

ANNUAL REPORT
2018

## BUILDING OCEAN KNOWLEDGE; DELIVERING OCEAN SERVICES

## To the Minister for Agriculture, Food and the Marine

In accordance with the requirements of the Marine Institute Act, 1991, I have the honour of presenting the Annual Report and Financial Statements of the Marine Institute for the year ended 31 December 2018.

## Dr John Killeen,

Chairman

## The Marine Institute is a national agency with the following mission:

The Marine Institute provides government, public agencies and the maritime industry with a range of scientific, advisory and economic development services that inform policy-making, regulation and the sustainable management and growth of Ireland's marine resources. The Institute undertakes, coordinates and promotes marine research and development, which is essential to achieving a sustainable ocean economy, protecting ecosystems and inspiring a shared understanding of the ocean.

## **Our Vision:**

The Marine Institute, as a global leader in ocean knowledge, empowering Ireland and its people to safeguard and harness our ocean wealth.

#### **Photo credits**

#### Front cover

Photo 1 – Andrew Downes Photo 5 – Jason Clarke (also on Page 91) Photo 6 – Wendy Bleming (also on Page 15)

Other photos – Marine Institute

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Page 42-43 – Andrew Downes

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Other photos – Marine Institute and stock imagery

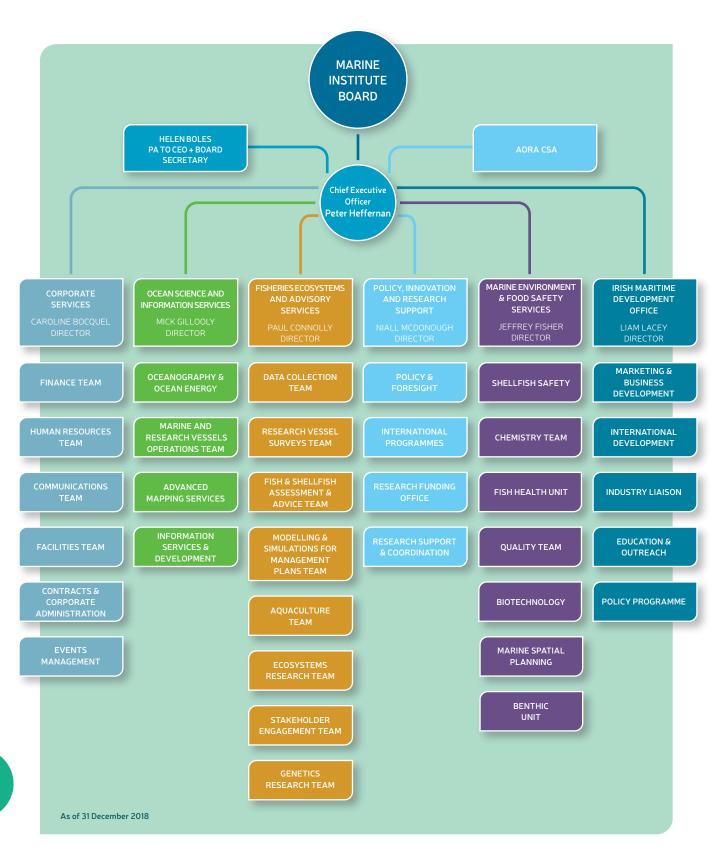


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The Marine Institute Annual Report is available in Irish and can be downloaded from **www.marine.ie** 

# MARINE INSTITUTE ORGANISATIONAL STRUCTURE





# INTRODUCTION, ORGANISATIONAL STRUCTURE AND STRATEGIC FRAMEWORK

The Marine Institute is the national agency for marine research, technology, development and innovation. It seeks to assess and realise the economic potential of Ireland's marine resource, promote sustainable development of marine industry through strategic funding programmes and essential scientific services, as well as safeguard Ireland's natural marine resource through research and environmental monitoring.

Ireland has a marine area of approximately 880,000 km² under the sea, which is over 10 times its land area, representing an enormous seabed and marine resource. The Marine Institute promotes the sustainable development of this vast resource through research, the application of new technologies and by providing credible science-based advice to industry, the Government and the EU.

## The Institute provides essential marine research services including:

- National research and development funding programmes
- Fish stock assessment and management advice
- Fish health services
- Marine food safety monitoring
- Environmental monitoring
- Research vessel operations
- Seabed mapping
- Data management
- Maritime development services

The Marine Institute has six service areas and the Office of the CEO. The service areas are:

- Corporate Services
- Ocean Science and Information Services
- Marine Environment and Food Safety Services
- Fisheries Ecosystems Advisory Services
- Irish Maritime Development Office
- Policy, Innovation and Research Support

## The organisation has established a culture which is characterised by:

- Ethical behaviour throughout
- A clear vision
- Teamwork
- Clear communication; and
- Being a place where people can flourish

That culture provides the platform on which our Strategic Plan has been founded.

Since its establishment in 1991, the Marine Institute has been a key component of a national effort to grow our maritime economy, to create new marine business opportunities and jobs and to generate a greater knowledge and understanding of the seas and oceans. This Annual Report highlights the key deliverables and progress made towards our vision during 2018.

## STRATEGIC FRAMEWORK

The Marine Institute has developed *Building Ocean Knowledge - Delivering Ocean Services*, a strategic plan for the period 2018 – 2022.

