sustainable Fisheries programme also publishes an annual stock assessment booklet and holds 2 stakeholder briefings on ICES advice and is regularly involved in ad hoc meetings with various industry groups while the Marine Analytical Unit produces the Scottish Sea Fisheries Statistics. Articles have been published in trade and other relevant journals, including Fish Farmer and the Atlantic Salmon Trust Journal.

Presentations have been made to meetings with industry and stakeholders to explain our research projects, gain collaborations and provide question and answers. Informal gatherings of the sea fishing industry and science are also held to exchange information, knowledge and ideas.

FIGURE 3.7
MEETING AT ANSTRUTHER.

During 2011–12 MSS met with the fishing industry at the Scottish Fisheries Museum in Anstruther to share information and genuinely learn from each other. This two day event was very much a discussion between MSS and the fishing industry (Figure 3.7) with a focus on demersal white fish fisheries. The process is due to be repeated during 2012–13 when it is planned that the discussion will focus on *Nephrops* fisheries.

C. Collaboration

3. Integration of natural and socioeconomic sciences with policy

The Marine Analytical Unit (MAU) and its in-house socio-economic expertise is a relatively new addition to Marine Scotland Science. Nevertheless, the need for this input will grow as increasing numbers of projects include this requirement. In 2011-12, 19 separate projects incorporated socioeconomic science, with the bulk of these relating to sustainable fisheries and marine spatial planning. The number of projects that include socioeconomic work is predicted to rise substantially over the next 2–3 years.

D. Balance Between Strategic Science and Routine Activities

1. Proportion of science programme allocated to strategic science and routine activities
2. Proportion of in-year resource reallocation between strategic science and routine activities

The distribution of science spend between Programmes is illustrated in Figure 3.8. Just under a quarter (24%) of the 2011-12 budget was planned for strategic science with the remainder for routine activity. Out-turn figures show that 21% of the budget was spent on strategic science with the remaining 79% on routine advice, monitoring, regulatory and surveillance work.

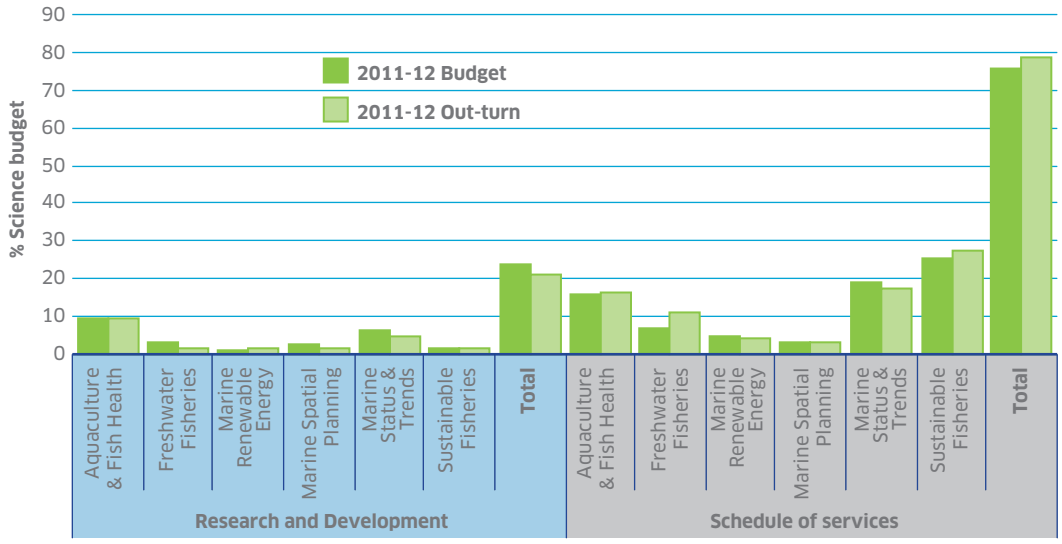


FIGURE 3.8
SUMMARY OF SCIENCE SPEND ACROSS THE 6 SCIENCE PROGRAMMES PRESENTED IN TERMS OF RESEARCH AND DEVELOPMENT AND THE SCHEDULE OF SERVICES.

In 2011-12 the Sustainable Fisheries budget was the largest of the science programme budgets within the Schedule of Services, while Aquaculture and Fish Health had the largest research and development budget. As programmes such as Marine Spatial Planning and Marine Renewable Energy develop, so the budgets are likely to grow further through internal resource allocation.

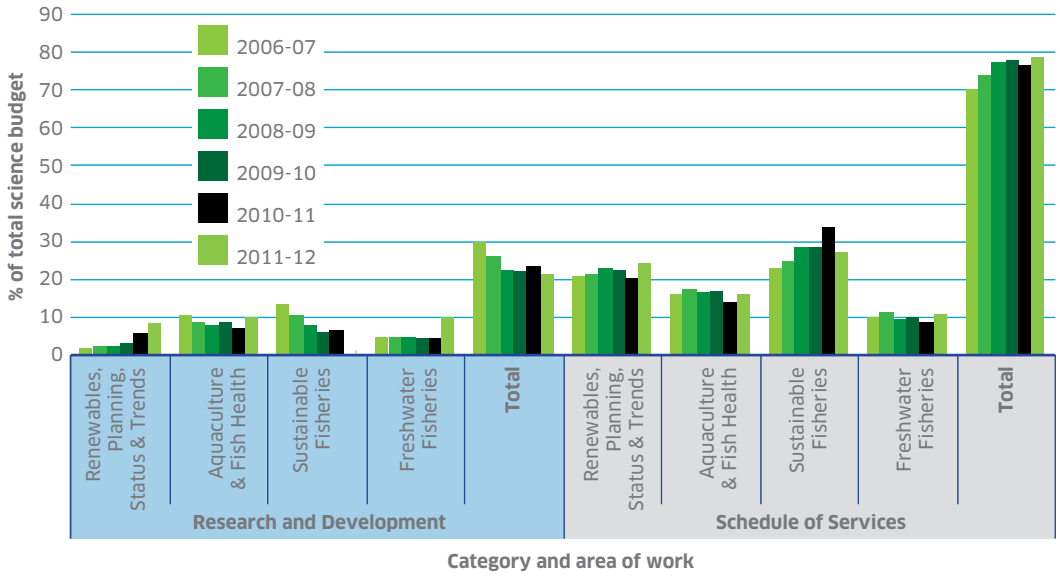


FIGURE 3.9

PERCENTAGE OF THE SCIENCE BUDGET SPENT AGAINST VARIOUS CATEGORIES OVER THE LAST 6 YEARS.

Comparison of budget figures across the period 2006-07 to 2011-12 shows there is a consistently higher spend on routine work and lower spend on R&D. This transfer of effort away from research towards routine work is increasing year-on-year. The proportion of research spend has fallen from a ratio of 30:70 in 2006 to 21:79 in 2012; a drop of one third and equivalent to at least £750k of spend.

Across the science programmes, increased demand for work on Marine Renewable Energy and Marine Spatial Planning has led to increased activity in these areas. These are still relatively new fields of work and so research in particular started from a low baseline, but the increase in effort in these areas has been significant in the last 2 years and already the research activity in these programmes is of the same order as that in Freshwater Fisheries and Sustainable Fisheries (Figure 3.9). Sustainable Fisheries research has seen a decrease in research activity, over the period 2006-07 to 2010-11. However, this trend was reversed in 2011-12 (Figure 3.9)

In conclusion, overall delivery of the science programme for 2011-12 remained strong for routine activity, with high achievement rates and utilisation of ships, and maintenance of an excellent record in formal quality assurance. However, strategic science, or R&D activity, showed a significant drop in attainment and resource allocation. This is particularly evident when trends over the last 5 years are considered. Some of this is probably due to increased pressure to deliver Schedule of Services at the expense of research, but reorganisation and the loss of several experienced researchers and movement of staff into areas such as renewables, where research activity may be lower, are also likely to have had a negative impact.

Strategic or research orientated science is important for MSS in relation to the reputation of MSS as a source of authoritative quality advice, the ability to influence decision makers such as the European Commission, and the need to attract and retain high calibre scientists to build capacity for the future. Clearly there is a risk that MS Science's capacity to provide high quality advice could be adversely affected by reduced research activity. Selecting an appropriate percentage for strategic science is not obvious, and managing the staff effort to achieve this is not straightforward. Recent experience would suggest that a minimum figure of about 25% represents an amount that can sustain capacity in each science programme.


4

// A FORWARD LOOK: 2012-13

The requirements for marine science have never been greater. As such, there are huge opportunities as well as challenges facing MSS in 2012-13. Not least of these is ensuring that MSS is undertaking the right science to the right timescale. As in previous years the 2012-13 science programme was developed through a series of meetings which involved Policy leads, the Chairman of the Science Advisory Board, SEPA, MASTS and SNH. The Science Advisory Board provided feedback and wider stakeholders were also consulted. The MSS science programme represents one component of the marine science effort conducted in Scottish waters. The MSS science programme must deliver the requirements of Scottish Government while also providing a fundamental component of the Scottish, and indeed wider, marine science programme. By mapping the MSS programme to the Scottish Marine Science Strategy, it is evident where MSS is delivering. As guardian of the Scottish Marine Science Strategy, MSS needs to ensure that other contributing organisations are similarly mapping their programmes to the Strategy so as to provide a full picture and allow a gap analysis to be undertaken.

The Key Outcomes for each of the 6 Science Programmes have been developed by the relevant Science Programme Managers together with Key Outcomes for the Marine Analytical Unit, Science OPerations and Business Management (Box 4.1). These Key Outcomes, presented in the Marine Scotland Directorate Plan 2012-13, represent the highest level of aspiration and will be reported on in the 2012-13 Annual Report. Underlying these are the various Schedule of Services, research projects and contracts. During 2012-13 MSS needs to ensure that progress against the targets is monitored and appropriate action taken as the year progresses. This will be the first year where all Science Programme Managers will have been in post from the start of the process and thus delivering a science programme that they have developed.

Where appropriate, the science planning process will be adjusted so as to give greater opportunity for comments from stakeholders as well as secure full buy-in from the relevant Policy leads. Resource constraint means that improved prioritisation is required across Marine Scotland – it is not simply about deciding what should be done, but also about what cannot be done in-house. If appropriate, consideration should be give to partner organisations undertaking specific aspects of the overall science requirement for Scottish Government, being guided by the Scottish Marine Science Strategy with direction from MSS.

