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VERSION 1.0, PUBLISHED AUGUST 2016

SCIENCE REVIEW 2015/16

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ABSTRACT BOOKLET

MARINE SCOTLAND SCIENCE STAFF PUBLICATIONS 2015/16



**HEAD OF SCIENCE:
Prof. Colin Moffat**

VISION

To provide robust research and advice underpinning the management of Scotland's marine and freshwater resources.

KEY MESSAGE

Marine Scotland Science will enhance our reputation for reliable advice and high quality science, ensuring that all staff are valued and contribute fully to Scotland's future.



INTRODUCTION

High quality science and advice that has an impact is fundamental to Marine Scotland Science (MSS). In this new-style, electronic Science Review 2015-16, there are many examples of delivery with impact. Whether these are supporting Scotland's aquaculture production to the highest level in terms of volume and value, providing the economic analyses needed to implement the management measures for inshore Marine Protected Areas, providing world leading science on understanding how sea lice are distributed in the environment, leading to strategic sea lice control or implementing the new Conservation Regulations for salmon, all have direct impact. The associated underpinning work often draws on long data series, and knowledge and expertise built up over many years.

As well as providing specific advice to Scottish Government (SG) policy divisions and other national stakeholders, MSS expertise influences the development and implementation of international policy and regulations through participation in the International Council for the Exploration of the Sea (ICES), the OSPAR Commission and other international organisations. The breadth and depth of our impact in our external networks can be seen in the representation section of this report and further details of the impact of MSS are presented in the programme summaries.

Ensuring that our science is of an appropriate quality is the responsibility of every member of staff and all the students at MSS. External scrutiny is essential to provide an independent assessment of the quality of our science and advice. To facilitate this, the MSS Quality Manager oversees a network of specialised staff who undertake audits and ensure that the MSS Quality System operates effectively. The annual United Kingdom Accreditation Service (UKAS) visit assessed a range of accredited methods against the ISO 17025 Testing and 17020 Inspection standards. UKAS praised staff working in MSS on their excellent technical competence and quality system knowledge. For the second year in succession, the audit programme was fully up to date at the end of the calendar year. Further information about the MSS Quality System is presented in the Quality section of this review.

Information is our currency. In order to improve our management of information our Quality, Data and Information Technology (IT) managers have worked closely to develop a set of baseline information management standards, and have developed an assessment process to measure how well each stage of the information lifecycle is performed.

External scrutiny of our science is also provided by the Marine Scotland (MS) Science Advisory Board (SAB) which has, over the last two years, undertaken an assessment of



INTRODUCTION

each science programme. Under the skilled chairmanship of Professor Selina Stead, the SAB will present its findings and conclusions to the Marine Scotland Board during the summer of 2016.

Integration of natural and socioeconomic sciences with policy contributes significantly to the delivery and impact of MSS. The Marine Analytical Unit now delivers socioeconomic advice and services in the same manner as the other science programmes. The integration of socioeconomic and the natural sciences is now common place across a range of MSS projects.

MSS collaborate with a plethora of organisations. Some are local and include both the University of Aberdeen (through the Marine Collaboration Research Forum (MarCRF) partnership) and the Robert Gordon University. Others are Scottish organisations. For example, MSS is integral to the Coordinated Agenda for Marine, Environmental and Rural Affairs Science (CAMERAS) and the Marine Alliance for Science and Technology for Scotland (MASTS). The former includes organisations such as the Scottish Environment Protection Agency (SEPA) and Scottish Natural Heritage (SNH), while MASTS provides links to a number of Universities across Scotland, a graduate school and hosts the largest annual marine science and technology conference in the UK. At a UK level MSS is represented right across the UK Marine Monitoring and Assessment Strategy (UKMMAS) implementation structures, contributing to the

delivery of the Scottish vision for clean, healthy, safe, productive, and biologically diverse marine and coastal environments managed to meet the long-term needs of people and nature.

As a part of Marine Scotland, MSS has contributed to stakeholder engagement through the Marine Strategy Forum. Our Science, Technology, Engineering and Mathematics (STEM) Ambassadors have been heavily involved with local schools, education programmes and science centres and, led by our Communications team, the MSS contribution to 'Doors Open Day' in Aberdeen was highly valued by those who visited the Marine Laboratory.

Good economic performance and a safe working environment are equally as important as any of the items mentioned thus far. During 2015/16 MSS ended the year on-budget, while our new Safety Advisor undertook their first tranche of training.

Whether in Aberdeen or Pitlochry, Edinburgh or Montrose, MSS operations are well known. Ultimately this is due to the dedication of all our staff and students, whatever part they play in the delivery of MSS – each individual makes an impact.

This has been a challenging year, but I am genuinely proud of what MSS has achieved. I would like to thank everybody who has contributed to ensuring that, despite some difficulties and exigent circumstances, MSS has made a real impact in 2015/16.