The process required extensive input from clients, external stakeholders, the Marine Institute Board, the management team and staff. This engagement process with stakeholders was used to inform how the Institute is performing and how the organisation can serve their current and future needs more effectively.

The Strategic Plan ensures that the Institute continues to meet national needs and international challenges, opportunities and commitments. It sets a strong strategic vision and a clear plan for the journey ahead.

In line with the strategic framework in the plan, this Annual Report is organised into four Strategic Focus Areas and four Strategic Enablers. The six service areas of the organisation (outlined on the previous page) feed into these eight sections of the report.

## THESE ARE THE STRATEGIC FOCUS AREAS:

Scientific Advice & Services

Forecasting Ocean & Climate Change

Research & Innovation

Ireland's Ocean Economy

## THESE ARE THE STRATEGIC ENABLERS:

Our People

Infrastructure

Data & IT

**Engagement & Education** 

To deliver on our vision requires strategic enhancement of our organisational strengths and this is where Strategic Enablers are so vital. Our people, our infrastructure, our data and IT capabilities and our engagement and education capabilities all work towards enabling the Strategic Focus Areas and their respective goals.



## **BOARD MEMBERS**



## **DR JOHN KILLEEN** (2014 – 2019)

Dr Killeen is an engineer and a native of County Roscommon who became an Honorary Freeman of Galway City in 2012. His career spans working with local government, with a multinational construction company that built the Grand Canal tunnel in Dublin in 1973 and seven years with a Shell International subsidiary.

Dr Killeen was President of Engineers Ireland (1995-1996) and was founding President of the Academy of Engineering in Ireland (1996-1998). He is retired CEO of the Colas Group in Ireland and retired Managing Director of Cold Chon Galway Ltd.

In 2009, he was Chairman of the Volvo Ocean Race event in Galway. In 2012, he was President of the Volvo Ocean Race Festival and finale which broke all attendance records for a sporting event in Ireland, valued at approximately €80m in tourism and business income to the city. Dr Killeen is Chairman of the Saolta University Health Care Group and President of the Timoney Leadership Institute – a charity that promotes international leadership training for Irish CEOs.



## PROFESSOR PATRICIA BARKER (2013 - 2018),(2018 - 2023)

Professor Barker is a Fellow of Chartered Accountants Ireland and qualified in 1973. Prof Barker completed an MPhil in Gender Studies at Trinity College Dublin. Her PhD developed a paradigm of disclosure of financial information to employees in organisations. She served her articles with Stokes Bros & Pim in Dublin and worked for Peat Marwick Mitchell in Manchester. She later became a partner in an accounting practice in Manchester for six years, and worked in Manchester University as a principal lecturer.

Patricia was appointed lecturer in Dublin City University (DCU) in 1980 and progressed through senior lecturer, Associate Dean (Business School) and University Vice-President (Academic). She has worked as a visiting professor in universities in New York, Boston, Angers, Malawi, Dares Salaam, Sydney and Cape Town and has been an external examiner for universities and professional bodies.

She served as Chairman of Chartered Accountants' Accounting Committee for 20 years and was a member of the Council of Chartered Accountants for four years in the 1990s and again for five years in the 2010s. She represented Ireland on the Accounting Standards Board in London for nine years and chaired the expert group reporting to the European Union on the role, structure and functions of the European Court of Auditors. She had several tours of duty as Election Supervisor for the Organisation for Security and Cooperation in Ireland (OSCE) in Bosnia-Herzegovina, Republika Srpska, South Africa, Kosovo, Kazakhstan, Montenegro, Malawi and Belarus.

Patricia worked as Human Rights Monitor in Israel and Palestine. She has been a member of the Boards of Women's Aid, the Sonas Housing Association, the National Chamber Choir and the Higher Education Authority (chairing the Audit Committees), and was Chairperson of the Irish Blood Transfusion Service for three years.

She is currently a Director of Dublin Bus Ltd and Tallaght Hospital, chairing their Audit Committees. In addition, she is Chair of the Education Board of Chartered Accountants Ireland. In addition, she is Chair of the Audit and Risk Committee for the Marine Institute. She is currently a voluntary counsellor and trainer for the Dublin Rape Crisis Centre. She has written books on group accounting, flexible working in the profession and, more recently, on women who have succeeded in the accountancy profession, as well as on corporate governance and professional ethics.



## MR DERMOT CLOHESSY (2015 - 2020)

Mr Dermot Clohessy (BSc Eng) is an engineer by profession with postgraduate qualifications in both business strategy and finance. He has an extensive understanding of foreign direct investment having spent 28 years working with IDA Ireland.

Dermot was the IDA's Executive Director/COO from 2006 to 2015 and was directly involved in the development and successful implementation of the IDA's corporate strategies during this period. His broad responsibilities included expanding the global markets in which Ireland competes for investment and developing new business areas for foreign direct investment into Ireland.

Dermot was a member and a sub-committee chairman of the Development Task Force established to support the implementation of *Harnessing Our Ocean Wealth – an integrated marine plan for Ireland.* Prior to joining the IDA in 1987, Dermot worked with an engineering design consultancy and as a technical director of a construction-related manufacturing company.

He is now a consultant, working internationally on investment attraction and business development strategies for both the private sector and government bodies which include strategic advisor with the Ireland-based International Economic Development Consultancy.