Box 4.1 Key Outcomes for 2012-13

Aquaculture and Fish Health - Complete a programme of surveillance, inspection and regulation in support of aquatic animal health and sustainable aquaculture.

Freshwater Fisheries - Improve the evidence base for the management of early running spring salmon on the River South Esk.

Marine Analytical Unit - Robust and comprehensive sustainability appraisals of Offshore Wind, Wave and Tidal Sectoral Plans, the National Marine Plan and the Marine Protected Area Network.

Marine Status and Trends - Completion and submission of the UK initial assessment of the current status of our seas and the determination of the specific characteristics of GES, and related targets and indicators, for our marine waters.

Marine Spatial Planning - Complete scientific support for the Scottish Marine Protected Area project, leading to submission of proposals for a coherent network of MPAs in Scottish waters.

Marine Renewable Energy - Complete Regional Locational Guidance for wind, wave and tidal stream energy developments.

Sustainable Fisheries - Successful development of revised and improved cod recovery plans (tailored to the needs of affected stocks).

Science Operations - Complete review of the operation of Scottish Marine Research Vessels.

Business Management - To increase external income by £500k by 1 April 2013.

Partnership working is fundamental and during 2012-13 MSS must ensure appropriate input to MASTS, the development of the Centre of Expertise for Fisheries Management and the development of the UK-Integrated Marine Observing Network as well as sustaining its input to ICES, the UK Marine Monitoring and Assessment Strategy and other collaborative initiatives. Furthermore, MSS must position itself so that it can better utilise European funding and will work closely with the Marine Scotland Representative to the EU, Andrew Brown.

In previous years, MSS has directly funded research at various Scottish Universities. Currently, MSS supports a number of MASTS-related PhD studentships. A more strategic approach needs to be taken to the further development of this aspect of the MSS

science programme. Students add a considerable amount to the life and work of MSS. However, there is a need to clarify the situation with respect to students and headcount which is currently 281.

Our staff are our backbone. During 2012-13 there is a need to ensure that we maximise the opportunities afforded MSS through a headcount of 281. A significant recruitment programme will be undertaken which will last at least until the end of 2012. Having the right staff in post will ensure timely delivery of quality outputs. It will also ensure appropriate workloads. However, recruitment itself takes time and new staff will need to be inducted and trained. MSS must ensure that these processes are prioritised so as to optimise the utilisation of the staff. This will also require there to be a strong focus on the Science Programmes as the science delivery bodies. Science programme managers will be required not only to provide, but to monitor and report on progress as well as provide an in-depth look at a specific aspect of their programme at the regular management meetings. This latter aspect will include presentations by staff conducting the research or monitoring and will increase engagement with staff as the SPMG will meet with staff 'at the bench'.

Providing direction for staff is crucial and opportunities will be provided, on a regular basis, for staff to meet with the Head of Science in an informal setting. During 2012-13 a set of Principles for Marine Scotland Science will be finalised and widely disseminated. These principles will cover collective leadership, work culture, communication and several other headings and will be linked into the Scottish Government People Strategy. The purpose statement will be promoted and as phase 2 of the staff accommodation move is finalised, MSS will work with MS Communications to provide new and informative posters providing staff with clear information around the Purpose and Principles of Marine Scotland Science.

Two areas of frustration, IT and obtaining Practical Completion for the Ellis Building, will be tackled head on during 2012-13. With respect to IT, a survey of all MSS staff will be conducted to assess the requirements of each individual. This will be translated into an implementation programme where staff will be given appropriate access to the Off-SCOTS environment (OSE) through new virtual machines (VMs), and in some cases 'high-spec' VMs. At the same time, staff will transfer over to the Windows 7 operating system. It is planned that by mid-November, this IT change programme will be complete after which MSS will assess any follow-up that is required to ensure an appropriate IT environment for our business. The specific IT issues experienced at the Freshwater Laboratory will be further investigated and a procurement process will be put in place, by ISIS, for a new link to the SG computing systems and the outside world.

During 2011-12, MSS, together with other Divisions of MS, responded to several **marine emergencies**. This highlighted a very strong media interest in Scottish marine incidents and the need for robust assessments of the environmental impact of such events. In the coming year, MSS will work with other MS Divisions to refine the response plans. MSS operates the UK Sensory Assessment Panel for the detection of hydrocarbon taint in fish and shellfish. During 2012-13, MSS will need to better articulate the requirements of such a panel and prepare relevant guidance for both MS staff and other organisations likely to be collecting samples for sensory assessment.

MSS successfully published 99 peer-reviewed papers during 2011-12. It is hoped that MSS can keep up this level of output. MSS also needs to further develop its outward focus, building on the successes of 2011-12. Clearly focussed on delivery through collective leadership and a work culture where we have mutual respect, with shared skills so as to ensure that tasks do not rely on individuals, Marine Scotland Science will remain at the forefront of marine science such that our advice is respected and understood by those who receive it and our contribution makes a genuine difference to the management of Scottish seas.

// APPENDIX 1

Response of Marine Scotland Science, the Science Advisory Board and Marine Scotland to the Recommendations from the Sinclair Review (*Sinclair, L. (2011) Review of Marine Scotland Science and Associated Policy Integration: Final Report March 2011, 21pp*).

Code	Recommendation	Responsible Group	Action during 2011-12
1. Enhance and streamline existing mechanisms for integrated planning and aligned commissioning:			
1.1	Coordinated Agenda for Marine, Environment and Rural Affairs Science (CAMERAS) to drive a horizon scanning programme building on current Futures work.	Science Programme Management Group.	Regular input to the CAMERAS Board and CAMERAS Monitoring Coordination Group. Implementation of the Scottish Marine Science Strategy and Focus on Freshwater Science.
1.2	Develop a 3-5 year Marine Scotland Evidence Strategy (expand with key partners over time) which could form part of the MS Strategic Plan.	Marine Scotland Board.	Implementation of the Scottish Marine Science Strategy 2010 – 2015 which links in with UK Marine Science Strategy.
1.3	Align commissioning of science with Scottish Environment Protection Agency (SEPA) and Scottish Natural Heritage (SNH) with a Marine Science Strategy Annual Report published with delivery partners.	Marine Scotland Board.	SEPA and SNH incorporated into MSS science planning process. Scottish Marine Science Strategy promoted via CAMERAS.
1.4	Marine Scotland 1 year integrated delivery plans developed for key delivery priorities, within the Directorate Plan.	Science Programme Management Group and Policy/Compliance Divisions supported by Performance, Aquaculture and Recreational Fisheries Division.	Revised planning processes developed. Combined into the Marine Scotland Directorate Plan and Performance Framework.
1.5	External review of science activities, undertaken by independent scientists and overseen by the Science Advisory Board (SAB), to feed into the Spending Review cycle. Builds on current quality reviews, within current MS Science resources.	Science Programme Management Group and Science Advisory Board.	An in-depth review of all science programmes, undertaken by the SAB on a rolling basis, has been initiated. Currently does not involve scientists external to the SAB.
1.6	Streamline research commissioning by agreeing joint priorities for research at the outset of the Research Programme (ROAMEs) process to improve transparency and speed up decision making.	Science Programme Management Group and Policy Divisions.	Improved system developed during 2011-12. Further refinements planned for 2012-13.

Code	Recommendation	Responsible Group	Action during 2011-12
2. Mechanisms to make best use of available resources to meet demands			
2.1	Introduce a light touch strategic examination of research projects by the SAB, reflecting their role providing advice on science priorities to input a wider view point on the research programme and help ensure the best use of available resources.	Science Advisory Board.	SAB has reviewed research projects and receive a summary of progress from each Science Programme for comment. In-depth review of all science programmes on a rolling basis has been initiated.
2.2	Using the SAB as a sounding board, identify opportunities to reduce investment in routine monitoring considering the risks and pressures this may create. Work has been ongoing in this area and this is an extension of this activity.	Science Programme Management Group and Science Advisory Board.	Continued discussions at the SAB meetings.
2.3	The Science Management Team and wider Marine Scotland Board should consider how best to capitalise on the suggested collaborative opportunities and inter-disciplinary approaches (perhaps building on a regional pilot – in particular between compliance and science activities) to augment and target Marine Scotland Science resources to the best advantage.	Science Management Team and Marine Scotland Board.	There has been an increased use of the Fisheries Officers (e.g. SCOTMap) and the actual offices are now termed Marine Offices.
2.4	Improved contingency management, including call off contracts and staff skills resilience pool.	Science Management Team and Policy/Compliance Divisions.	Workforce 2015 discussions and prioritisation led to a case being prepared and Headcount numbers consolidated at 281. Recruitment processes underway specifically in fisheries and renewables science.
2.5	Better use of existing Contract Research Fund (CRF) to deliver on short term policy needs. Develop procedures to link with the RPID Contract Research Fund to support joint projects on land-freshwater-marine processes.	Science Management Team and Policy Divisions with Rural Environmental Research and Analysis Division (RERAD)[3]. SMT and Rural Payments and Ispections Directorate (RPID).	Revised procedures put in place such that both the Director of Marine Scotland and Head of Science review all Marine Scotland CRF bids prior to submission.

[3] Now Rural Environmental Science and Analytical Services (RESAS)

Code	Recommendation	Responsible Group	Action during 2011-12
3. Enhance integrated ways of working			
3.1	Supporting job shadowing and secondment opportunities and promoting the use of hot desking to break down informal barriers.	Science Management Team and Policy Divisions.	Programme Managers actively encouraged to spend time hot desking in Edinburgh. Head of Science regularly in Edinburgh.
3.2	Increase frequency of attendance of science staff at policy management team meetings and vice versa.	Policy Divisions and Science Programme Management Group.	Programme Manager for Sustainable Fisheries now teleconfereneces into Marine Fisheries meetings. Performance Aquaculture and Recreational Fisheries and Aquaculture and Fish Health have in place a timetable of regular meetings.
3.3	Re-introduction of Policy/Science awareness events to publicise and involve staff in activities.	Science Programme Management Group and Policy Divisions.	A programme of monthly talks by Policy leads to science and science leads to policy was conducted during 2011-12.
3.4	Organise joint events to industry and other stakeholders.	Science Programme Management Group and Policy Divisions.	A number of events have been undertaken, some traditional events, some new.
3.5	Increased use of Blogs/web pages and better use of Topic Sheets to publicise research and other activities.	Science Programme Management Group and MS Communications.	Marine Monitoring Blog in regular use. Further Topic Sheets developed. Increased use of the web with new pages for monitoring and Marine Scotland Interactive.
3.6	Integrated delivery plans enhancing virtual teams (building on current close connections) and increased collaborations to deliver science activities.	Science Programme Management Group and Policy Divisions.	Matrix management system fully implemented. Greater connectivity in respect of Directorate Plan.