HEADLINE STORY 2015/16 – MARINE PROTECTED AREAS

30

NATURE CONSERVATION
MARINE PROTECTED AREAS
(MPAs) DESIGNATED BY
MINISTERS

2014

23%

THE EXTENT OF SCOTLAND'S
MPA NETWORK

80

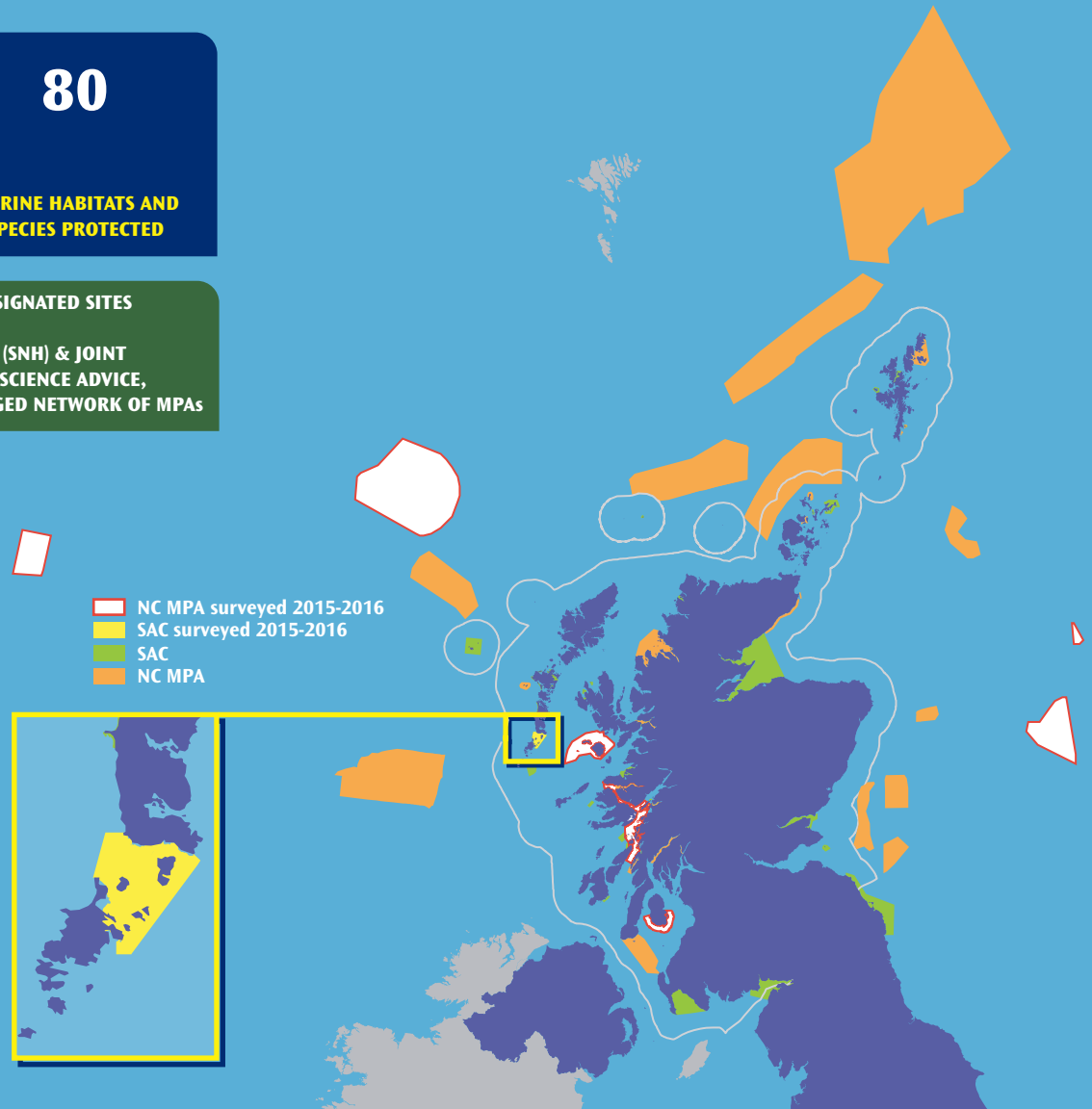
MARINE HABITATS AND
SPECIES PROTECTED

2016 MANAGEMENT MEASURES WERE ANNOUNCED FOR THE FIRST PHASE OF DESIGNATED SITES

MARINE SCOTLAND SCIENCE (MSS) AND PARTNERS SCOTTISH NATURAL HERITAGE (SNH) & JOINT NATURE CONSERVATION COMMITTEE (JNCC) PROVIDED THE EVIDENCE BASE AND SCIENCE ADVICE, WHICH LED TO THESE IMPORTANT MILESTONES TO HELP ACHIEVE A WELL MANAGED NETWORK OF MPAs

DURING 2015/16 MSS DELIVERED:

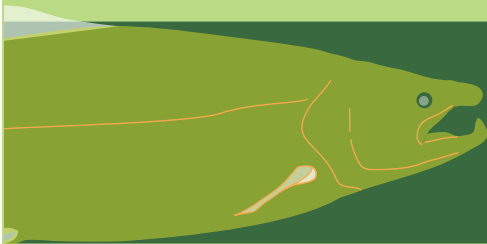
- ▶ Surveys to monitor the seabed features of 8 of the designated MPAs
- ▶ A robust survey design to detect future changes at the Small Isles MPA
- ▶ Advice on the impacts of management measures on inshore fishing
- ▶ Research on the movement of flapper skate on the west coast, helping to inform the designation and management measures of inshore NCMPAs
- ▶ Species distribution models to better inform future revisions of the MPA network by estimating the wider distribution of protected features



SAC = Special Area of Conservation

NCMPA = Nature Conservation Marine Protected Area

HEADLINE STORY 2015/16 – FRESHWATER FISHERIES



THE SCOTTISH WILD FISHERIES REVIEW (2014)

◀◀ AS SOON AS IS PRACTICABLE MINISTERS SHOULD INTRODUCE A BAN ON THE KILLING OF WILD SALMON IN SCOTLAND EXCEPT UNDER LICENCE ▶▶

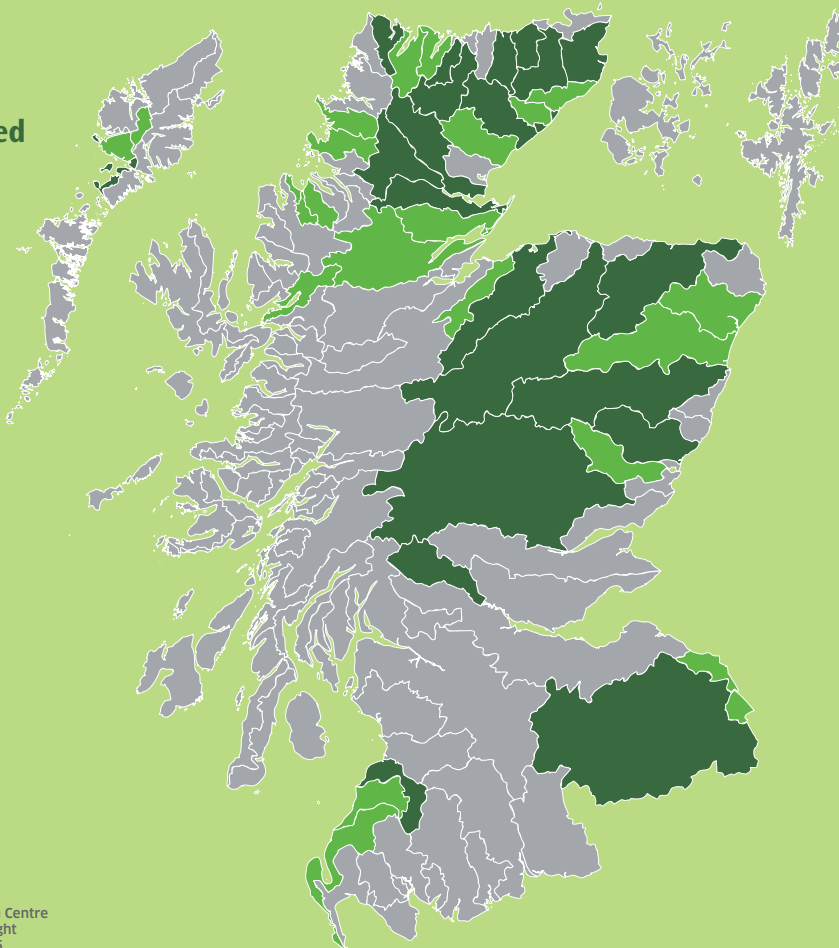
After extensive consultation with stakeholders and consideration of practicalities, Marine Scotland devised and implemented a system to grade salmon fisheries districts and SACs on the basis of conservation status determined by best available scientific information.

Areas (fisheries districts and SACs) were each allocated to one of three grades:

GRADE 1:
good conservation status:
KILLING OF SALMON ALLOWED

GRADE 2:
moderate conservation status:
REDUCE EXPLOITATION

GRADE 3:
poor conservation status:
NO KILLING OF SALMON



Conservation status is assessed as the likelihood that sufficient salmon spawn to exceed a conservation limit. Deriving estimates for the stocks of salmon and the conservation limits, draws on a wide range of scientific information, including rod catches, fish counts and biological parameters such as sizes of salmon, sex ratios and numbers of eggs in each female.

Models have been produced using data collected by Marine Scotland and others over many decades.

Information is now being refined by networks of biologists at both local and national scales. Such stakeholder engagement will help inform the methods and data used in future assessments.

Some features of the map are based on digital spatial data licensed from Centre for Ecology and Hydrology, © NERC, © Crown copyright and database right (2016). All rights reserved Ordnance Survey License number 100024655

PROGRAMME MANAGER:
Dr. Rob R aynard

OBJECTIVE:

The Aquaculture and Fish Health Programme (AFH) provides regulation and scientific advice underpinned by research to support the Scottish Government's vision of a sustainable and growing aquaculture industry, while safeguarding the high health status of farmed and wild fish and shellfish stocks in Scotland.