## PROFESSOR ALAN DOBSON (2015 – 2020)

Professor Dobson is Chair of Environmental Microbiology at the School of Microbiology at University College Cork (UCC). From 2005 to 2014, he was Director of the Environmental Research Institute at UCC. He has a PhD in Biochemistry (1985) and obtained a DSc in Microbiology and Molecular Biology from the National University of Ireland (2006). He was elected as a Fellow of the Royal Society of Biology, UK (FRSB) (2005) and a member of the Royal Irish Academy (MRIA) (2013).

His main area of interest is the study of microorganisms in marine and terrestrial environments and their potential biotechnological exploitation. In particular, his group employ both genomic and metagenomic approaches to exploit the microbiota of different environments with the goal of identifying novel bioactive compounds and enzymes with potential biopharmaceutical applications. His group also studies the microbiology of biogas production, microbial biopolymer production and the biodegradation of synthetic polymers such as plastics. He is currently a board member of the International Marine Biotechnological Association.



## DR BERNA GRIST (2015 - 2018),(2018 - 2023)

Dr Berna Grist BL, a barrister and chartered town planner, is Adjunct Professor in the School of Architecture, Planning and Environmental Policy at University College Dublin. She holds a PhD from the University of Ulster on *The Legislative and Regulatory Framework for Development in the Republic of Ireland* and has published widely in the fields of planning and environmental law, public policy and governance. Together with the late James Macken SC, she coedited the *Irish Planning Law Factbook* (2013), which she continues to update annually, and in 2012, published the second edition of *An Introduction to Irish Planning Law*.

Dr Grist was appointed Deputy Chairperson of the Aquaculture Licences Appeals Board on its establishment in 1998. During the period 2001-2006, she served as a member of An Bord Pleanála and in 2013, she was appointed to the expert group advising the Minister for Housing and Planning on a successor to the *National Spatial Strategy 2002-2020*. She has contributed to a number of environmental research projects sponsored by the Environmental Protection Agency and is a member of the Irish Environmental Law Association.



## MR DONAL KELLY (2013 - 2018),(2018 - 2023)

Mr Donal Kelly is Managing Director of Fast Fish Ltd, a successful fish sales and oil supply business based in Castletownbere, County Cork. Mr Kelly served on the Celtic Sea Herring Management Committee for 10 years, and on the West Pelagic Committee for three years.

Mr Kelly has served on a number of boards, both in the private and voluntary sector, including the Cork County Community and Voluntary Forum and the Cork County Development Board and has acted as Chairman of Castletownbere GAA Management Committee. He is also a member of Berehaven Golf Club and the Castletownbere Community Development Association.



## PROFESSOR JOWEN LEWIS (2015 - 2020)

Professor Lewis is Emeritus Professor of Architectural Science, University College Dublin (UCD). He is Vice President of the Royal Dublin Society, Chair of the Energy Institute Ireland, and a member of the Boards of the National Gallery of Ireland, the Irish Green Building Council and the Tipperary Energy Agency.

Professor Lewis is a former Chief Executive of the Sustainable Energy Authority of Ireland (SEAI) (2009 – 2012) and was Chair of the inter-departmental and inter-agency Ocean Energy Steering Committee. As a qualified architect, engineer and energy technologist, he has practised professionally in Ireland, England and Zambia. Prof Lewis was Executive Director for Innovation and R&D at Bord na Móna from 2006 to 2008. He was Dean of the Faculty of Engineering and Architecture at UCD and later, Principal of the UCD College of Engineering, Mathematical & Physical Sciences 2001 – 2006; and was Director of the UCD Energy Research Group from 1974 to 2008. He has published circa 200 papers and books as author, joint-author or editor. Expert advisor to the European Commission and coordinator of various European Commission energy R&D projects 1986 – 2003, with sub-contractors in all member states. In 1976, Prof Lewis co-founded the Solar Energy Society of Ireland.



## MR DAVID OWENS (2012 - 2018).(2018 - 2023)

Mr David Owens FCA is currently Senior Vice President, Finance and Operations for SolarWinds. Prior to joining SolarWinds, Mr Owens worked for Red Hat Inc., an enterprise software company for over seven years where he served initially as Director of Global Logistics and Production and later as Senior Director of Finance EMEA.

Mr Owens qualified as a chartered accountant with Ernst & Young and is a member of Chartered Accountants Ireland.



## MR LORCÁN Ó CINNÉIDE (2010 – 2015),(2015 – 2020)

Mr Lorcán Ó Cinnéide is currently National Secretary of the Irish Fish Processors and Exporters Association (IFPEA) and Board Member of the European Fish Processors Association (AIPCE). He is a former member of the board of the Aquaculture Licences Appeals Board (ALAB) and a former CEO of the Irish Food Producers Organisation (IFPO) and has participated in many forums and management structures related to the fishing industry in Ireland and at EU level over the past two decades. He is a member of the Sea Fisheries Protection Authority (SFPA) Consultative Committee. He has also been involved in the evaluation of various marine science programmes on behalf of the EU Commission. A former fishing vessel owner, Mr Ó Cinnéide has a degree in Economics and Politics from Trinity College Dublin. He maintains a wide range of local development and conservation interests including TV production and is Secretary of the Blasket Foundation. He lives in the Dingle Peninsula, County Kerry.