Code	Recommendation	Responsible Group	Action during 2011-12
4. Refine and improve business infrastructure and processes			
4.1	Identify current and future pressure points of the skills complement in Marine Science to meet current and future delivery requirements.	Science Management Team.	Consolidation of Headcount at 281. Case accepted for recruitment to fisheries and renewables posts. Pressure points identified.
4.2	Improved financial project monitoring to support project and contract monitoring and cross cutting delivery.	Business Management Unit, Performance, Aquaculture and Recreational Fisheries Division.	Marine Scotland Science Business Manager appointed. Improved Projects system piloted. Improved business processes put in place through developing appropriate business management strategies.
4.3	Set efficiency targets to further reduce science support, building on the opportunities created by incorporation within Marine Scotland.	Science Management Team.	Developed Key Performance Indicators for Science.
4.4	Reintroduce performance monitoring through annual reports to the MS Board on performance and pressures from the Head of Science and Chair of Science Advisory Board; Development of a performance monitoring framework (e.g. through Key Performance Indicators (KPIs)), in consultation with the SAB, to support performance reporting.	Science Management Team, Science Programme Management Group and Science Advisory Board.	Key Performance Indicators re-introduced and reviewed by SAB. Annual report presented to MS Board.

// APPENDIX 2

Full listing of Peer-reviewed Papers, Book Chapters, Scottish Marine and Freshwater Science Series Reports, Marine Scotland Science Reports, Presentations at the ICES Annual Science Conference and Other Publications (including presentations at meetings, posters) for 2011–12. This listing does not include the Topic Sheets nor does it reflect the increased use of the Scottish Government Website.

Peer Reviewed Papers (99)

Anderwald, P., P.G.H. Evans, R. Dyer, A. Dale, P.J. Wright and A.R. Heoelzel. (2012). Spatial scale and environmental determinants in minke whale habitat use and foraging. *Marine Ecology Progress Series* **450**:259-274.

Armstrong, J.D., K.J. Millidine and N.B. Metcalfe. (2011). Ecological consequences of variation in standard metabolism and dominance among salmon parr. *Ecology of Freshwater Fish* **20 (3)**:371-376.

Armstrong, J.D. and K. Nislow. (2012). Modelling approaches for relating effects of change in river flow to populations of Atlantic salmon and brown trout. *Fisheries Management and Ecology*. **Online version 31 January 2012 at present**

Bacon, P.J., J.C. MacLean, I.A. Malcolm and W. Gurney. (2012). Ova-fecundity in Scottish Atlantic Salmon: predictions, selective forces and causal mechanisms. *North American Journal of Fisheries Management* **81(3):** 921-938.

Berx, B. (2012). The hydrography and circulation of the Faroe Shetland Channel. *Ocean Challenge* **19 (1)**:15-19.

Bland, F., R. McIntosh, N. Bain and M. Snow. (2012). Development and validation of a range of endogenous controls to support the implementation of practical Taqman real-time PCR-based surveillance for fish diseases within aquaculture. *Journal of Fish Diseases* **35 (6)**:447-454.

Boulcott, P. and T.R.W. Howell. (2011). The impact of scallop dredging on rocky-reef substrata. *Fisheries Research* **110 (3)**:415-420.

Brand, L.E., L. Campbell and E. Bresnan. (2012). *Karenia*: the biology and ecology of a toxic genus. *Harmful Algae* **14**:156-178.

Brewer, M.J., D. Tetzlaff, I.A. Malcolm and C. Soulsby. (2011). Source distribution modelling for end-member mixing in hydrology. *Environmetrics* **22(8)**: 921-932.

Brown, J. M., T.J. Chesher, A.J. Beveridge, S.H. Shafiai, R.B.O. Murray, T.A.G. Smyth, L.M. Bricheno and O.G. Way. (2012). Briefing: Young Coastal Scientists and Engineers Conference 2011. *Proceedings of the Institution of Civil Engineers-Maritime Engineering* **165 (1)**:7-20.

Burton, T., M.O. Hoogenboom, J.D. Armstrong, T.G.G. Groothuis and N.B. Metcalfe. (2011). Egg hormones in a highly fecund vertebrate: do they influence offspring social structure in competitive conditions? *Functional Ecology* **25 (6)**:1379-1388.

Butler, J.R.A., S.J. Middlemas, I.M. Graham and R.N. Harris. (2011). Perceptions and costs of seal impacts on Atlantic salmon fisheries in the Moray Firth, Scotland: Implications for the adaptive co-management of seal-fishery conflict. *Marine Policy* **35 (3)**:317-323.

Capell, R., D. Tetzlaff, I. A. Malcolm, A.J. Hartley and C. Soulsby. (2011). Using hydrochemical tracers to conceptualise hydrological function in a larger scale catchment draining contrasting geologic provinces. *Journal of Hydrology* **408 (1-2)**:164-177.

Chang, M., B. Collet, P. Nie, K. Lester, S. Campbell, C.J. Secombes and J. Zou. (2011). Expression and Functional Characterization of the RIG-I-Like Receptors MDA5 and LGP2 in Rainbow Trout (*Oncorhynchus mykiss*). *Journal of Virology* **85 (16)**:8403-8412.

Collet, B. and K. Lester. (2011). Establishment of an Atlantic salmon kidney cell line with an inducible gene expression system. *Journal of Biotechnology* **154 (4)**:209-211.

Collet, B. and K. Lester. (2012). Establishment of a Chinook salmon cell line with an inducible gene expression system. *In vitro Cellular and Developmental Biology - Animal* **47 (10)**:695-697.

Dale, A.C., P. Boulcott and T.J. Sherwin. (2011). Sedimentation patterns caused by scallop dredging in a physically dynamic environment. *Marine Pollution Bulletin* **62**:2433–2441.

Demain, D.K., A. Gallego, A. Jaworski, I.G. Priede and E.G. Jones. (2011). Diet and feeding niches of juvenile *Gadus morhua, Melanogrammus aeglefinus* and *Merlangius merlangus* during the settlement transition in the northern North Sea. *Journal of Fish Biology* **79 (1)**:89-111.

Dias, P.J, S. Piertney, M. Snow and I.M. Davies. (2011). Survey and management of mussel *Mytilus* species in Scotland. *Hydrobiologica* **670 (1)**:127-140.

Dixon, P.F., D.A. Smail, M. Algoet, T.S. Hastings, A. Bayley, H. Byrne, M. Dodge, A. Garden, C. Joiner, E. Roberts, D. Verner-Jeffreys and F. Thompson. (2012). Studies on the effect of temperature and pH on the inactivation of fish viral and bacterial pathogens. *Journal of Fish Diseases* **35 (1)**:51-64.

Einum, S., A.G. Finstad, G. Robertsen, K.H. Nislow, S. McKelvey and J.D. Armstrong. (2012). Natal movement in juvenile Atlantic salmon: a body size-dependent strategy? *Population Ecology* **54 (2)**:285-294.

Einum, S., K. Nislow, S. McKelvey and J.D. Armstrong. (2011). The spatial scale of competition from recruits on and older cohort in Atlantic salmon. *Oecologia* **167 (4)**:1017-1025.

Fernandes, P.G., K. Coull, C. Davis, P. Clark, R. Catarino, N. Bailey, R. Fryer and A. Pout. (2011). Observations of discards in the Scottish mixed demersal trawl fishery. *ICES Journal of Marine Science* **68 (8)**:1734-1742.

Fourrier, M., S. Heuser, E. Munro and M. Snow. (2011). Characterization and comparison of the full 3‘ and 5‘ untranslated genomic regions of diverse isolates of infectious salmon anaemia virus by using a rapid and universal method. *Journal of Virological Methods* **174 (1-2)**:136-143.

Fridjonsson, O., K. Olafsson, S. Tompsett, S. Bjornsdottir, S. Consuegra, D. Knox, C. Garcia de Leaniz, S. Magnusdottir, G. Olafsdottir, E. Verspoor and S. Hjorleifsdottir. (2011). Detection and mapping of mtDNA SNPs in Atlantic salmon using high throughput DNA sequencing. *BMC Genomics* **12:179. (Published online only)**

Gallego, A., E.W. North and E.D. Houde. (2012). Understanding and quantifying mortality in pelagic, early life stages of marine organisms - old challenges and new persepctives. *Journal of Marine Systems* **93**:1-3.

Graham, I.M., R.N. Harris, I. Matejusova and S.J. Middlemas. (2011). Do ‘rogue’ seals exist? Implications for seal conservation in the UK. *Animal Conservation* **14 (6)**:587-598.

Green, D.M., M. Werkman and L.A. Munro. (2012). The potential for targeted surveillance of live fish movements in Scotland. *Journal of Fish Diseases* **35 (1)**:29-37.

Green, D.M., M. Werkman, L.A. Munro, R.R. Kao, I.Z. Kiss and L. Danon. (2011). Tools to study trends in community structure: Application to fish and livestock trading networks. *Preventive Veterinary Medicine* **99 (2-4)**:225-228.

Greenstreet, S.P.R., H.M. Fraser, S.I. Rogers, A.V. Trenkle, S.D. Simpson and J.K. Pinnegar. (2012). Redundancy in metrics describing the composition, structure and functioning of the North Sea’s demersal fish community. *ICES Journal of Marine Science* **69 (1)**:8-22.

Greenstreet, S.P.R., S.I. Rogers, J.C. Rice, G.J. Piet, E.J. Guirey, H.M. Fraser and R.J. Fryer. (2012). Corrigendum - A reassessment of trends in the North Sea Large Fish Indicator and a re-evaluation of earlier conclusions. *ICES Journal of Marine Science* **69 (2)**:343-345.

Gurney, W.S.C., P.J. Bacon, D.C. Speirs, P. McGinnity, and E. Verspoor (2012). Sea-age variation in maiden Atlantic salmon spawners: phenotypic plasticity or genetic polymorphism? *Bulletin of Mathematical Biology* **74 (3)**:615 - 640.

Heath, M.R., J. Rasmussen, M.C. Bailey, J. Dunn, J. Fraser, A. Gallego, S.J. Hay, M. Inglis and S. Robinson. (2012). Larval mortality rates and population dynamics of lesser sandeel (*Ammodytes marinus*) in the northwestern North Sea. *Journal of Marine Systems* **93**:47-57.