SCIENCE DELIVERY:

Service Level Agreements (SLAs):	14
Research Projects:	4
External Contracts:	7
Peer-reviewed papers:	21
Book chapter:	0
Government Reports, Conference Proceedings etc:	18
Commissioned Reports:	0

AQUACULTURE AND FISH HEALTH (AFH)

« 275 site inspections conducted »»

AQUACULTURE AND FISH HEALTH

Key Highlights and Impact from 2015/16

- Developed new research collaborations through the Biotechnology and Biological Sciences Research Council (BBSRC) & Natural Environment Research Council (NERC) aquaculture initiative, Scottish Aquaculture Innovation Centre (SAIC) and European Union (EU) funding through Horizon 2020.
- Increased industry interest in developing contracts to deliver research and technical services through the high bio-contained aquaria and using the expertise of the programme.
- Supported the increase in Scotland's Aquaculture production to the highest level both in terms of volume and value. (The overall value to the Scottish economy is estimated to be £1.4 billion per annum with predictions of £2 billion by 2020 if growth targets are achieved).
- Contributed to the management of significant risk to sustainable aquaculture through regulation under the Aquatic Animal Health Regulations and the

Aquaculture and Fisheries (Scotland) Acts. All of these statutory obligations were delivered.

- Presented at industry focussed technical meetings, addressing some of the key challenges to aquaculture. These included the Pancreas Disease Tri-Nation meeting and Gill Health Platforms.
- Provided world leading science in understanding how sea lice are distributed in the environment. This is informing industry and the Fish Health Inspectorate in strategic sea lice control. The developments on the threshold for reporting and action on sea lice was a major achievement for the Fish Health Inspectorate.
- Contributed scientific evidence on interactions between aquaculture and wild salmonids for an International Council for the Exploration of the Sea (ICES) working group. The report from that working group is the basis for the development of key international advice.

AQUACULTURE AND FISH HEALTH

Delivery Against Key Programme Objectives

- Completed a programme of surveillance, inspection, testing and regulation in support of aquatic animal health and growth in sustainable aquaculture, in line with National Marine Plan targets.
- Provided regulation requiring prevention, control and reduction of sea lice and the prevention of the escape of fish at fish farms.
- Provided assurance over the health status of animal stocks in Scotland's aquaculture industry.
- Protected safe trade in aquatic animals and markets for aquaculture products.
- Developed a programme of research that underpins the management of disease risks.
- Provided advice to Local Authorities.
- Published two annual aquaculture production surveys (official statistics).
- Contributed to the Multi-Annual National Control Plan (MANCP) for the UK. <https://www.food.gov.uk/enforcement/regulation/europeleg/feedandfood/ncpuk>
- Conducted risk-based inspections of all fish and shellfish farms and responded to reports of mortality/other issues. The number of fish health inspection cases that disease investigation and testing took place at were:
 - 33 from fish farm site
 - 4 from shellfish sites
 - 2 from still water fisheries
 - 16 from wild fish
- Maintained UKAS accreditation for testing and inspections.
- Continued to develop and improve diagnostic methods.
- Tested the national contingency plan for *Gyrodactylus salaris* with the Department for Environment, Food & Rural Affairs (Defra).
- Developed an assessment tool for disease emergence and testing data to provide the Fish Health Inspectorate with alerts for emerging disease.



PROGRAMME MANAGER:
Stuart MacDonald

OBJECTIVE:

The Business Operations and IT Programme (BOIT) supports science delivery through direct participation in research and monitoring projects and indirectly in providing the following support functions:

- **IT** – Contributing to the ‘Enabling our Business’ strategy.
- **Health and Safety** – Delivery of the Health and Safety (H&S) management system.
- **Finance and Contracts** – Provision of financial and contract management and related management information.
- **Freshwater Fisheries Science Support** – Provision of localised admin and library support at Freshwater Fisheries Laboratory, Pitlochry.
- **Learning and Development** – Delivery of the training programme across Science, Marine Planning and Policy and Compliance and provision of guidance, coaching and support to all staff.
- **Business Support** – Support for Head of Science, Programme Managers and their teams, liaison with corporate functions.

BUSINESS OPERATIONS AND IT (BOIT)

◀◀ 720 days of training provided for Science staff ▶▶

BUSINESS OPERATIONS AND IT

Key Highlights and Impact from 2015/16

- Progressed The Royal Society for the Prevention of Accidents (RoSPA) recommendations.
- Provided critical GIS input across MS Divisions supporting policy priorities.
- Ensured that legacy IT and software applications were maintained and where necessary updated to maintain functionality.
- Successfully delivered an extensive training development plan, through collaboration with the wider public sector, which also included significant individual coaching and mentoring of staff across MS Divisions and locations.
- Provided improved financial information and processes in relation to budget planning and monitoring including support to external income bids.
- Updated the business management support provided to the Head of Science and wider MSS.
- Delivered improved Health and Safety through the implementation of new policies and procedures.
- Delivered staff seminars on finance and corporate issues to raise awareness and improve the business.
- Enhanced the working relationships with shared service providers.
- Replaced Video Conferencing equipment.

Delivery Against Key Programme Objectives

- Provision of expert financial advice in relation to MSS activities including contract income.
- Facilitated areas of collaborative working to deliver maximum value for money for Scottish Government in Learning and Development, IT and Health and Safety.
- Delivery of planned programme of process improvements across the support functions including streamlined financial planning, safer and improved infrastructure.
- Developed and implemented more detailed management information with regards to budgeting, staff complement, studentships and external income.

PROGRAMME MANAGER:
Dr. Bill Turrell

OBJECTIVE:

The Environment Monitoring and Assessment Programme (EMA) runs two principal monitoring areas: Clean and Safe Seas focussing on the chemical content of our waters, seabed habitats and living resources, and; Healthy and Biologically Diverse Seas which monitors: phytoplankton and zooplankton, and water column properties such as temperature, salinity and nutrients. In addition to monitoring, assessment and advice, the programme also undertakes a range of research projects concerning the marine environment and marine ecosystems.

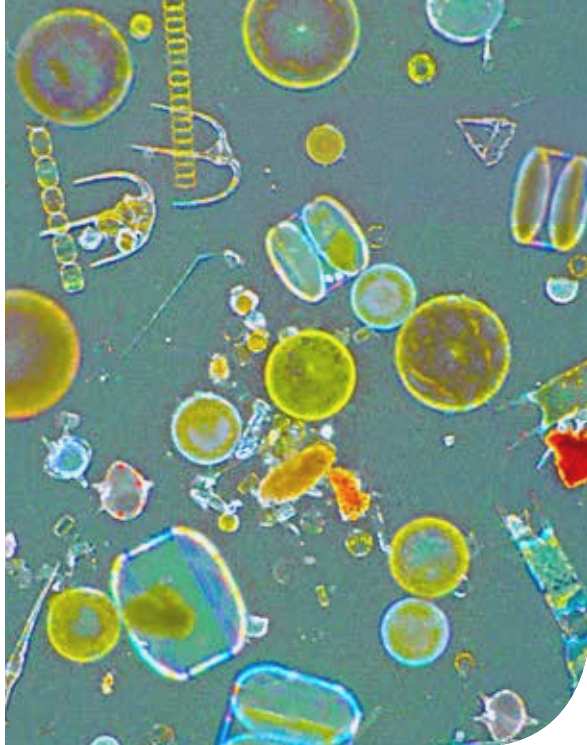
SCIENCE DELIVERY:

Service Level Agreements (SLAs):	11
Research Projects:	6
External Contracts:	6
Peer-reviewed papers:	18
Book chapter:	0
Government Reports, Conference Proceedings etc:	31
Commissioned Reports:	0

ENVIRONMENT MONITORING AND ASSESSMENT (EMA)

“ More than 29,000 environmental samples taken from 6 sites around Scotland’s coasts since 1997 ”

ENVIRONMENT MONITORING AND ASSESSMENT



Key Highlights and Impact from 2015/16

- Delivered the Scottish ecosystem and environmental monitoring programmes and quality-assured data submission.
- Completed the 5-year programme to collate, quality assure and archive a decade of coastal ecosystem monitoring in Scotland in readiness for its use in regional planning and ecosystem health assessments.
- Made progress towards a coherent multi-national data set describing fish community structure in the OSPAR

Convention maritime area (North-East Atlantic).