## CHAIRMAN'S STATEMENT

2018 saw significant progress in the implementation of the Marine Institute's Strategic Plan 2018 – 2022, Building Ocean Knowledge – Delivering Ocean Services. The Strategic Plan, which was published during 2018, sets out a strong strategic vision and forms the basis for how the Marine Institute will work and deliver to the highest standards of excellence over the next five years. Significant thanks and credit goes to the staff of the Institute who contributed actively and enthusiastically in developing the Strategy.

Full compliance with the 2016 Code of Practice for Governance of State Bodies, including the relevant aspects of the Public Spending Code, was achieved with nine internal audits throughout 2018. This provided governance oversight and high levels of assurance to the Board. Thanks to the Board Strategy Sub-Group for its valuable work over the past year.

SeaFest, Ireland's national maritime festival, took place in Galway from 29th June to 1st July 2018, during a memorably warm Irish summer. Attendance again reached over 100,000 visitors and created public awareness of the immense marine resources which are abundant around the island of Ireland. The event, coordinated by the Marine Institute on behalf of the Government Marine Coordination Group, is a key outreach event in realising the Harnessing Our Ocean Wealth goal of engaging the public with the sea.

The Institute's engagement and education activities during 2018 also included the Explorers Education Programme which delivered its marine themed modules to primary schools in 10 counties, reaching up to 13,000 children. Other key engagement activities during 2018 included Institute participation in the Galway Science and Technology Festival exhibition and the Mayo Science and Technology Festival, along with an open day held in Newport research facility which saw visits by more than 400 members of the public including primary school students.

The Marine Institute website continues to be a vital information source with over 162,158 unique visits during 2018, an increase of 11% in new visitors over 2017. Library Services at the Institute continued to support staff in their research, by providing access to publications and maximising their research impact through Open Access and promotion.

The Institute presented the 2018 Annual Stock Book to the Minister for Agriculture, Food and the Marine, Michael Creed TD. The publication provides the latest scientific advice for fish stocks of interest to Ireland and is used by the Department at the annual fisheries quote negotiations with the EU in December of each year and throughout the year at fisheries management meetings. Throughout the year, the Stock Book also serves as a valuable reference guide to a wide audience, including the fishing industry, managers, marine scientists, environmental NGOs, third level institutes and financial institutions.

The Marine Institute once again retained its Excellence Through People (ETP) accreditation under the NSAI Standard – ETP 1000:2012. It has held this award continuously since 2005 and it reflects the Institute's investment in its staff who play a key role in maximising the efficiency of the organisation and building key capabilities.

These achievements show both the abilities and dedication of the people that make up the Marine Institute and I'd like to take this opportunity to acknowledge Dr Peter Heffernan and the Marine Institute staff for their achievements this year and their commitment to the delivery of excellence in the services they provide.

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**Dr John Killeen** Chairman, Marine Institute



## CHIEF EXECUTIVE'S REPORT

Influenced by the goals of the Government's national marine strategy 'Harnessing Our Ocean Wealth' and the 'National Marine Research and Innovation Strategy 2017 – 2021', this last year has seen the Marine Institute play a crucial role in catalysing, coordinating, promoting, funding and implementing marine research.

This has been driven by the invaluable calibre of staff who are passionate about our work as well as the development of our research infrastructure, our data and our IT capabilities, which are used to provide excellence in our services. The breadth and quality of activities captured in this Annual Report are a testament to the ongoing work by staff at the Marine Institute.

Providing advice and services to the Department of Agriculture, Food and the Marine, and other departments, agencies and stakeholders, the Marine Institute has completed projects in fisheries research, marine environment and food safety, oceanography, data and technology, as well as seabed mapping. The Irish Maritime Development Office's (IMDO's) remit has included ongoing development, promotional and marketing support for the shipping and shipping services sector, all framed within the uncertainty during 2018 over Brexit.

The RV Celtic Explorer and RV Celtic Voyager completed a total of 50 surveys and 575 survey days between them during 2018. Highlights included exploring and mapping the tectonic spreading at the Charlie-Gibbs Fracture Zone of the Mid-Atlantic Ridge, the SEA-SEIS D Project (led by the Dublin Institute for Advanced Studies) which successfully deployed 18 state-of-the-art ocean bottom seismometers to measure movement at the floor of the Atlantic Ocean and the SeaRover Survey which investigated Ireland's deep ocean territory 300 miles off the west coast which led to a number of 'firsts' using the ROV Holland I.

Footage of coral species different to others described to date was captured along with the discovery of a very rare shark nursery, on a scale not previously documented in Irish waters. It was a very significant discovery, which was widely shared by national and international news media

The Marine Institute welcomed the announcement of a new marine research vessel for the State, replacing the 31m RV *Celtic Voyager*, which has been at sea for more than 20 years. The new vessel is expected to be more than 50m in length and to be put to sea for the first time in 2022. It will greatly enhance the Institute's many research and data gathering activities along with marine operations e.g. maintaining and deploying weather buoys.

The work of the Marine Institute in 2018 saw significant collaborations with industry and other research centres and universities in Ireland, Europe and international stakeholders, strengthening Ireland's ability in providing a foundation for applied research and innovation.