Holmes, S.J., N. Bailey, N. Campbell, P.G. Fernandes, R. Catarino, K. Barratt and A. Gibb. (2011). Using fishery dependent data to inform the development and operation of a co-management initiative to reduce cod mortality and cut discards. *ICES Journal of Marine Science* **68 (8)**:1679-1688.

Hoogenboom, M.O., J.D. Armstrong, M.S. Miles, T. Burton, T.G.G. Groothuis and N.B. Metcalfe. (2011). Implantation of cocoa butter reduces egg and hatchling size in *Salmo trutta*. *Journal of Fish Biology* **79 (3)**:587-596.

Hussy, I., L. Webster, M. Russell and C.F. Moffat. (2012). Determination of chlorinated paraffins in sediments from the Firth of Clyde by gas chromatography with electron capture negative ionisation mass spectrometry and carbon skeleton analysis by gas chromatography with flame ionisation detection. *Chemosphere* **88 (3)**: 292-299.

Imholt, C., C.N. Gibbins, I.A. Malcolm and C. Soulsby. (2011). Effects of riparian tree cover on stream temperatures and invertebrate growth. *Aquatic Ecology* **44 (4)**:669-678.

Imholt, C, C. Soulsby, I.A. Malcolm, M. Hrachowitz, C.N. Gibbins, S. Langan and D. Tetzlaff. (2011). Influence of scale on thermal characteristics in a large montane river basin. *River Research and Applications*. **Online version December 2011 at present**

Ivanovic, A., R.D. Neilson and F.G. O'Neill. (2011). Modelling the physical impact of trawl components on the seabed. *Ocean Engineering* **38 (7)**:925-933.

Jarwoski, A. (2011). Evaluation of methods for predicting mean weight-at-age: an application in forecasting yield of four haddock (*Melanogrammus aeglefinus*) stocks in the Northeast Atlantic. *Fisheries Research* **109**:61-73.

Johansson, P., Y. Corripio-Miyar, T. Wang, B. Collet, C.J. Secombes and J. Zou. (2012). Characterisation and expression analysis of the rainbow trout (*Oncorhynchus mykiss*) homologue of the human dendritic cell marker CD208/lysosomal associated membrane protein 3. *Developmental and Comparative Immunology*. **37 (3-4):** 402-413.

Johansson, P., J. Zou, B. Collet, C. Secombes and Y. Corripio-Miyar. (2011). Characterising dendritic cells in fish. *Immunology* **135**:112-112.

Kroencke, I., H. Reiss, J.D. Eggleton, J. Aldridge, M.J.N. Bergman, S. Cochrane, J.A. Craeymeersch, S. Degraer, N. Desroy, J-M. Dewarumez, G.C.A. Duineveld, K. Essink, H. Hillewaert, M.S.S. Lavaleye, A. Moll, S. Nehring, R. Newell, E. Oug, T. Pohlmann, E. Rachor, M. Robertson, H. Rumohr, M. Schratzberger, R. Smith, E.Vanden Berghe, J. van Dalfsen, G. van Hoey, M. Vincx, W. Willems and H.L. Rees. (2011). Changes in North Sea macrofauna communities and species distribution between 1986 and 2000. *Estuarine Coastal and Shelf Science* **94 (1)**: 1-15.

Langton, R., I.M. Davies and B.E. Scott. (2011). Seabird conservation and tidal stream and wave power generation: Information needs for predicting and managing potential impacts. *Marine Policy* **35 (5)**:623-630.

Lester, K., J. Black and D.W. Bruno. (2012). Prevalence of salmonid alphavirus in Scottish fish farms from 2006 to 2007. *Bulletin of the European Association of Fish Pathologists* **31 (5)**:199-204.

Lester, K., M. Hall, K. Urquhart, S. Gahlawat and B. Collet. (2012). Development of an in vitro system to measure the sensitivity to the antiviral Mx protein of fish viruses. *Journal of Virological Methods*. **182**(1-2): 1-8.

Malcolm, I.A, P.J. Bacon, S.J. Middlemas, R.J. Fryer, E.W. Shilland and P. Collen. (2012). Relationships between hydrochemistry and the presence of juvenile brown trout (*Salmo trutta*) in headwater streams recovering from acidification. *Ecological Indicators (special issue on acid recovery)*. **Online version March 2012 at present**

Malcolm, I.A., C.N. Gibbins, R.J. Fryer, J. Keay, D. Tetzlaff and C. Soulsby. (2012). The Influence of forestry on acidification and recovery: Insights from long-term hydrochemical and invertebrate data. *Ecological Indicators (special issue on acid recovery)*. **Online version January 2012 at present**

Malcolm, I.A., S.N. Gibbins, H.J. Moir, C. Soulsby and D. Tetzlaff. (2011). The Influence of hydrology and hydraulics on salmonids between spawning and emergence: implications for the management of flows in regulated rivers. *Fisheries Management and Ecology*. **Online version January 2012 at present**

Malcolm, I.A., A.F. Youngson, C. Soulsby and C. Imholt. (2011). Is interstitial velocity a good predictor of salmonid embryo survival? *Transactions of the American Fisheries Society* **140 (4)**:898-904.

Marcos-Lopez, M., S.W. Feist, R. Hicks and P.A. Noguera. (2011). Systemic megalocytivirus infection in three-spined stickleback *Gasterosteus aculeatus*. *Bulletin of the European Association of Fish Pathologists* **31 (6)**:227-234.

Marjara, I., N. Bain and O. Evensen. (2011). Naïve Atlantic salmon (*Salmo salar* L.) surviving a lethal challenge with infectious pancreatic necrosis virus (IPNV) shows upregulation of antiviral genes in head-kidney, including Vig-2. *Aquaculture* **318**:300-308.

Martinez, I., E.G. Jones, S.L. Davie, F.C. Neat, B.D. Wigham and I.G. Priede. (2011). Variability in behaviour of four fish species attracted to baited underwater cameras in the North Sea. *Hydrobiologia* **670 (1)**:23-34.

Matejusová, I., F. Bland, A.J. Hall, R.N. Harris, M. Snow, A.Douglas and S.J. Middlemas. (2012). Real time PCR assays for the identification of harbor and gray seal species and sex: a new tool for ecology and management. *Marine Mammal Science.* **Online version March 2012 at present.**

Mauritzen, C., E. Hansen, M. Andersson, B. Berx, A. Beszczynska-Moeller, I. Burud, K.H. Christensen, J.

Debernard, L. de Steur, P. Dodd, S. Gerland, O. Godoy, B. Hansen, S. Hudson, F. Hoydalsvik, R. Ingvaldsen, P.E. Isachsen, Y. Kasajima, I. Koszalka, K.M. Kovacs, M. Koltzow, J. LaCasce, C.M. Lee, T. Lavergne, C. Lydersen, M. Nicolaus, F. Nilsen, O.A. Nost, K.A. Orvik, M. Reigstad, H. Schyberg, L. Seuthe, O. Skagseth, J. Skarohamar, R. Skogseth, A. Sperrevik, C. Svensen, H. Soiland, S.H. Teigen, V. Tverberg and C. Wexels Riser. (2011). Closing the loop - Approaches to monitoring the state of the Arctic Mediterranean during the International Polar Year 2007-2008. *Progress in Oceanography* **90 (1-4)**:62-89.

Mayor, D.J., K. Cook, B. Thornton, P. Walsham, U.F.M. Witte, A.F. Zuur and T.R. Anderson. (2011). Absorption efficiencies and basal turnover of C, N and fatty acids in a marine Calanoid copepod. *Functional Ecology* **25 (3)**:509-518.

Mayor, D.J., N.R. Everett and K. Cook. (2012). End of century ocean warming and acidification effects on reproductive success in a temperate marine copepod. *Journal of Plankton Research* **34 (3)**:258-262.

McBeath, A., M. Fourrier, E. Munro, K. Falk and M. Snow. (2011). Presence of a full length highly polymorphic region (HPR) in the ISAV haemagglutinin-esterase does not affect the primary functions of receptor binding and esterase activity. *Archives of Virology* **156 (12)**:2285-2289.

McGinnity, P., E. De Eyto, J. Gilbey, P. Gargan, W. Roche, T. Stafford, M. McGarrigle, N. O'Maoileidigh and P. Mills. (2012). A predictive model for estimating river habitat area using GIS-derived catchment and river variables. *Fisheries Management and Ecology* **19 (1)**:69-77.

McIntosh, A.D., R.J. Fryer, L. Webster and A.B. Cundy. (2012). Long-term fate of polycyclic aromotic hydrocarbons (PAH) in sediments from Loch Leven after closure of an aluminium smelter. *Journal of Environmental Monitoring* **14 (5)**:1335-1344.

Munchow, A., K. K. Falkner, H. Melling, B. Rabe and H. L. Johnson. (2011). Ocean warming of Nares Strait bottom waters off northwest Greenland, 2003-2009. *Oceanography* **24 (3)**:114-123.

Munro, L.A. and I.S. Wallace. (2012). Analysis of farmed fish movements between catchments identifies a simple compartmentalised management strategy for bacterial kidney disease in Scottish aquaculture. *Aquaculture* **338-341**:300-303.

Murray, A.G. (2011). A simple model to assess selection of treatment-resistant sea lice. *Ecological Modelling* **222**:1854-1862.

Murray, A.G. (2012). Modelling management strategies for bacterial kidney disease in Scottish salmonid aquaculture. *Epidemics* **3**:171-182.

Murray, A.G., L.A. Munro, I.S. Wallace, C.E.T. Allan, E.J. Peeler and M.A. Thrush. (2012). Epidemiology of *Renibacterium salmoninarum* in Scotland and the potential for compartmentalised management of salmon and trout farming areas. *Aquaculture* **324-325**:1-13.

Neat, F. and N. Campbell. (2011). Demersal fish diversity of the isolated Rockall plateau compared with the adjacent west coast shelf of Scotland. *Biological Journal of the Linnean Society* **104 (1)**:138-147.

Needle, C.L. and R. Catarino. (2011). Evaluating the effect of real-time closures on cod targeting. *ICES Journal of Marine Science* **68 (8)**:1647-1655.

Nislow, K. and J.D. Armstrong. (2011). Towards a life-history-based management framework for the effects of flow on juvenile salmonids in streams and rivers. *Fisheries Management and Ecology.* **Online version October 2011 at present**.