- Continued to support the Clyde 2020 process with the establishment of a Research Advice Group, publication of juvenile fish studies and publication of industry-led white fish survey.
- Compiled and disseminated MSS incident response guidelines.
- Provided advice in support of policy response to the finding of the invasive carpet sea squirt *Didemnum vexillum* in Loch Creran.
- Delivered the National Marine Plan interactive (NMPi) climate change data layer draft report.
- Submitted Environmental data to ICES, OSPAR and national data centres, which have been used for initial preparation and assessment of Marine Strategy Framework Directive (MSFD) related indicators.
- Prepared the fish community database.
- Supported the Clyde 2020 initiative.
- Contributed to the national Evidence Groups helping the UK progress towards delivery of its commitments for the OSPAR Intermediate Assessment 2017, and the 2018 national assessment.

Delivery Against Key Programme Objectives

- Made good progress with collating, quality assuring and publishing underlying data sets.
- Published summaries of regional environmental data which will provide input to regional assessments and the MSFD Article 12 Assessment, including:
 - **Decadal review of inshore ecosystem monitoring.**
- Prepared evidence for the OSPAR Intermediate Assessment 2017, including indicator development, preparation of data and data systems and preliminary analysis for common indicators for which the UK has lead responsibility.
- Provided data layers on Scottish ocean climate status and environmental monitoring for NMPi.
- Produced guidance on MSS incident response capability.

PROGRAMME MANAGER:
Dr John Armstrong

OBJECTIVE:

The Freshwater Fisheries Programme delivers regulation and scientific advice underpinned by research to support the Scottish Government's vision of productive freshwater fisheries with clear social and economic benefits.

SCIENCE DELIVERY:

Service Level Agreements (SLAs):	13
Research Projects:	2
External Contracts:	9
Peer-reviewed papers:	10
Book chapter:	0
Government Reports, Conference Proceedings etc:	27
Commissioned Reports:	1

FRESHWATER FISHERIES (FF)

“ 1,857 salmon and sea trout catch returns processed ”



FRESHWATER FISHERIES

Delivery Against Key Programme Objectives

- Managed a Contract Research Fund project to provide technical methods for fish counter installation and operation.
- Installed a fish trap adjacent to the North Esk salmon counter.
- Derived conservation limits for salmon in Scotland.
- Modelled abundance of young salmon in rivers as a function of habitat using a GIS approach then applied to the Rivers South Esk (www.gov.scot/Resource/0049/00497696.pdf) and Dee in support of local management.
- Published Catch statistics for salmon www.gov.scot/Publications/2016/04/3392 and sea trout www.gov.scot/Publications/2016/04/1137 supported by a report on stock status www.gov.scot/Resource/0050/00500249.pdf
- Operated traps at Shildaig and Deeside to continue important time series on production and survival of salmon and sea trout.
- Explored the integration of the River Conon monitoring data to supplement the North Esk as a national monitored river for trend in salmon survival.
- Supported new Conservation Regulations by grading rivers into categories,

determining whether or not killing of salmon can continue.

- Established the mixed-stock nature of net fisheries in North-East England, Armadale and North Esk regions.
- Progressed development of a genetics technique to differentiate river sub-stocks.
- Developed a genetics technique to determine sex of salmon from scales.
- Established a network of acoustic receivers to track the passage of salmon smolts around the Isle of Mull.
- Commenced development of a network of sites for assessing spatial and inter-annual variation in the impact of sea lice on wild salmon.
- Developed a national network of temperature recorders to facilitate a rationalised response to environmental change.
- Continued monitoring of upland chemistry as part of the upland water monitoring and CAMERAS networks.
- Worked closely with River Dee Fisheries Board to develop riverine tree-planting schemes.
- Processed 244 licenses for fisheries activities.

Key Highlights and Impact from 2015/16

- Implemented Conservation Regulations for salmon that balance the conservation of salmon in Scotland with social and economic benefits from exploitation.
- Established a river temperature network in collaboration with stakeholders to facilitate informed management response to climate change.
- Commenced development of a network of trap sites to assess effects of sea lice on salmon in support of sustainable development of aquaculture.
- Completed a report of an investigation of South Esk salmon.

PROGRAMME MANAGER:
Dr Cornilius Chikwama

OBJECTIVE:

The Marine Analytical Unit (MAU) ensures access to the necessary socio-economic and statistical advice and analysis to ensure effective policy development and operational delivery. It provides evidence that is used to develop policies which encourage the continued growth and future development of existing and new key sectors, such as aquaculture, fisheries and renewable energy.

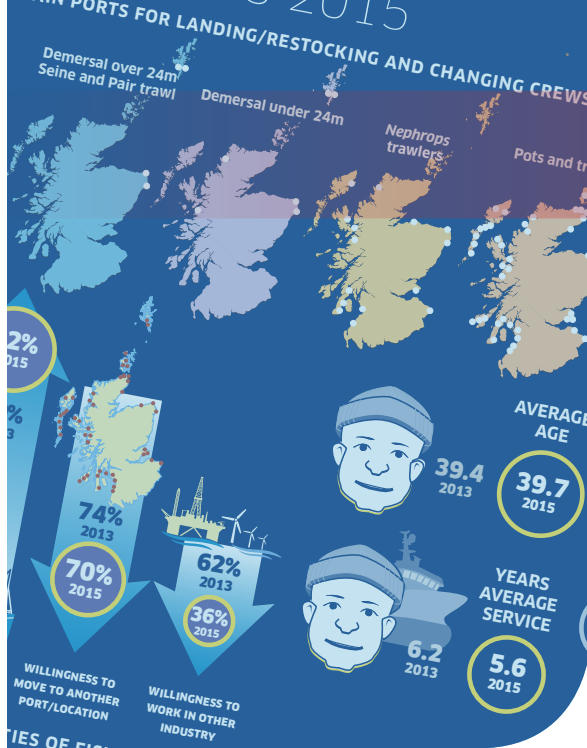
SCIENCE DELIVERY:

Service Level Agreements (SLAs):	13
Research Projects:	2
External Contracts:	9
Peer-reviewed papers:	0
Book chapter:	0
Government Reports, Conference Proceedings etc:	5
Commissioned Reports:	0

MARINE ANALYTICAL UNIT (MAU)

“ 14 Regulatory Impact Assessments of MPA measures undertaken ”

MARINE ANALYTICAL UNIT



Key Highlights and Impact from 2015/16

- Delivered on a programme of economic analysis and evidence that informed and supported Conservation Orders and Inshore Fisheries Orders to implement Phase 1 management measures for Inshore Marine Protected Areas (MPAs) and Special Areas of Conservation (SACs).
- Provided key management information to Marine Scotland's policy divisions, Compliance division and to industry to support fisheries management.
- Delivered a programme of work in partnership with Seafish and Defra to assess how the Landing Obligation will affect the Scottish fishing fleet.