Our Research Funding Office managed competitive research calls totalling €9.28m in 2018, ensuring a number of high impact investments in line with the national Marine R&I Strategy. Some notable highlights included a commitment of €2.38m over three years to 12 companies under our Industry-led Awards call and €2m over five years to Maynooth University for a Principal Investigator-led programme of research on oceans and climate change.

The fifth Our Ocean Wealth Summit, which took place in June 2018 at SeaFest, highlighted a positive message indicating that Ireland's 'blue economy' continues to grow at a faster pace than the general economy. Growth is being driven by strong performances in the aquaculture, sea fisheries, shipping and marine tourism industries, as well as continued growth in the emerging ocean industries.

My sincere thanks to all the staff of the Marine Institute for their continued commitment and consistently high standard of service delivery, and to the Board for their oversight and diligence in maintaining the highest standards of corporate governance.

Dr Peter Heffernan

Chief Executive. Marine Institute

# YEAR IN REVIEW - SNAPSHOT OF 2018 IN THE MARINE INSTITUTE



Survey days undertaken collectively by research vessels *Celtic Explorer* and *Celtic Voyager*. The vessels carried out a total of 50 surveys between them during 2018.



The amount of competitive research calls managed by the Research Funding Office. This ensured a number of high impact investments under the Marine Research programme.

400 P

More than 400 person hours were spent by the IMDO on the delivery of ad hoc advice relating to Brexit. Due to the uncertainty surrounding Brexit, there was a significant increase in the demand for advice and information.



The area of seabed mapped in the Celtic Sea by Marine Institute vessels and the Advanced Mapping Services team, as part of the INFOMAR programme undertaken in partnership with Geological Survey Ireland (GSI).



Analyses for toxins were carried out on 3,468 shellfish samples by Marine Environment and Food Safety Services, in co-operation with the Sea Fisheries Protection Authority and shellfish industry.

3,523

Seawater samples were analysed for toxic and harmful phytoplankton species by Marine Environment and Food Safety Services (this is in addition to the shellfish toxin analyses).

**103,416** 

Visitors attended SeaFest 2018 – the biggest visitor numbers for the festival to date.



Shipwrecks were surveyed offshore in the Celtic Sea as part of INFOMAR's survey operations. A large submarine channel complex was partially mapped, now visibly extending over 80km in length and up to 3km wide.

€2.38<sub>M</sub>



The value of the Institute's Industry-led awards call – awarded to 12 companies (in collaboration with five Higher Education Institutions) over three years.



The number of years that the Institute has continuously held the prestigious Excellence Through People (ETP) accreditation. It retained it again in 2018.

900,000



Fish/shellfish were measured during the 2018 Data Collection Multiannual Programme (DCMAP).



7th

The maritime sector recorded its seventh consecutive year of growth, with trade volumes exceeding the previous record set in 2007

€1.25B



The contribution of the seafood sector annually to Ireland's Blue Economy (BIM Business of Seafood 2018). Providing the scientific advice that ensures the sustainable exploitation of these resources is a key part of Marine Institute work programmes.

# **\$192,000**

The number of views of a video on the discovery of a rare shark nursery during a SeaRover survey (viewed on the Marine Institute YouTube Channel). It became the most watched video ever on the channel and the story was featured by news outlets in Ireland, UK, USA and many other countries around the world.

## **DIRECTORS' STATEMENTS**

## CORPORATE SERVICES

The implementation of the Institute's new strategy provided an opportunity for the Corporate Services team fully to review the services provided by our team to ensure that we continue to meet the needs of the organisation both now and over the next five years in realising the ambitions set out in our Strategy. Leading the Our People, Engagement and Education and Infrastructure Strategic Enablers are the cornerstone of our contribution to this, however these are underpinned by strong, best practice corporate governance and financial management. The team methodically and comprehensively dealt with the challenges associated with the implementation of the General Data Protection Regulation in 2018, and led an organisation-wide culture change to the way we manage and process personal data.

### Highlights of 2018 included:

- Retention of Excellence Through People (ETP)
   accreditation under the NSAI Standard ETP
   1000:2012. ETP is Ireland's only national human
   resource management scheme dedicated to the
   role of people and their impact on business. The
   Marine Institute has held this prestigious award
   continuously since 2005. It reflects the Institute's
   investment in our staff who play a key role in
   maximising the efficiency of our business and
   building organisational capabilities
- Full compliance with the 2016 Code of Practice for the Governance of State Bodies with governance oversight including nine internal audits, all of which reported high levels of assurance to the Board
- Substantial compliance with the General Data Protection Regulation in 2018 with comprehensive and ongoing training and awareness throughout the organisation
- The Marine Institute hosted SeaFest 2018 Ireland's national maritime festival in Galway from 29<sup>th</sup> June 1<sup>st</sup> July 2018. The weekend festival attracted more than 100,000 visitors and is an important outreach event in realising the *Harnessing Our Ocean Wealth* goal of engaging the public with the sea
- An organisation-wide Get Greener Energy Team
  has made substantial progress in implementing the
  Energy Strategy 2016-2020 with energy reductions
  of 27.3% achieved to date and further for 2019
- A strong focus on safety and wellbeing with high safety standards resulting in no significant accidents, and seven minor incidents. Promotion

- of health and safety and employee wellbeing remains a priority to maintaining a safe and healthy workplace
- Increased social media engagement over a range of channels including our website <u>www.marine.ie</u> which recorded 162,158 unique visits in 2018 which is an increase of 11% in new visitors over 2017.
   Supported by a range of online services and easily accessible, user friendly data and information, we continue to optimise our services to ensure we continue to meet user's needs, in a responsive, efficient manner.