O'Brien, T. D., P.H. Wiebe and S. Hay. (2011). *ICES Zooplankton Status Report 2008/2009*. No 307, *ICES Cooperative Research Report*. Copenhagen: ICES. 155pp.

O'Hara Murray, R.B., D.M. Hodgson and P.D. Thorne. (2012). Wave groups and sediment resuspension processes over evolving sandy bedforms. *Continental Shelf Research.* **Online version March 2012 at present**

Ondrackova, M., I. Matejusova and J. Grabowska. (2012). Introduction of *Gyrodactylus perccotti* (Monogenea) into Europe on its invasive fish host, Amur sleeper (*Perccottus glenii*, Dybowski 1877). *Helminthologia* **49 (1)**:21-26.

O'Neill, F. G. and K. Summerbell. (2011). The mobilisation of sediment by demersal otter trawls. *Marine Pollution Bulletin* **62 (5)**:1088-1097.

Pert, C.C., A.J. Mordue (Luntz), B. O'Shea and I.R. Bricknell. (2012). The settlement and reproductive success of *Lepeophtheirus salmonis* (Ktoyer 1837; Copepoda: Caligidae) on atypical hosts. *Aquaculture Research* **43 (6)**:799-805.

Picon-Camacho, S.M., M. Marcos-Lopez, J.E. Bron and A.P. Shinn. (2012). An assessment of the use of drug and non-drug interventions in the treatment of *Ichthyophthirius multifiliis* Fouquet, 1876, a protozoan parasite of freshwater fish. *Parasitology* **139**:149-190.

Rabe, B., H.L. Johnson, A. Muenchow and H. Melling. (In press). Geostrophic ocean currents and freshwater fluxes across the Canadian polar shelf via Nares Strait. *Journal of Marine Research*.

Reid, D., J.D. Armstrong and N.B. Metcalfe. (2011). Estimated standard metabolic rate interacts with territory quality and density to determine the growth rates of juvenile Atlantic salmon. *Functional Ecology* **25 (6)**:1360-1367.

Reid, D., J.D. Armstrong and N.B. Metcalfe. (2012). The performance advantage of a high resting metabolic rate in juvenile salmon is habitat dependent. *Journal of Animal Ecology* **81 (4)**:868-875.

Reid, D.G., N. Graham, D.J. Rihan, E. Kelly, I.R. Gatt, F. Griffin, H.D. Gerritsen and R.J. Kynoch. (2011). Do big boats tow big nets? *ICES Journal of Marine Science* **68 (8)**:1663-1669.

Reid, D.G., R.J. Kynoch, I. Penny, K. Summerbell, A. Edridge and F.G. O'Neill. (2012). A comparison of the GOV survey trawl with a commercial whitefish trawl. *Fisheries Research* **121-122**:136–143.

Russell, M., C.D. Robinson, P. Walsham, L. Webster and C.F. Moffat. (2011). Persistent organic pollutants and trace metals in sediments close to Scottish marine fish farms. *Aquaculture* **319 (1-2)**:262-271.

Salama, N. K. G. and A. G. Murray (2012). Farm Size as a Factor in Hydrodynamic Transmission of Pathogens in Aquaculture Fish Production. *Aquaculture Environment Interactions* **2**(1):61-74.

Serpetti, N., M. Heath, E. Armstrong and U. Witte. (2011). Blending single beam RoxAnn and multi-beam swathe QTC hydro-acoustic discrimination techniques for the Stonehaven area, Scotland, UK. *Journal of Sea Research* **65 (4)**:442-455.

Serpetti, N., M. Heath, M. Rose and U. Witte. (2012). High resolution mapping of sediment organic matter from acoustic reflectance data. *Hydrobiologia* **680 (1)**:265-284.

Shephard, S., D.G. Reid and S.P.R. Greenstreet. (2011). Interpreting the large fish indicator for the Celtic Sea. *ICES Journal of Marine Science* **68 (9)**:1963-1972.

Shutler, J.D., K. Davidson, P.I. Miller, S. Swan, M.G. Grant and E. Bresnan. (2012). An adaptive approach to detect high biomass algal blooms from EO chlorophyll-*a* data in support of harmful algal bloom monitoring. *Remote Sensing Letters* **3 (2)**:101-110.

Snow, M. (2011). The contribution of molecular epidemiology to the understanding and control of viral diseases of salmonid aquaculture. *Veterinary Research* **42**(56): 1-12.

Soares, S., D.M. Green, J.F. Turnbull, M. Crumlish and A.G. Murray. (2011). A baseline method for benchmarking mortality losses in Atlantic salmon (*Salmo salar*) production. *Aquaculture* **314 (1-4)**:7-12.

Stebbing, P., P. Johnson, A. Delahunty, P.F. Clark, T. McCollin, C. Hale and S. Clark. (2012). Reports of American Lobsters, *Homarus americanus* (H.Milne Edwards, 1837), in British waters. *Bioinvasions Records* **1**:17-23.

Thrush, M., A.G. Murray, E. Brun, I.S. Wallace and E.J. Peeler. (2011). The application of risk and disease modelling to emerging freshwater diseases in wild aquatic animals. *Freshwater Biology* **56 (4)**:658-675.

Tobin, D. and P.J. Wright. (2011). Temperature effects on female maturation in a temperate marine fish. *Journal of Experimental Marine Biology and Ecology* **403 (1-2)**:9-13.

Ulrich, C., S.A. Reeves, Y. Vermand, S.J. Holmes and W. Vanhee. (2011). Reconciling single-species TACs in the North Sea demersal fisheries using the Fcube mixed-fisheries advice framework. *ICES Journal of Marine Science* **68 (7)**:1535-1547.

Vasilakopoulos, P., F. G. O'Neill and C.T. Marshall. (2011). Misspent youth: does catching immature fish affect fisheries sustainability? *ICES Journal of Marine Science* **68 (7)**:1525-1534.

Webster, L., M. Russell, P. Walsham, L.A. Phillips, I. Hussy, G. Packer, E.J. Dalgarno and C.F. Moffat. (2011). An assessment of persistent organic pollutants in Scottish coastal and offshore marine environments. *Journal of Environmental Monitoring* **13**:1288-1307.

Webster, L., P. Walsham, M. Russell, I. Hussy, F. Neat, E. Dalgarno, G. Packer, J.A. Scurfield and C.F. Moffat. (2011). Halogenated persistent organic pollutants in three species of deep water fish. *Chemosphere* **83 (6)**:839–850.

Werkman, M., D.M. Green, L.A. Munro, A.G. Murray and J.F. Turnbull. (2011). Seasonality and heterogeneity of live fish movements in Scottish fish farms. *Diseases of Aquatic Organisms* **96**:69-82.

Winfield, I.J., C.E. Adams, J.D. Armstrong, W.R. Gardiner, A. Kirika, J. Montgomery, B.M. Spears, D.C. Stewart, J.E. Thorpe and W. Wilson. (2012). Changes in the fish community of Loch Leven: untangling anthropogenic pressures. *Hydrobiologia* **681**:73-84.

Wright, P.J., C.P. Millar and F.M. Gibb. (2011). Intrastock differences in maturation schedules of Atlantic cod, *Gadus morhua*. *ICES Journal of Marine Science* **68 (9)**:1918-1927.

Yates, K., P. Pollard, I.M. Davies, L. Webster and C.F. Moffat. (2011). Application of silicone rubber passive samplers to investigating the bioaccumulation of PAHs in *Nereis virens* from marine sediments. *Environmental Poulltion* **159**:3351-3356.

Youngson, A.F., S.B. Piertney, J.L. Thorley, I.A. Malcolm and C. Soulsby. (2011). Spatial association of nest construction by brown trout (*Salmo trutta*). *Journal of Fish Biology*, **78 (3):**713-725.

Book Chapters & Editor (9)

Bruno, D.W., P. van West and G.W. Beakes. (2011). *Saprolegnia* and other Oomycetes. In *Fish Diseases and Disorders, Volume 3: Viral, Bacterial and Fungal Infections. 2nd edition*, edited by D. W. Bruno and P. T. K. Woo. Wallingford: CABI Publishing: 669-720.

Bruno, D. W. and P. T. K. Woo (2011). *Fish Diseases and Disorders, Volume 3: Viral, Bacterial and Fungal Infections. 2nd edition*. Wallingford, CABI Publishing. **(Book Editor)**

Finstad, A.G., J.D. Armstrong and K.H. Nislow. (2011). Freshwater habitat requirements of Atlantic salmon. In *Atlantic salmon ecology*, edited by O. Aas, A. Klemetsen, S. Einum and J. Skurdal. Chichester: Wiley-Blackwell**:** 67-88.

Gallego, A. (2011). Bio-physical models: an evolving tool in marine ecological research. In *Modelling Complex Ecological Dynamics: An Introduction into Ecological Modelling for Students, Teachers & Scientists,* edited by F. Jopp, B. Breckling and H. Reuter. London: Springer: 279-290.

Gallego, A., E.W. North, E.D. Houde (eds). (2012). Understanding and quantifying mortality in pelagic, early life stafes of marine organisms: experiments, observations and models (WKMOR) special issue. *Journal of Marine Systems* **93**:1-94.

Moffat, C.F., L. Webster and R. Fryer. (2011). Classical chemical monitoring of the marine environment. In *Chemical marine monitoring – policy framework and analytical trends*, edited by P. Quevauviller, P. Roose and G. Verreet. Chichester: John Wiley and Sons Ltd**:** 225-259.

Murray, A.G., T.L. Amundrud, M.J. Penston, C.C. Pert and S.J. Middlemas. (2011). Abundance and distribution of larval sea lice in Scoottish coastal waters. In *Salmon lice: an integrated approach to understanding parasite abundance and distribution*, edited by S. Jones and R. Beamish. Chichester: Wiley-Blackwell**:** 51-82.

Smail, D.A. and E.S. Munro. (2012). The virology of teleosts. In *Fish Pathology*, edited by R. Roberts. Oxford: Wiley Blackwell**:** 186-291.

Smail, D.A. and M. Snow. (2010). Viral haemorragic septicaemia. In *Fish Diseases and Disorders Vol. 3, Viral , Bacterial and Fungal Infections*, edited by P. T. K. Woo and D. W. Bruno. Cambridge: CABI Publishing**:** 110-142.

Scottish Marine and Freshwater Science Series (11)

Davies, I.M. and R. Watret. (2011). Scoping study for offshore windfarm development. *Scottish Marine and Freshwater Science* **2(13)**:51pp.