Delivery Against Key Programme Objectives

Maintained up-to-date information on fishing quota allocations and swaps, fishing effort management, weekly reports to Producer Organisations on vessel and voyage quota uptake and on-going support to Marine Scotland's broader science work.

- Delivered the 2015 provisional and final Scottish Sea Fisheries Statistics publications on time and to National Statistics Authority standards.
- Updated Scotland's National Performance Framework marine indicator, including responding to the Rural Affairs, Climate Change and Environment's (RACCE) committee on drivers of change for the indicator and progress towards developing an improved indicator.
- Contributed directly to meeting Marine Scotland's obligation to provide data to the European Commission and coordinated with the Marine Management Organisation (MMO) to fulfil the UK's obligations under EC Data Collection Framework (DCF) regulation and for EU audit purposes.
- Completed Business Regulatory Impact Assessments (BRIAs) bringing together the science-led arguments for management measures and an assessment of associated social and economic consequences for five Orders passed at the start of 2016.
- Produced a report assessing the economic impacts of MPA management measures on the fishing industry – key evidence that supported Ministerial decisions and views of the RACCE committee on the Orders. Further work is on-going to develop a framework to monitor the socioeconomic impacts of MPAs linked to the fishing industry - a Ministerial commitment to Parliament.
- Delivered socioeconomic analysis and advice to guide the development and implementation of policies for sea fisheries, aquaculture and recreational fisheries, and to deliver the European Maritime and Fisheries Fund (EMFF).
- Contributed to delivering a programme of work to assess the economic impacts of the Landing Obligation – working with Seafish and Defra economics teams.
- Conducted the 'Scottish Sea Fisheries Employment' survey to provide current information on the profile of Scotland's sea fisheries labour force and remuneration practices in the Scottish fishing fleet.
- Delivered a programme of work to estimate the contributions of wild fresh water recreational fisheries (mainly salmon, sea trout and coarse angling and netting) to Scotland's economy and trends in the sector. The work provides key baseline evidence that will guide Marine Scotland's work on Wild Fisheries Reform.

PROGRAMME MANAGER:
Dr Matt Gubbins

PLANNING AND ENVIRONMENTAL ADVICE (PEA)

OBJECTIVE:

The Planning and Environmental Advice Programme (PEA) provides the evidence base to support the development of national and regional planning and the development of a network of Marine Protected Areas in Scottish waters. It also provides advice to Scottish Government on monitoring, environmental assessments and management measures to achieve Good Environmental Status for the Marine Strategy Framework Directive (MSFD).

SCIENCE DELIVERY:

Service Level Agreements (SLAs):	9
Research Projects:	2
External Contracts:	5
Peer-reviewed papers:	11
Book chapter:	0
Government Reports, Conference Proceedings etc:	6
Commissioned Reports:	0

« 8 Marine Protected Areas surveyed »

PLANNING AND ENVIRONMENTAL ADVICE

Key Highlights and Impact from 2015/16

- Contributed heavily to the Scottish Marine Protected Area (MPA) project with management measures agreed for inshore sites. This is the culmination of several year's work for Marine Scotland with support from Science.
- Produced significant publications on the Clyde cod closure, the impacts of deep sea fishing and protected features of the MPA network.
- Completed surveys of eight protected areas with one of these involving the confirmed discovery of a unique deepwater ecosystem, with significant press interest at the time and multiple publications planned.
- Conducted an investigation, in collaboration with University of Glasgow, into depth related changes in deep water fish composition and identified a depth zone beyond which by-catch rapidly increased.
- Studied the effectiveness of the Clyde cod seasonal closure, in collaboration with University of Glasgow, and found that this measure had no detectable effect in halting the decline in mature cod.
- Led a review about the nature of cod population structuring in the North Sea and presented it to an ICES workshop. This has led ICES requesting the monitoring of the population components included in the North Sea stock.
- Conducted scientific investigations into flapper skate and sandeel connectivity and survival which have underpinned the design and management options discussed for a number of nature conservation MPAs.
- Undertaken species distribution modelling and survey work to help refine our knowledge of some species of conservation priority informing nature conservation MPA measures.



PLANNING AND ENVIRONMENTAL ADVICE

Delivery Against Key Programme Objectives

- Provided advice and a review on Regional Marine Planning for Clyde and Shetland Regions.
- Developed spatial data to support with the development of further spawning maps for commercial fish species and aquaculture locational guidance.
- Completed a research project showing proof of concept for monitoring methodology and PEA took ownership of the emerging Scottish MPA monitoring strategy for development in 2016.
- Communicated the outputs of a project to map the constraints and opportunities to develop the aquaculture industry in Scottish waters.
- Chaired the ICES Working Group on Marine Planning and Coastal Zone Management and staff have been invited speakers at the EUs MSP Expert Group in 2016.
- Chaired a sub-group focussing on MPA Monitoring Assessment and Reporting in 2016. Research on flapper skate, sea pens, fan mussels and connectivity of protected benthic features with planktonic larval stages was all produced during 2015/16 and communicated with the MPA steering group.
- Undertook survey work of an inshore MPA (The Small Isles) in 2015 to inform future effectiveness of management measures.
- Analysed and reported data collected during 2014 of the fish communities, benthic features and hydrocarbon contamination in deep water ecosystems to the north west of Scotland.
- Completed surveys of inshore and offshore Marine Protected Areas to establish baseline status of features in conjunction with MASTS, Joint Nature Conservation Committee (JNCC) and Scottish Natural Heritage (SNH).

PROGRAMME MANAGER:
Dr Ian Davies

RENEWABLES AND ENERGY (RE)

OBJECTIVE:

The Renewables and Energy Programme (RE) applies best regulatory practice supported by high quality science to ensure that renewable energy on land and at sea develop in a planned and sustainable manner, and that supports the regulation of the oil and gas industries. The sustainable management of Scotland's marine and freshwater resources requires us to provide robust science and reliable advice in these areas that are central to Scotland's economic plans.

SCIENCE DELIVERY:

Service Level Agreements (SLAs):	9
Research Projects:	2
External Contracts:	5
Peer-reviewed papers:	4
Book chapter:	0
Government Reports, Conference Proceedings etc:	21
Commissioned Reports:	4

« Provided environmental advice on 1,630 oil and gas industry applications in 2015/16 »»

RENEWABLES AND ENERGY

Key Highlights and Impact from 2015/16

- Provided advice on marine renewables development proposals enabling Marine Scotland Licensing Operations Team (MS-LOT) to make informed judgements on licensing advice such that the industries are able to move forward.
- Provided reliable advice on oil and gas developments that was delivered on time and facilitating Department of Energy and Climate Change (DECC) (now the Department for Business, Energy and Industrial Strategy) in managing these offshore industries to the best advantage of the UK
- Secured external income from the European Union to support marine planning for renewables, and aspects of policy on site characterisation and post-consent monitoring.
- Secured external income from Shell and NERC to work on oil and gas infrastructure, interactions with fisheries, and decommissioning options.
- Deployed acoustic devices for marine mammals.
- Engaged with the process for identification of sea areas for the protection of harbour porpoise in Scottish waters, leading to an area off the west coast being put to consultation in 2016.