#### Ms Caroline Bocquel

Director - Corporate Services

## IRISH MARITIME DEVELOPMENT OFFICE (IMDO)

2018 was an extremely busy year for the Irish Maritime Development Office (IMDO). In pursuit of the advisory role that we fulfil for the Department of Transport, Tourism and Sport (DTTAS), a number of significant reports were undertaken, which included the Irish Maritime Transport Economist, a report on The Implications of Brexit on the Use of the Landbridge, a review of Irish Ports Offshore Renewable Energy Services (IPORES), a Ports Capacity Study, and a report into the viability of the creation of an International Shipping Services Centre (ISSC) in Cork. This work will inform policy and development in Ireland's strategically important maritime sector. In addition, the IMDO worked closely with colleagues in DTTAS to plan for Brexit and provided briefing papers and advice on a range of subjects related to the maritime industry.

In order to discharge our developmental responsibilities, the IMDO engaged with industry through a range of national and international events and conferences, participated in inward trade missions, arranged industry briefings, hosted important meetings of the Maritime Commerce Forum, and continued to foster collaboration through the Irish Marine Industry Network. The development of the maritime sector is critically important to the success of the Irish economy. It facilitates trade and throughout the ports network, offers ideal locations for logistics and distribution companies. The sector has emerged successfully from the economic crisis and in 2018, recorded its seventh consecutive year of growth, with trade volumes exceeding the previous record set in 2007.

The IMDO is a key contributor to several areas of the Institute's new Strategic Plan, including SFA1 (Scientific Advice and Services), SFA 2 (Research and Innovation), Strategic Enabler 4 (Engagement and Education) and, with most relevance, SFA 4 (Ireland's Ocean Economy).

The IMDO plays a significant part in the development of the maritime industry. Working collaboratively with ports and shipping companies, we monitor the performance of the industry and comment on future trends and directions. We provide important advice and expert analysis to our sponsoring department (DTTAS) and engage with colleagues within the Department and across industry in pursuit of common objectives, such as increased efficiency, decarbonisation, digitalisation, and maximizing the drawdown of funding from EU programmes that support our shared objectives.

The work described above is strategically important and its value has been brought into sharp relief in recent times by Brexit. The work we do would not be possible without the support and funding of DTTAS and the Department of Agriculture, Food and the Marine (DAFM), the commitment of industry and the professionalism of colleagues in the IMDO. I would like to express my gratitude to them all.

#### Mr Liam Lacey

Director - Irish Maritime Development Office

# FISHERIES ECOSYSTEMS ADVISORY SERVICES (FEAS)

The Fisheries Ecosystems Advisory Services (FEAS) team provides the scientific advice that supports the sustainable exploitation of our living marine resources. This service underpins Ireland's Seafood Sector, which was worth €1.25 billion in 2018. The key client for our advice is the Department of Agriculture, Food and the Marine (DAFM) and the main delivery mechanism is the Stock Book and the Shellfish Stock Book, which were delivered to DAFM during 2018. These books provide the latest resource assessments and scientific advice for the stocks exploited by the Irish fishing fleet.

The 2018 scientific advice was used by managers (DAFM and EU) to develop regulations and management plans for the sustainable use of the living resources in the marine waters around Ireland. A new web based interactive application of the Stock Book was finalised and is now available on the Marine Institute website, along with the traditional electronic versions. These Marine Institute advisory services are key components in the delivery of SFA1 of the Institute's Strategic Plan.

New and innovative ways to integrate and present complex data sets is a vital tool in the delivery of scientific advice to decision makers. In 2018, Brexit presented an opportunity for FEAS to link complex spatial data sets and deliver simple, high quality schematics and maps that policy makers used in Brexit preparations and negotiations.

Engaging with stakeholders is a very important part of the scientific advisory process. The 50th meeting of the Irish Fisheries Science Research Partnership (IFSRP) took place in Galway in July 2018. This group meets every quarter and is a very valuable forum to discuss science issue that impact the fishing industry. Throughout 2018, quarterly meetings also took place with the environmental NGOs (eNGOs) on the latest scientific advice for our living resources and on marine biodiversity issues.

The international dimension to our scientific services is critical to ensure co-ordination, co-operation and a standard methodology in our data collection, management and analysis programmes. This was achieved through participation at many expert group meetings of the International Council for the Exploitation of the Sea (ICES) which is based in Copenhagen, Denmark.

Innovative research is crucial to "future proof" the Institute's scientific advisory services. FEAS carried out a broad range of funded research projects that will ensure we meet the needs of our clients in a changing marine landscape.

2018 was a major milestone in the delivery of the strategy for the Marine Institute Newport Facility. The Marine Institute Beirtreach Bui (BB) aquaculture research site near Carna, Co Galway, was linked into the hatchery facility at Marine Institute Newport and a range of externally funded aquaculture research projects were secured for the next four years. These projects will focus on research that meets the needs of the aquaculture sector.