Dobby, H. and L. Allan. (2011). The Scottish Industry-Science Anglerfish Tallybook Scheme. *Scottish Marine and Freshwater Science* **2(9)**:21pp.

Drewery, J., J. Mair, A. Edridge and F. G. O'Neill. (2011). 35 and 40 mm Swedish Grids in a Scottish *Nephrops* Trawl Fishery. *Scottish Marine and Freshwater Science* **2(4)**:18pp.

Drewery, J., J. Pirie, J. Mair, A. Edridge, R.J. Kynoch and F.G. O'Neill. (2011). 45 mm flexible grids in a Scottish *Nephrops* fishery. *Scottish Marine and Freshwater Science* **2(5)**:18pp.

Godfrey, J.D. and A.E. Thorne. (2011). Variation in the results of hydroacoustic surveys of Scottish lochs: the importance of season, diurnal timing and fish species assemblage. *Scottish Marine and Freshwater Science* **2(8)**:33pp.

Godfrey, J.D., A.E. Thorne and A.F. Youngson. (2011). Hydroacoustic surveys of five Scottish lochs. *Scottish Marine and Freshwater Science* **2(7)**:27pp.

Kynoch, R. J., F. G. O'Neill and K. Summerbell. (2011). 300, 600 and 800 mm diamond mesh belly panels in demersal whitefish trawl fisheries. *Scottish Marine and Freshwater Science* **2(6)**:17pp.

Mesquita, C., H. Dobby and A. McLay. (2011). Crab and lobster fisheries in Scotland: results of stock assessments 2006 - 2008. *Scottish Marine and Freshwater Science* **2(11)**:105pp.

Murray, A.G., L.A. Munro, I.S. Wallace, E.J. Peeler and M.A. Thrush. (2011). Bacterial kidney disease: assessment of risk to Atlantic salmon farms from infection in trout farms and other sources. *Scottish Marine and Freshwater Science* **2(3)** :84pp.

Wallace, I.S., L.A. Munro, R. Kilburn, M. Hall, J. Black, R.S. Raynard and A.G. Murray. (2011). A report on the effectiveness of cage-level and farm level fallowing for the control of diseases (BKD and sleeping disease) on large cage-based trout farms in Scotland. *Scottish Marine and Freshwater Science* **2(10)**:40pp.

Webster, L., I. Hussy, A. Craig, M. Russell, G. Packer, E.J. Dalgarno, D.C. Moore and C.F. Moffat. (2011). Determination and environmental assessment of hydrocarbons in water, fish and sediment following an oil spill at the Gannet oil field. *Scottish Marine and Freshwater Science* **2(12)**:30pp.

Marine Scotland Science Report (19)

Armstrong, J.D., R.M. Armstrong, J.L. Graham, S.J. Middlemas, J.C.H. Ribbens, P. Rycroft and D.C. Stewart. (2012). Movements of Returning Atlantic Salmon Through Tongland Fish Pass. *Marine Scotland Science Report* **05/12**:17pp.

Bailey, N., D.B. Bailey, L.C. Bellini, P.G. Fernandes, C. Fox, S. Heymans, S. Holmes, J. Howe, S. Hughes, S. Magill, F. McIntyre, D. McKee, M.R. Ryan, I.P. Smith, G. Tyldsely, R. Watret and W.R. Turrell. (2011). The west of Scotland marine ecosystem: a review of scientific knowledge. *Marine Scotland Science Report* **09/11**:292pp.

Cauwelier, E., D. Knox, S. Marshall and E. Verspoor. (2011). Genetic Assessment of Sea Trout Populations within West Sutherland: Report on Microsatellite Analysis. *Marine Scotland Science Report* **10/11**:26pp.

Coulson, M.W., M. Halliday, A. Armstrong, E. Cauwelier, L. Stradmeyer, J. Gilbey, C. Sinclair and E. Verspoor. (2012). An Overview of Population Genetic Structuring in the Esks Rivers and Fisheries Trust. *Marine Scotland Science Report* **11/12**:30pp.

Coulson, M.W., L.M.I. Webster, N. Chisholm, A. Armstrong, E. Cauwelier, L. Stradmeyer, J. Gilbey, C. Sinclair and E. Verspoor. (2012). An overview of population genetic structuring in the River Annan. *Marine Scotland Science Report* **01/12**:28pp.

Coulson, M.W., L.M.I. Webster, A. Kettle-White, A. Armstrong, E. Cauwelier, L. Stradmeyer, J. Gilbey, C. Sinclair and E. Verspoor. (2011). An overview of population genetic structuring in the Argyll Fisheries Trust. *Marine Scotland Science Report* **08/11**:30pp.

Coulson, M.W., L.M.I. Webster, R. Miller, A. Armstrong, E. Cauwelier, L. Stradmeyer, J. Gilbey, C. Sinclair and E. Verspoor. (2012). An Overview of Population Genetic Structering in the Deveron. *Marine Scotland Science Report* **03/12**:30pp.

Coulson, M.W., L.M.I. Webster, J. Urquhart, A. Armstrong, E. Cauwelier, L. Stradmeyer, J. Gilbey, C. Sinclair and E. Verspoor. (2012). An Overview of Population Genetic Structuring in the River Don. *Marine Scotland Science Report* **2/12**:28pp.

Drewery, J., M. Watt, R.J. Kynoch, A. Edridge, J. Mair and F.G. O'Neill. (2011). Catch comparison trials of the Flip Flap netting grid trawl. *Marine Scotland Science Report* **08/12**:16pp.

Gilbey, J., L. Stradmeyer, E. Cauwelier and S.J. Middlemas. (2012). Genetic Investigation of the North East English Net Fisheries. *Marine Scotland Science Report. Delivered in partnership with the Environment Agency, England.* **04/12**:83pp.

Glover, R. (2011). Deeside Monitoring Sites: Site Report 2010-2011. *Marine Scotland Science Report* **07/11**:17pp.

Howell, T.R.W., S.E.B. Davies, J. Turriff, H.A. McLay, P. Gibson, L. Allan, G. Jones, M. Harding and A. Tait. (2011). Survey of Solway cockle grounds 2008. *Marine Scotland Science Report* **06/12**:66pp.

Howell, T.R.W., H. Dobby, J. Turriff, P. Gibson, L. Allan, G. Jones, M. Harding, N. Campbell and H.A. McLay. (2011). Survey of Solway cockle grounds 2009. *Marine Scotland Science Report* **07/12**:70pp.

MacKay, F. and G. smith. (2011). Sampling North Esk Juvenile Salmon Populations by Means of Rotary Screw Traps (RSTs): 12. Water of Mark, Spring 2010. *Marine Scotland Science Report* **06/11**:16pp.

McCollin, T., D. Lichtman, E. Bresnan and B. Berx. (2011). A study of phytoplankton communities along a hydrographic transect on the North East coast of Scotland. *Marine Scotland Science Report* **04/11**:41pp.

Russell, M., G. Packer, P. Walsham, D.C. Moore and C.F. Moffat. (2012). Environmental assessment of the Elgin gas field incident - report 1, sensory assessment. *Marine Scotland Science Report* **09/12**:9pp.

Webster, L., M. Russell, I. Hussy, G. Packer, E.J. Dalgarno, D.C. Moore and C.F. Moffat. (2012). Environmental assessment of the Elgin gas field incident - report 2, water and sediment. *Marine Scotland Science Report* **10/12**:21pp.

Webster, L., M. Russell, I. Hussy, G. Packer, E.J. Dalgarno, D.C. Moore and C.F. Moffat. (2012). Environmental assessment of the Elgin gas field incident - report 3, water update. *Marine Scotland Science Report* **12/12**:18pp.

Webster, L., M. Russell, I. Hussy, G. Packer, L.A. Phillips, E.J. Dalgarno, D.C. Moore and C.F. Moffat. (2012). Environmental assessment of the Elgin gas field incident - report 4, fish muscle. *Marine Scotland Science Report* **13/12**:19pp.

ICES Annual Science Conference Presentations (12)

Bresnan, E., S.L. Hughes, S. Fraser, A-L. Amorim, K.W. Smith, P. Walsham, L. Webster, B. Berx, G. Slesser, J. Rasmussen and S. Hay. (2011). Observed changes in the marine phytoplankton community in the northeast of Scotland over the last decade. *ICES CM* **B:08**.

Davies, I.M., M. Harrald, M. Robertson and R. Watret. (2011). Facilitation of wave and tidal power developments through the application of a spatial planning approach. *ICES CM* **S:10**.

Davies, I.M., M. Robertson, G. Jones, R. Watret and J. McKie. (2011). Test centre to commercial arrays: progress towards wave and tidal energy in Scotland. *ICES CM* **S:12**.

Davies, I.M. and F. Thompson. (2011). Assessment of collision risk for seals and tidal stream turbines. *ICES CM* **S:11**.

Demain, D.K., A. Gallego, C. Millar, I.G. Priede and E.G. Jones. (2011). Temporal settlement patterns and size at transition of juvenile cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*) and whiting (*Merlangius merlangus*) in the northern North Sea. *ICES CM* **H:07**.

Fernandes, P., L. Scala, N. Collie, M. Stewart and F. McIntyre. (2011). Surveying sparsely distributed fish in large closed areas: a visual technique. *ICES CM* **B:09**.

Harrald, M., M. Robertson, P.J. Hayes and I.M. Davies. (2011). Marine Scotland Science: regional seabed habitat mapping contributing to planning for marine renewable energy development. *ICES CM* **S:03**.

Hayes, P.J., M. Harrald and I.M. Davies. (2011). Marine Scotland Science: contribution of bathymetric surveys to marine planning for renewable energy developments off the west coast of Lewis. *ICES CM* **S:02**.

Hughes, S., N.P. Holliday, F. Gaillard and ICES Working Group on Oceanic Hydrography. (2011). The ICES Report on Ocean Climate: variability in the ICES region. *ICES/NAFO Decadal Symposium 2011* **Ref K:1**.

Langton, R., B.E. Scott and I.M. Davies. (2011). A simulation modelling approach to predicting the impact on seabirds of generating power from waves and tides. *ICES CM* **S:21**.

McGregor, R., A. Douse, G. Lees and I.M. Davies. (2011). Ornithological interactions with wave and tidal energy developments in Scotland – filling the knowledge gaps. *ICES CM* **S:07**.