- Directed externally commissioned work on the interactions of birds and mammals with marine renewables. This has moved the risk assessment process for renewables forward.

Delivery Against Key Programme Objectives

- Established advisory structures to address post-consent monitoring requirements at marine renewables sites, and identify strategic research needs.
- Agreed post-consent monitoring plans for licensed renewables developments, including east coast windfarms and north coast tidal energy projects.
- Prioritised evidence plans to support the future development of marine renewables.
- Delivered research programmes on:
 - Ecosystem effects of large windfarms.
 - Movements of salmon smolts at sea.
 - Successful progression of external research projects in support of European scale energy resource assessments, and improved approaches to pre-consent renewable energy site characterisation.
 - Delivery of expert, reliable advice to the Department for Energy and Climate Change (DECC) on chemical discharges related to the oil and gas industries.



PROGRAMME MANAGER:
Dr Carey Cunningham

SCIENCE OPERATIONS (SO)

OBJECTIVE:

The Science Operations Programme (SO) provides scientific, engineering and logistics support services to all the science programmes in Marine Scotland Science (MSS). Science Operations contains statisticians, scientists, quality, data and information managers with knowledge and experience to contribute to the planning, construction and operation of various science programmes and projects.

SCIENCE DELIVERY:

Service Level Agreements (SLAs):	29
38 research surveys conducted	
582 days at sea	

« 582 days spent at sea by research vessels »

SCIENCE OPERATIONS

Key Highlights and Impact from 2015/16

- Designed, constructed and deployed underwater equipment including increasing the deployment of high definition (HD) cameras.
- Ensured maximum usage of research vessels, providing the highest number of active science days at sea of any Scottish or UK public research vessel.
- Delivered improved Quality, Data and Information management, making

Marine Scotland Science (MSS) data and information widely available through a new portal.

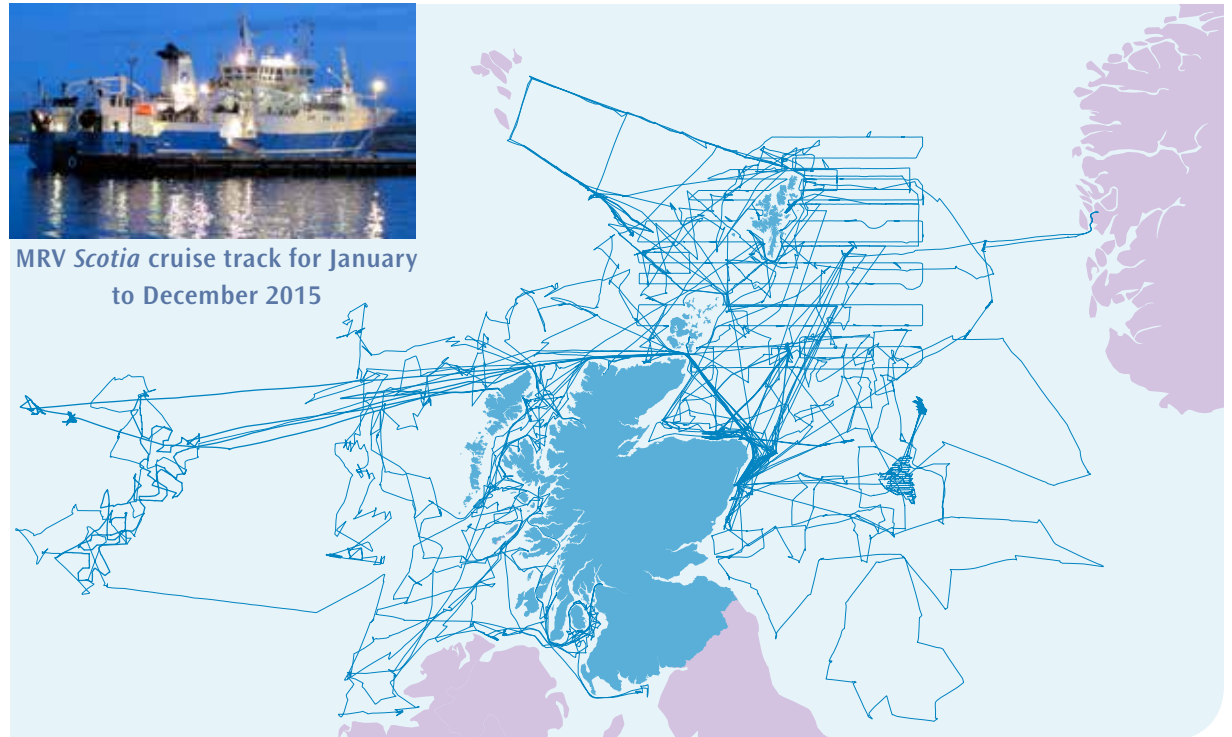
- Provided high quality fisheries data under European obligations, including a commended annual technical report.
- Provided high quality experimental design and data analysis, including the online assessment of levels and trends in marine contaminants and their biological effects for OSPAR.



MRV *Alba na Mara* cruise track for January to December 2015



MRV *Scotia* cruise track for January to December 2015



SCIENCE OPERATIONS

Summary statistics for each research vessel in 2015/16.

	MRV <i>Alba na Mara</i>	MRV <i>Scotia</i>
No. days at sea	289	293
No. surveys completed	20	18
Distance covered on surveys (km)	24,216	68,494



Delivery Against Key Programme Objectives

- Maintained engineering skills and capability whilst ensuring services and expertise are fully available to all science programmes.
- Facilitated the transition to new data collection arrangements by developing a new programme, with other EU member states and the European Commission, to achieve a practical outcome. The annual technical and financial reports were submitted on time and the technical report was complimented.
- Further developed the management of MSS data including a new information portal comprising of datasets and new reports, making them more widely available.
- Supported, assisted and advised areas of MS in relation to their improvement projects.
- Provided expert advice on handling Freedom of Information requests.
- Maintained statistical consultancy capacity.
- Expedited coordination of large research vessels across the UK.
- Promoted work to improve the gender balance within Science and Engineering Divisions of the Scottish Government.

SHIPS

Marine Scotland Science operates two offshore research vessels, MRVs *Scotia* and *Alba na Mara*, and three inshore workboats, including the *Temora* based in Stonehaven. The primary purpose is to conduct fishery and environmental monitoring. Survey vessel data is of critical importance to the provision of high quality scientific evidence and advice for the key policy areas of: sea fisheries management, aquaculture and fish health and marine planning and policy.

2015/16 has been a very busy, but highly successful, year for our vessels, serving Scotland's marine research needs for an impressive 293 and 289 days at sea for the *Scotia* and *Alba na Mara* respectively. Our vessels hosted over 275 scientific staff, engineers, stakeholders, students and visiting colleagues aboard 38 dedicated research surveys. Each vessel has fully equipped laboratories onboard that allow our scientists a unique platform to conduct their research in real time, often changing the course of the survey programme in light of their findings.

MSS is a member of MASTS and continues to collaborate with other MASTS members (e.g. SNH and SEPA) and other organisations such as JNCC through provision of vessel time. In 2015/16 a total of 46 vessel days were assigned to stakeholder surveys.