Meeting the needs of decision makers in 2018, through a broad portfolio of scientific advisory programmes was achieved through great team work within FEAS and within the wider Marine Institute. Our close working relationship with colleagues in OSIS (Infrastructure; Research Vessel Operations; Data), PIRS (Research Funding Support), MEFS (MSFD; NATURA, Aquaculture) and Corporate Services (People; Finance; Procurement) ensured a very high quality scientific service to our key client (DAFM) and a satisfied customer.

#### **Dr Paul Connolly**

Director – Fisheries Ecosystems Advisory Services

## MARINE ENVIRONMENT AND FOOD SAFETY SERVICES (MEFS)

The Marine Environment and Food Safety Services (MEFS) team at the Marine Institute supports the sustainable use of marine resources through a variety of scientific sciences aligned with the Institute's current Strategic Plan. Consistent with Strategic Focus Area 1 of the plan – Scientific Advice and Services – MEFS personnel monitor chemical, physical and biological indicators of Ireland's marine environment to ensure the high biological and chemical integrity of our marine waters and resources are maintained for the protection of human and environmental health, and that problem areas are managed accordingly.

Our work includes: the disease diagnoses and welfare management of wild and cultured fish and shellfish; the monitoring of shellfish growing waters for harmful algal blooms and associated toxins in shellfish; the analyses of marine waters, sediments and biota for priority pollutants; the provision of scientific advice on compliance of aquaculture farm and foreshore licence applications with Natura and Environmental Impact Assessment (EIA) Directives; and the coordination and management of spatial data collected by the Marine Institute and others for applications to marine spatial planning.

The MEFS team's support to SFA 1 of the Marine Institute's Strategic Plan is underpinned by a robust quality management system (QMS). Our QMS ensures MEFS laboratory and data management procedures are fit for purpose, engendering confidence for all government and public stakeholders using our publicly available data. Improvements in our QMS were implemented in 2018, enabling MEFS labs to retain Irish National Accreditation Board (INAB) accreditation under the International Standard Organisation (ISO) 17025 standard, while our accreditation under ISO 9001 for the work of the Fish Health Competent Authority office successfully transitioned to a new risk-based/process-flow standard.

The scope of our ISO 17025 accreditation was further extended for two methods: BCT-100 Paralytic Shellfish Poisoning by UPLC-FLD and PHY-55 Real-time PCR detection of Azadinium spinosum in seawater — both highly relevant to shellfish safety and industry.

Our scientists continued to participate in international scientific and technical fora such as ICES and OSPAR, as experts in working groups thematic to the broad scope of work addressed within the service area. Further, active participation in research programmes, aligned with Strategic Focus Areas 2 (Forecasting Ocean and Climate Change) and 4 (Ireland's Ocean Economy) of our Strategic Plan, and projects associations with Strategic Enabler 3 – Data and IT – continue to support core environmental and seafood safety monitoring and advisory roles. Highlights

of the MEFS directed programmes from 2018 are included in the relevant Strategic Focus Areas and Strategic Enabler sections in this report.

#### Dr Jeff Fisher

Director - Marine Environment and Food Safety Services

## OCEAN SCIENCE AND INFORMATION SERVICES (OSIS)

Ocean Science and Information Services (OSIS) continued to provide a wide range of services in 2018, including operating research infrastructures, technology initiatives and significant observation and mapping programmes to acquire data. OSIS operated across the whole data value chain from data acquisition to data analysis to service delivery to a wide range of internal, national and international clients and stakeholders including Government.

OSIS management and staff made a significant contribution to the process of developing the Institute's new strategy. OSIS was particularly active in the roll out of various operational initiatives which laid much of the groundwork under the Data and IT enabler of the Institute's Strategic Plan.

OSIS staff participated in a wide range of internal, national, European and international programmes and were again particularly active across a significant number of EU-funded programmes including new projects. This improves our technical capacity to provide support services tailored to the needs of integrated science programmes that inform cross-sectoral policy advice.

## Significant activities of the year include:

- As part of the INFOMAR programme undertaken in partnership with Geological Survey Ireland, the Marine Institute's Advanced Mapping Services team and vessels RV Celtic Explorer and RV Celtic Voyager mapped over 7,685 km² of seabed in the Celtic Sea during 98 allocated vessel days in 2018. The Marine Institute's INFOMAR survey operations involved acquisition of 20,729 line kilometres of multibeam data, mapping of 18 shipwrecks, and collaborative acquisition of 359 seabed samples.
- The Holland I ROV spent three weeks on the SeaRover3 survey, with a team of scientists from the Marine Institute and National Parks and Wildlife Services (NPWS) led by the Marine Institute. This programme delivered significant biodiversity data and formed part of the three planned expeditions jointly funded by the Irish Government and the EU's European Maritime and Fisheries Fund (EMFF)

- An important achievement was Government approval to build a replacement vessel for the RV Celtic Voyager and the award of the design contract in December 2018
- Significant advances in oceanographic activity by the Oceanographic Services Team included new operational modelling activities, providing marine input as part of national climate change adaptation and mitigation planning and developing potential new EU-funded projects
- A key highlight was the award of a significant infrastructure grant from SFI to upgrade and replace some marine observation infrastructures and acquire new observation equipment
- The Institute was active in the H2020 AtlantOS project in 2018 with a number of reports published, including a cost and feasibility report on existing ocean observing networks in the Atlantic
- OSIS operates the cabled observatory in Galway
  Bay which operates as part of the Smartbay
  Ocean Energy Test Bed and technology test and
  demonstration platform and continued to provide a
  wide range of services as part of our Service Level
  Agreement with SEAI. The Galway Bay cabled
  observatory continues to be used for a number of
  research projects.