Robertson, M.R., M. Harrald, T. LeBas, P.J. Hayes and I.M. Davies. (2011). A comparative study of three methods for the derivation of seabed habitat information from multibeam acoustic backscatter data. *ICES CM* **S:22**.

Contributions to Meetings and Other Publications (70)

Scottish sea fisheries statistics 2010. (2011). Edinburgh: Scottish Government: 85pp.

Augley, J., S. Devalla, C. Robinson, P.J. Wright and F. Neat. (2011). Juveniles connect isolated grenadier aggregations in the NE Atlantic. *MASTS Annual Science Meeting, Aug 22-24. Edinburgh Conference Centre, Heriot-Watt University, UK*.

Bain, N. (2011). Infectious Pancreatic Necrosis History in Scotland. What can we do now? *Novartis IPN meeting, 14 November 2011, Edinburgh, UK.*

Balaam, J., P. Bersuder, T. Bolam, J. Dobson, A. Gravell, C.D. Robinson, F. Smedes, L. Steven and R. Thomas (2011). Project C3461 – From Marine Strategy Framework to Good Environmental Status: The use of passive sampling for monitoring offshore waters. *Cefas report to Defra*: 74pp.

Bresnan, E., M. Edwards, R. Stern, S.L. Hughes, S. Fraser, D.G. Johns and J.P. Lacaze. (2011). Changes in the diversity of the dinoflagellate genus Dinophysis (Ehrenberg) in the north west North Sea. *World Conference on Marine Biodiversity, September 2011, Aberdeen, UK*.

Bruno, D.W. (2012). Haemorrhagic smolt syndrome. *Fish Farmer*.

Bruno, D.W., D. Elliott and B. Nowak. (2012). Lymphoid organ pathology. *Split 2011 histopathology workshop. CD. ISBN 00-9546666-6-6*.

Bruno, D.W. and A.M. Shanks. (2011). Long-term fish health monitoring in the common dab (*Limanda limanda*) in the northern North Sea. *European Association of Fish Pathologists Conference, 11 September, Split, Croatia.*

Cook, K., M. Penston, J. Rasmussen, J. Fraser, S. Robinson, P. MacLachlan, J. Dunn and S. Hay. (2011). Interannual variation in 'indicator' chaetognaths off the east and west coasts of Scotland. *ICES/NAFO Symposium on the Variability of the North Atlantic and its Marine Ecosystems during 2000–2009, 10-12 May 2011, Santander, Spain.*

Devalla, S., C.D. Robinson, L. Webster, M. Darding and A. Fernandes. (2011). Trace Elements in Food and the EU Marine Strategy Framework Directive: The Scottish experience *4th International IUPAC Symposium for Trace Elements in Food, 20-22 June, Aberdeen, UK*.

Dymond, P., C.D. Robinson, J. Balaam and L. Webster. (2011). Estimation of Freely-dissolved Background and Background Assessment Concentrations of PAHs and PCBs in Scottish Waters. *4th International Passive Sampling Workshop and Symposium, 11-14 May 2011, Krakow, Poland*.

Dymond, P., C.D. Robinson, L. Webster, I.M. Davies and J. Balaam. (2011). The use of silicone rubber passive samplers as a tool to monitor organic pollutants in the marine environment. *Scottish Marine Group Open Meeting, 20 October 2011, University of the Highlands and Islands, Perth, UK*.

Emelogu, E.S., P. Pollard, C.D. Robinson, L. Webster, C. McKenzie, F. Napier, T.B. Seiler and C.F Moffat. (2011). Investigation of organic contaminants in the catchment area of Scotland using passive sampling and *in vitro* bioassays. *Scottish Marine Group Open Meeting, 20 October 2011, University of the Highlands and Islands, Perth, UK*.

Emelogu, E.S., C.D. Robinson, L. Webster, C.F. Moffat, F. Napier, P. Pollard and C. McKenzie (2011). Field application of silicone rubber passive samplers in monitoring aqueous freely-dissolved concentrations of organic contaminants in the Ythan catchment area of Scotland. *4th International Passive Sampling Workshop and Symposium, 11–14 May 2011, Krakow, Poland*.

Emelogu, E.S., C.D. Robinson, L. Webster, C.F. Moffat, P. Pollard, C. McKenzie and F. Napier. (2011). Biological effects assessment of freely-dissolved hydrophobic organic contaminants (HOCs) from water bodies of Ythan catchment area of Scotland using silicone rubber passive sampling (PS) and dosing (PD) techniques. *4th International Passive Sampling Workshop and Symposium, 11 – 14 May 2011, Krakow, Poland*.

Fraser, D.I. (2011). United Kingdom (UK) epidemiological report 2010, including England, Scotland, Wales & Northern Ireland *Report of the Annual Meeting of the National Reference Laboratories for Mollusc Diseases, IFREMER, 2011 Report*.

Glover, R., A. Thorne and P.J. Bacon. (2011). Rotary Screw trap on the Water of Cruick. *Atlantic Salmon Trust e-Newsletter.*

Graham, J., C. Collins, L. Brown, E. Bresnan, E. Turrell and M. Gubbins. (2011). Evidence of possible hybridisation in *Alexandrium tamarense* from Scottish waters using TaqMan PCR (QPCR) and traditional PCR. *NERC SOFI Workshop on Genomics Technologies for Marine Models, 5-6 April 2011, Oban, UK*.

Green, D.M., M. Werkman and L.A. Munro. (2011). The potential for targeted surveillance of live fish movements in Scotland. *European Association of Fish Pathologists 15th Annual Conference on Fish and Shellfish Health, 12-15 September 2011, Split, Croatia.*

Grunow, B., P. Noguera, K. Lester, M. Gebert and C. Kurse. (2011). *In vitro* developed long-term autonomously contracting cardiomyogenic aggregate for studying viral infections in fish. *European Association of Fish Pathologists 15th Annual Conference on Fish and Shellfish Health, 12 -15 September 2011, Split, Croatia.*

Hall, L.M., S. Duguid and I.S. Wallace. (2012). Surveillance Indicates a Difference in the Prevalence of R. salmoninarium Infected Salmon and Trout Farms in Scotland. *Society for Veterinary Epidemiology and Preventive Medicine Meeting, 28-30 March 2012, Glasgow, UK.*

Hall, L.M., I.S. Wallace, L.A. Munro and A.G. Murray. (2011). Epidemiology informs policy regarding surveillance of a notifiable disease of salmonids. *Epidemiolgie et Santé Animale: Proceedings of the International Conference on Animal Health Surveillance (ICAHS), 17-20 May 2011, Lyon, France*. **59-60**: p392-394.

Helliwell, R., J. Aherne, G. MacDougall, T. Nisbet, S. Broadmeadow, J. Sample, L. Jackson-Blake, R. Doughty and I.A. Malcolm. (2011). Modelling the long-term response of stream water chemistry to atmospheric pollution and forestry practices in Galloway, SW Scotland – available online at http://www.forestry.gov.uk/pdf/FC_Galloway_water_report_27sep11.pdf/$FILE/FC_Galloway_water_report_27sep11.pdf: 84pp.

Keltz, S. and N. Bailey. (2012). *Fish and shellfish stocks 2012*. Edinburgh, Scottish Government.

Lester, K., M. Hall, S.K. Gahlawat and B. Collet. (2011). Antiviral activity of the MX protein in salmonids cells. *European Association of Fish Pathologists 15th Annual Conference on Fish and Shellfish Health, 12-15 September 2011, Split, Croatia.*

MacLean, J. C. (2011). *Scottish salmon and sea trout fishery statistics: a report of the stakeholder feedback exercise 2011.* Edinburgh, Scottish Government.

Maguire, S. (2012). Economics and science in disease management. *Fish Farmer* **January/February**: 20-21.

Marcos-Lopez, M., S.W. Feist and P.A. Noguera. (2011). Iridovirus infection in stickleback (*Gasterostreus Aculeatus*). *European Association of Fish Pathologists Conference, 11 September 2011, Split, Croatia.*

Marcos-Lopez, M. and P.A. Noguera. (2011). Haplosporidian-like parasite in blue mussels (*Mytilus Edulis*) in Scotland, UK. *European Association of Fish Pathologists Conference, 11 September 2011, Split, Croatia.*

Matejusova, I., N. Bain, L.M. Hall, U. McCarthy, M. Snow, I.S. Wallace and A.G. Murray. (2011). Characterisation of a Tandem Repeat Polymorphism in *Renibacterium salmoninarum* and its use in Management of the Bacterial Kidney Disease in Scottish Aquaculture. *European Association of Fish Pathologists 15th Annual Conference on Fish and Shellfish Health, 12-15 September 2011, Split, Croatia.*

Mayes, A.S. and D.I. Fraser (2011). *Scottish shellfish farm production survey 2010*. Edinburgh, Scottish Government, 19pp.

Mayes, A.S. and D.I. Fraser (2012). *Scottish shellfish farm production survey 2011*. Edinburgh, Scottish Government, 20pp.

McCollin, T. and L. Brown. (2011). Assessing the risk of transporting non native species to Scotland via biofouling on vessels. *World Conference on Marine Biodiversity, September 2011, Aberdeen, UK.*

Méndez-Fernandez, P., B. Simon-Bouhet, P. Bustamante, T. Chouvelon, M. Ferreira, A. López, C.F. Moffat, G.J. Pierce, M. Russell, M.B. Santos, J. Spitz, J. Vingada, L. Webster and Caurant F. (2012). Concentrations and patterns of polychlorinated biphenyls in five toothed whale species from the NW Iberian Peninsula. *26th European Cetacean Society Conference 2012, 26-28 March 2012, Galway, Ireland.*

Minghetti, M., V. Zacchino, S.G. George, C.D. Robinson and M.J. Leaver. (2011). Effects of environmental pollutant exposure on the flounder hepatic transcriptome: pathways of ecotoxicity and novel biomarkers. *NERC / SOFI Workshop on "-omics" Technologies for Marine Models, 5-6 April 2011, Scottish Association for Marine Science, Oban, UK.*

Moffat, C.F. (2011). Are we getting it right in terms of managing our seas? How can we manage our seas in the real world? *Plymouth Marine Science Partnership and the Marine Management Organisation Conference, 13–14 September 2011, Plymouth, UK.*

Moffat, C.F. (2012). Considering the present and the future for marine biodiversity. *Joint British Society of Soil Science/British Ecological Society/Scottish Government meeting, Challenges for Scotland's Biodiversity Conservation: From the Soils to the Skies, 8–9 March 2012, Edinburgh, UK.*

Moffat, C.F. and D. Johnson. (2011). The state of the Northeast Atlantic marine environment and marine biodiversity – successes and future challenges. *Seas the Future, Nordic Oceans Conference, 7–8 June 2011, Tórshavn, Faroe Islands*.