PROGRAMME MANAGER:
Dr Coby Needle

OBJECTIVE:

The Sea Fisheries Programme (SF) provides innovative science and sound advice to managers and stakeholders which leads to sustainable sea fisheries and enhances the potential for economic growth.

SCIENCE DELIVERY:

Service Level Agreements (SLAs):	27
Research Projects:	4
External Contracts:	11
Peer-reviewed papers:	14
Book chapter:	1
Government Reports, Conference Proceedings etc:	6
Commissioned Reports:	3

SEA FISHERIES (SF)

« Biological data obtained for 250 fish and shellfish species »»



SEA FISHERIES

Key Highlights and Impact from 2015/16

- Participated in all relevant ICES fishery Expert Group meetings, including assessment work groups, advice drafting groups, data collation meetings, and a wide range of pertinent and timely study groups and workshops.
- Provided essential advice and recommendations to policy colleagues in Edinburgh, London, Brussels, Bergen and elsewhere. Policy requests included such aspects as the EU Landing Obligation, Marine Protected Area implementation and evaluation, inshore fisheries monitoring and management, and gear development (through the Gear Innovation and Technology Advisory Group (GITAG) and others).
- Conducted sampling and monitoring programmes (at-sea observers, market sampling, research-vessel cruises, and subsequent data collation) efficiently and successfully. Notable achievements included the completion of the 2015 *Nephrops* underwater TV survey on *Scotia* in dire June weather, and the completion of several additional tows to the north-west on the August 2015 International Bottom Trawl Survey (IBTS) Quarter 3 (Q3) survey.
- Presented at the Fisheries Innovation Scotland (FIS) conference on Fishing Industry Science Alliance (FISA) and West coast surveys which highlights the industry-related work that we are doing.
- Contributed to ICES Annual Science Conference and DEMaT'15 (international workshop/conference on engineering methods in maritime technology). Chaired by MSS the conference attracted about 50 scientists/engineers from 14 different countries.
- Developed methods and capacity for fully-documented fisheries.
- Developed new, innovative mackerel acoustic tests using the Thunderbird 4 sonar to determine fish sizes in partnership with the University of Aberdeen.
- Provided support for outreach activities, including contributions to the Aberdeen Doors Open Day, and sterling work with local schools from our Science, Technology, Engineering and Mathematics (STEM) ambassadors.
- Contributed information and advice to set annual fishing quotas – Scientific assessments and advice to fisheries managers from Sea Fisheries staff over many years have helped to contribute to improvement in the status of many fish stocks important to Scotland.
- Contributed to a joint North Sea/West of Scotland stock assessment for haddock.

SEA FISHERIES

Previously these areas had been assessed separately. The stock is now assessed in this way and the conclusions are thought to be more representative of true stock dynamics as a result.

- Involved in the successful bid for H2020 funding award in the EU DiscardLess project, a multi-million pound initiative that brings together scientists from across Europe to develop strategies for reducing unwanted catches and better using unavoidable ones.

Delivery Against Key Programme Objectives

- Over 400,000 fish of at least 245 different species were sampled during the course of this year.
- Provided timely and statistically robust data collection, collation, assessment and advice for relevant fish and shellfish stocks.
- Provided advisory support during ongoing negotiation of fishing opportunities and management processes.

- Developed long term and multi-annual fishery management plan reviews and evaluations.
- Provided advice and technical support on measures to facilitate implementation of the EU Landing Obligation, including:
 - Participation in gear trials, in conjunction with industry, to help reduce unwanted catch.
 - Development of monitoring tools (such as CCTV) and analysis of resulting data.
- Provided advice on the implications of the landing obligation, including socio-economic, ecosystem and stock dynamics impacts.
- Continued to work with external stakeholders to deliver on the objectives of the Fishing Industry Science Alliance (FISA).
- Continued to roll out the Inshore Fisheries Strategy, including: completing the review of the network of Inshore Fisheries Groups and contributing to decisions on the way forward.

KEY PERFORMANCE INDICATORS (KPIs)

MSS has undertaken an annual review of performance against a set of Key Performance Indicators (KPIs) for many years. The process was initiated when MSS was an Agency and there was a requirement to report to the Scottish Parliament. However, continuation of the use of KPIs permits a longer-term assessment to be made of any changes in performance. Over time, there has been a change in emphasis such that assessing 'impact' is more critical today than even three or four years ago, hence the specific reference to 'impact' within each Programme summary.

Individual Programme publications are also presented in the Programme summaries, however, for consistency, publications are summarised in this section. The KPIs are presented, in full, to the Science Advisory Board and the relevant paper can be accessed. A summary is presented in this Annual Review highlighting key aspects of:

- A. Delivery of service
- B. Quality of science output
- C. Collaboration
- D. Balance between Strategic Science and routine activities.

« 80 Peer reviewed publications »»

A. Delivery of service

Assessed using percentage delivery of service and research targets, as well as the use of ships, the former is presented here with details on the use of the ships presented in the Science Operations Programme summary.

KPI: Plan, execute and report a programme of science to meet the needs of Scottish Government

In 2015-16, Marine Scotland Science achieved 92.2% of its services targets and 66.7% of research project milestones. This is a similar level to the 2014/15 achievements and higher than in the two years prior to 2014/15.

B. Quality of science output

This is assessed through publications as well as both external and internal audits. The former is presented here with the latter presented in the Quality Assessment.

KPI: Number of peer-reviewed publications.

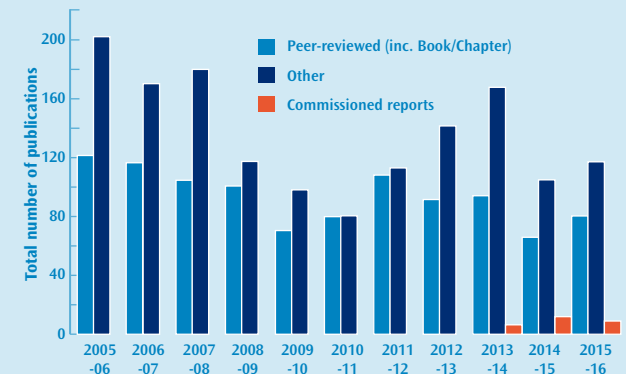
(This includes peer-reviewed papers and books/book chapters)

In 2015/16, MSS produced 80 peer-reviewed papers and book chapters. Publication output, particularly peer-reviewed papers, is an important route for maintaining scientific reputation and credibility for MSS. The increase relative to 2014/15 represents a significant staff achievement.

KPI: Number of non-peer-reviewed publications produced.

(This includes the Scottish Marine and Freshwater Science Series, Marine Scotland Science Reports, Fish and Shellfish Stocks booklets in addition to conference proceedings, posters and presentations)

The number of non-peer-reviewed publications rose from 105 in the previous year to 121 in 2015/16. The number of these publications does vary quite considerably from year to year.



Since 2013/14, MSS has also been reporting on the number of published Commissioned Reports. These may be delivered through the Scottish Marine and Freshwater Science Series. MSS is responsible for ensuring the overall quality and finalisation of the Commissioned Reports.

KEY PERFORMANCE INDICATORS (KPIs)

CLICK TO LINK TO ASSOCIATED DOCUMENTS

ABSTRACT BOOKLET



MARINE SCOTLAND SCIENCE STAFF PUBLICATIONS 2015/16



C. Collaboration

The value of externally funded work, communication with stakeholders and integration of natural and socioeconomic science with policy all contribute to the topic of Collaboration. The latter two are covered elsewhere in the Review, with the value of externally funded work detailed below.