Moffat, C.F. and R. Proudfoot. (2012). Marine monitoring: developing the response from coastal to ocean assessment. *Coastal Futures 2012 – Review and Future Trends, 18–19 January 2012, London, UK*.

Monteiro, S., M.B. Santos, M. Ferreira, A. Marçalo, J.V. Vingada, A. López, D. Feijó, A. Moreno, R.J. Reid, A. Brownlow, P. Walsham, C. Moffat and G.J. Pierce. (2012). The use of ecological tracers such as fatty acid profiles to discriminate Pilot whale (*Globicephala melas*) population structure in Atlantic waters. *26th European Cetacean Society Conference 2012, 26–28 March 2012, Galway, Ireland*.

Munro, E.S. (2011). Infectious salmon anaemia and HPR0 - an overview. *15th Annual Meeting of the National Reference Laboratories for Fish Diseases, 26-27 May 2011, Aarhus, Denmark*.

Munro, E.S. , K.J. Stewart, W.J. Murray and O.L.M. Haenen. (2011). Characterisation of a virus isolated from farmed European eel elvers (*Anguilla anguilla*) undergoing a mortality event in the Netherlands. *15th International Conference on Diseases of Fish and Shellfish, 12-16 September 2011, Split, Croatia*.

Munro, L.A. and I.S. Wallace. (2012). A Simple Compartmentalised Management Strategy for Control of Bacterial Kidney Disease in Scottish Aquaculture. *Society for Veterinary Epidemiology and Preventive Medicine Meeting, 28-30 March, Glasgow, UK*.

Murray, A.G. and L.A. Munro. (2012). A Simple Model of Disease Spread and Targeted Surviellance in the Scottish Fish Farm Network. *Society for Veterinary Epidemiology and Preventive Medicine Meeting, 28-30 March, Glasgow, UK*.

Murray, A.G., M. Hall, L.A. Munro and I.S. Wallace. (2011). Modelling control options for a disease with hidden sub-clinical infection: bacterial kidney disease in Scottish aquaculture. In *MODSIM2011, 19th International Congress on Modelling and Simulation. Modelling and Simulation Society of Australia and New Zealand, December 2011*, edited by F. Chan, D. Marinova and R.S. Anderssen**:** 947-953.

Murray, A.G., S. Soares and D.M. Green. (2011). Benchmarking losses in salmon farms. *Fish Farmer Magazine* **May/June** 44.

Noguera, P.A., C. Collins, C.C. Pert, N. MacManus and D.W. Bruno. (2011). Distribution of *Anisakis simplex* larvae in wild adult Atlantic salmon (*Salmo Salar*) affected by red vent syndrome. *European Association of Fish Pathologists Conference, 11 September, Split, Croatia*.

Noguera, P.A., S.W. Feist, T. Lang, F. Baumgart, M. Fourrier and D.W. Bruno. (2011). An Investigation into the cause of hyperpigmentation in the common dab (*Limanda limanda*) in the North Sea. *European Association of Fish Pathologsts Conference, 11 September 2011, Split, Croatia*.

Ojaveer, H., S. Olenin, D. Minchin, A. Amorim, J. Canning-Clode, P. Chainho, G. Copp, B. Galil, S. Gollasch, A. Jelmert, S. Kacan, F. Kerkhof, I. Laing, M. Lehtiniemi, T. McCollin, C. McKenzie, J. Mikus, L. Miossec, A. Occhipinti, M. Pecarevic, J. Pederson, G. Quilez-Badia, A. Sneekes, L. Urho, J. Wijsman and A. Zenetos. (2012). Descriptior 2 of the Marine Strategy Framework: ten suggestions to move forward. *EU Marine Strategy Framework Conference, Copenhagen, Denmark*.

Penston, M.J., K. Cook, J. Rasmussen, J. Fraser, S. Robinson, P. MacLachlan, J. Dunn and S. Hay. (2011). Seasonal and interannual variation of two Calanus species off the east and west coasts of Scotland. *ICES/ NAFO Symposium on the Variability of the North Atlantic and its Marine Ecosystems during 2000–2009, 10-12 May 2011, Santander, Spain.*

Pert, C.C., P. Noguera and D.W. Bruno (2011). Investigating the prevalence of red vent syndrome (RVS) in wild Atlantic salmon (*Salmo salar* L.) around the Scottish coastal zone. *ISFP conference, 26-30 September 2011, Vina del Mar, Chile*.

Pert, C.C., S.J. Weir, S.R.M. Jones and I.R. Bricknell. (2011). The role of three-spined sticklebacks in *Lepeophtheirus salmonis* (Krøyer, 1837) transmission in Scottish sea lochs. *ISFP conference, 26-30 September 2011, Vina del Mar, Chile*.

Robinson, C.D. (2011). Environmental Monitoring and (eco)Toxicology at Marine Scotland Science. *Scottish Toxicology Interest Group, 15 June 2011, University of Aberdeen, UK*.

Robinson, C.D., M. Gubbins, B. Lyons, J. Bignell, J. Thain, T. Bean, L. Webster, J. Dobson and I.M. Davies. (2011). Towards an integrated assessment of marine environmental status using monitoring of contaminants and their effects in mussels (*Mytilus edulis*). *Marine Alliance for Science & Technology for Scotland (MASTS) Annual Science Meeting, 22-24 August 2011, Heriot-Watt University, Edinburgh, UK*.

Russell, M., L. Webster and C.F. Moffat. (2011). Marine litter: a problem in Scotland's seas? *MASTS Annual Science Meeting: Science to Support the Marine Plan, 22–24 August 2011, Heriot-Watt University, Edinburgh, UK.*

Salama, N.K.G., C.M. Collins, A.G. Murray, S.J. Middlemas, J. Dunn, J. Fraser, C.C. Pert and B. Rabe. (2012). Investigating sea lice dispersal in Loch Linnhe. *Society for Veterinary Epidemiology and Preventive Medicine Meeting, March 28-30 2012, Glasgow, UK*.

Salama, N.K.G. and A.G Murray. (2012). Fish farm size and surrounding water current speed dictate the separation required to avoid transmission of disease agents between production sites. In *Proceedings of the Society for Veterinary Epidemiology and Preventive Medicine Meeting 28-30 March 2012.* Roslin: Society for Veterinary Epidemiology and Preventive Medicine: 41-55.

Salama, N.K.G., A.G. Murray and B. Rabe. (2011). Modelling dispersal of salmon in a large fjordic salmon farming system: Loch Linnhe Scotland. In *MODSIM2011,19th International Congress on Modelling and Simulation. Modelling and Simulation Society of Australia and New Zealand, December 2011*, edited by F. Chan, D. Marinova and R. S. Anderssen. 2156-2162.

Salama, N.K.G., B. Rabe, A.G Murray, C.C. Pert, M.J. Penston, S.J. Middlemas and C.M. Collins. (2011). A multidisciplinary approach to the development of sea lice dispersal models in Scotland. *Atlantic Salmon Trust Journal*: 42-43.

Salama, N.K.G., B. Rabe, A.G. Murray, C.C. Pert, M.J. Penston, S.J. Middlemas and C.M. Collins. (2011). Sea Lice dispersal in Loch Linnhe. *MASTS annual science meeting, 22-24th August 2011, Heriot-Watt University, Edinburgh, UK*.

Shilland, E.M., R.W. Battarbee, R.J. Flower, J. Keay, I. Malcolm, A. McCartney, D.T. Monteith, K. Roe, N.L. Rose and H. Yang. (2011). Land-Use Experiments in the Loch Laidon Catchment: 2011 Report on Stream Water Quality to the Rannoch Trust. *ECRC Research Report Number 148*.

Soares, S., D.M. Green, A.G. Murray, J.F. Turnbull and M. Crumlish. (2011). Importance of diagnoses in aquaculture management. *European Association of Fish Pathologists 15th Annual Conference on Fish and Shellfish Health, 12-15 September 2011, Split, Croatia.*

Soares, S., A.G. Murray, M. Crumlish, T.F. Turnbull and D.M. Green. (2011). Elevated mortailty as an indicator of presence of disease. *European Association of Fish Pathologists 15th Annual Conference on Fish and Shellfish Health, 12-15 September 2011, Split, Croatia.*

Stutter, M.I., N. Baggaley, C. Barry, S. Chapman, J.J.C. Dawson, R.C. Helliwell, A. Higgins, N. Howden, L. Jackson-Blake, D.G. Lumsdon, I. Malcolm, J. Sample, J. Potts and F. Worrall. (2011). Assessment of the contribution of aquatic carbon fluxes to carbon losses from UK peatlands. *SNIFFER. Final Report Project ER18*.

Walker, A.J. and J.M. McAlister. (2011). *Scottish fish farm production survey 2010*. Edinburgh, Scottish Government, 50pp.

Wallace, I.S., N.L. Purvis, M. Hall and I. Matejusova. (2012). Spatial Analysis of a Gyrodactylid Surrveillance Data Set. *Society for Veterinary Epidemiology and Preventive Medicine Meeting 28-30 March 2012, Glasgow, UK*.

Walsham, P., L. Webster, M. Rose and C. Moffat. (2011). The winter nutrient status of Scottish Coastal and offshore waters: 2001 – 2009. *ICES/NAFO Symposium on the Variability of the North Atlantic and its Marine Ecosystems during 2000 – 2009, 10–12 May 2011, Santander, Spain*.

Webster, L., M. Russell, J. Dobson, L.A. Phillips, I. Hussy and C.F. Moffat. (2011). Are Scotland's seas clean and safe with respect to persistent organic pollutants? *MASTS Annual Science Meeting: Science to Support the Marine Plan, 22–24 August 2011, Edinburgh, UK.*

Werkman, M., D.M. Green, L.A. Munro, A.G. Murray and J.F. Turnbull. (2012). Seasonality in live fish movements and their effects on epidemics. *Society of Veterinary Epidemiology and Preventive Medicine, March 28-30 March 2012, Glasgow, UK.*

Werkman, M., L.A. Munro, D.M. Green, A.G. Murray and J.F. Turnbull. (2011). Seasonality and heterogeneity in live fish movements and their implication for Scottish aquaculture. *British Society of Animal Science, Annual Conference, 4-5 April 2011, University of Nottingham, UK*.