KPI: Value of externally funded work in total and for strategic science projects

MSS contract income increased to £1.6 million (excluding reimbursement of vessel funding under the Data Collection Framework). This illustrates success in a number of Horizon 2020 proposals and also some non-EU funding.

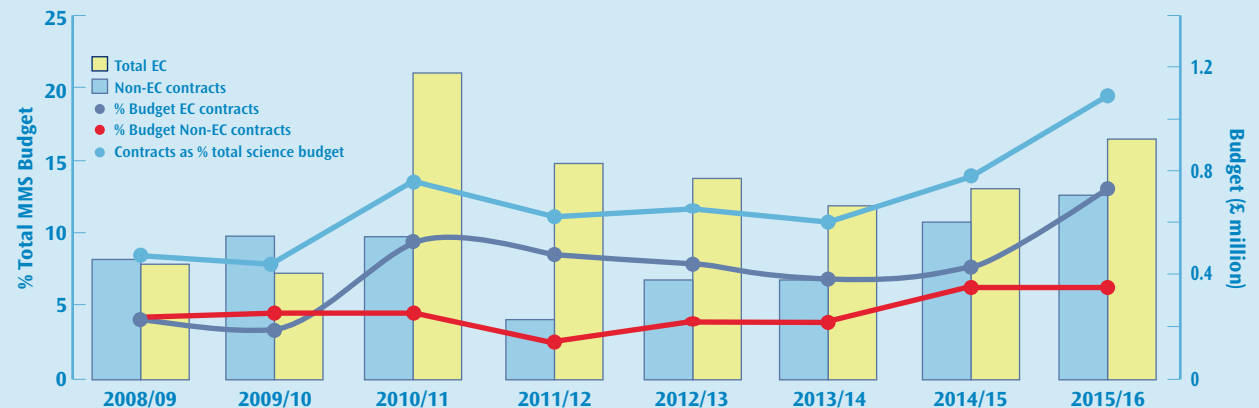
D. Balance between strategic science and routine activities

KPI: Proportions of science programme budget allocated to strategic science and to routine activities.

At the beginning of the year, 20.3% of the direct science project budget was allocated to strategic science projects and 79.7% allocated to advice, monitoring and regulatory services.

KPI: Proportion of in-year resource reallocation between strategic science and ongoing activities.

At the end of the year, out-turn figures show the actual spend was in line with budgeted amounts, with 20.2% of the budget spent on strategic science and the remaining 79.8% on advice, monitoring, regulatory and surveillance work. This balance has remained at similar levels for the last 4 years.



Gavin Grewar
Quality Manager

« 100% of audits
completed within this
accreditation cycle »

QUALITY ASSESSMENT

The United Kingdom Accreditation Service (UKAS) visit MSS each year to assess a range of accredited methods against the ISO 17025 Testing and 17020 Inspection standards. During the visit, independent technical experts witness the tests and inspections being performed, and propose improvement actions where issues are identified. UKAS have a high opinion of the staff working in MSS, and, as in previous years, praised their excellent technical competence and quality system knowledge. The distribution by Programme of methods that are accredited and those which were assessed this year is outlined in Table 1.

Newly accredited methods introduced this year included an enhanced method for the analysis of chlorophyll pigments, the reintroduction of a flexible approach to accrediting assays within

molecular genetics which allows the group to self-certify validation during the year, and the Oceanography Group's salinity method. The latter was a particular achievement for the Group as they have no previous experience of working within a quality system, so not only had to enhance aspects of their technical process to meet accreditation standards but also fully implement the wider quality system requirements.

MSS also operates an internal audit programme to support the accreditation system. The eight members of the audit team who support the programme are key to demonstrating that the UKAS requirements are met between external assessments. The auditors also identify potential improvements and efficiencies in the areas they audit, drawing on past experience

Table 1

Programme	Number of accredited methods	Number of methods assessed by UKAS 2016
Aquaculture & Fish Health	11	5
Freshwater Fisheries	6	2
Environment Monitoring and Assessment	17	7
Planning & Environmental Advice	2	0

Table 2

Programme	Number of system audits	Number of test audits	Number of sampler audits
Aquaculture & Fish Health	6	1	4
Freshwater Fisheries	0	2	–
Environment Monitoring and Assessment	9	6	–
Planning & Environmental Advice	3	0	–


QUALITY ASSESSMENT

and practice in their own area. For the second year in succession, the audit programme was fully up to date at the end of the calendar year, which provides UKAS with assurance that MSS is managing its own quality system and means fewer UKAS findings. The Programmes audited in 2015 are shown in Table 2.

From a wider MSS perspective, the Joint Code of Practice for Research (JCoPR) continues to be the standard against which our research is quality assured. Although no formal audits have been performed on research projects in the last year, a number of Groups have progressed with implementing parts of the Code within their routine work. Quality Management staff have also provided support to various Groups across Marine Scotland in developing and implementing aspects of quality management systems, for instance in formalising protocols and developing training record systems.

Complementing the more formal quality management systems above, members of the Information Governance Board (IGB) have recently completed a pilot project to assess how well Marine Scotland manages its information. The Quality, Data and IT managers have worked closely to develop a set of baseline information management standards, and have developed a metrics process for measuring how well each stage of the information lifecycle is managed. A number of areas have been reviewed against these metrics, and actions from these reviews are currently being implemented. The IGB also has responsibility for ensuring that Marine Scotland meets its obligations under the Public Records (Scotland) Act, and the Board has developed a series of actions to improve how the organisation manages its records which will be implemented in the course of the coming year.

MARINE SCOTLAND SCIENCE REPRESENTATION 2015/16

	Fisheries	Environment	Energy	Aquaculture	Freshwater Fisheries	General Science
International	EU-Norway & CS NEAFC ICES EGs	OSPAR ICES EGs	WREN ICES EGs	SAV Tri-nation WG ICES EGs Gill Health Initiative WG ScoFaNo Collaboration	NASCO ICES EGs IASRB	ICES Council & ACOM
Europe	Advisory Councils STECF COFASP	JRC MSFD review groups		EURLS COFASP DG SANCO FVO UK Mission EAS organising committee	 <p>Click columns for explanation of acronyms and their relevant links</p>	EFARO EMBRC European projects
UK		UKMMAS MCCIP – SG & MG UKIMON Exec Com UKMBMPB WFD UKTAG TTs NERC SGs OGUK OSRF / MTIG	SCOS MREOG ORELG EOSCA Chemical WG OGUK Environment Advisory Group	Animal By-product Waste Disposal Group BBSRC/NERC SG Defra CVO		MSCC Vessel coordination Grp
Scotland	FMAC / IFMAC FIS-SG FISA selection panel Fishermen's Associations	MPA SG SSDAG SMIG Biodiversity CG SMMCG SCSEMP SEWeb MINNSWG	SPORRAN FLOWW	Ministerial WGS (MGSA) SARF board CoGP MG ISLM Grp PO liaison Scottish-NRL	MS/SNH/SEPA IF FFAG Wild Fisheries SRG SFCC	MASTS CAMERAS MSF
Local	IFGs Clyde 2020	Clyde 2020 SG and RAG SOTEAG & Mon Com	Developers Groups & RAGs	Salmon Fishery Boards	MS / Local FB liaison Grp Scotland's Salmon Festival Steering Group	MarCRF