The wide range of services reflects the dedication, professionalism, technical expertise and fantastic teamwork of the staff of OSIS and the wider Marine Institute and collaborators and contractors. I look forward to another significant year of achievement for the OSIS group and associated highlights in 2019.

#### Mr Michael Gillooly

Director - Ocean Science and Information Services

# POLICY, INNOVATION AND RESEARCH SUPPORT SERVICES (PIRS)

Research and Innovation are central to the role and mission of the Marine Institute. The Institute is both a research performer and a research funder. In addition, we hold responsibility for coordinating national marine research & innovation (R&I) and supporting Irish-based researchers to achieve success in international programmes. The role of the Policy, Innovation and Research Support (PIRS) Service Area is central to managing this multi-layered role of the Marine Institute with respect to R&I.

The Marine Institute Strategy, Building Ocean Knowledge, Delivering Oceans Services (2018-2022), sets ambitious

targets for Marine Institute and national research performance as well as optimising the efficiency and impact of our competitive funding programmes. The Marine Institute has a responsibility, on behalf of the government's Marine Coordination Group, to coordinate implementation of the National Marine Research & Innovation Strategy (2017-2022).

In 2018, we established two key implementation mechanisms: a Marine Research Funders' Forum and a Marine Infrastructure Providers' Forum. More than 20 partner agencies and government departments are represented on these groups. Each group is working towards delivery of specific actions included in the national strategy. Already, for example, the funders forum members have provided extensive data on their funded marine research projects and programmes to support the establishment of a national marine research database.

Meanwhile our Research Funding Office managed competitive research calls totalling €9.28m in 2018, ensuring a number of high impact investments in line with the national Marine R&I Strategy. Some notable highlights included a commitment of €2.38m over three years to 12 companies under our Industry-led Awards call and €2m over five years to Maynooth University for a Principal Investigator-led programme of research on oceans and climate change.

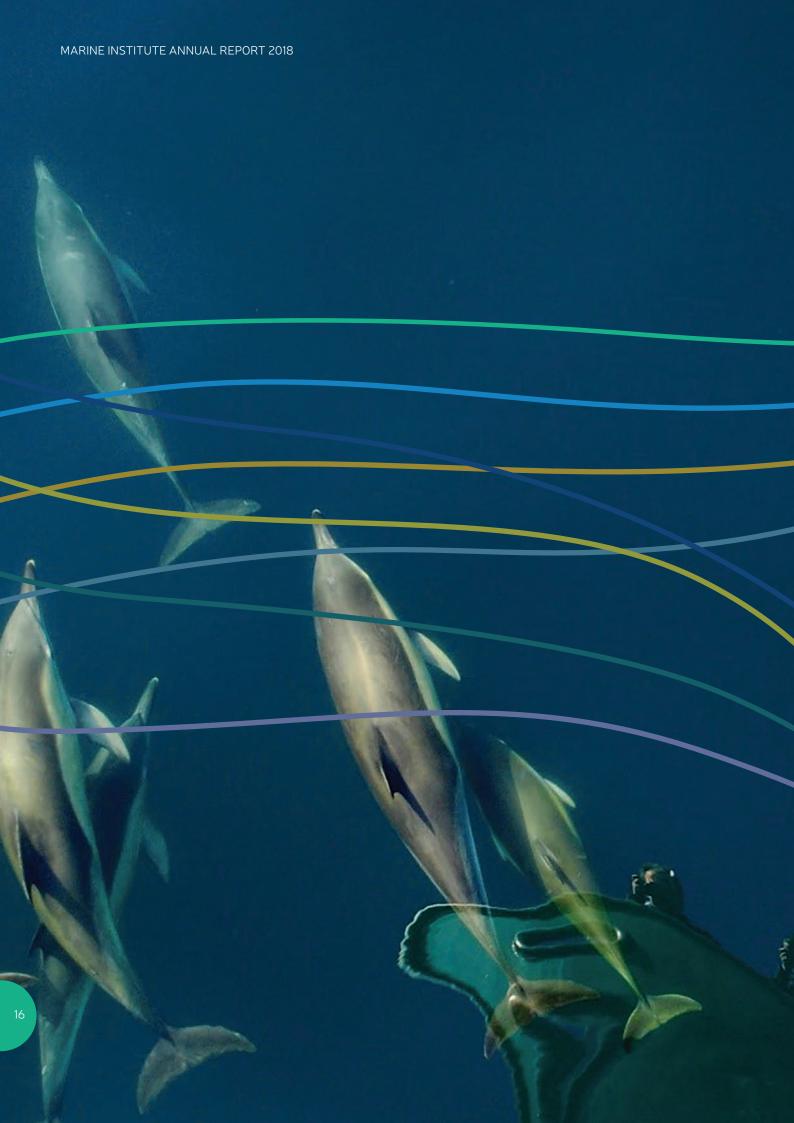
Finally, with the support of our Research Support and Coordination team and our International Programmes Manager, both the Marine Institute itself and Ireland as a whole performed to a high degree of success in national and international competitive marine research. As of the end of 2018, Irish-based researchers have been awarded a total of €48m for participation in marine research projects across all parts of the EU H2020 programme.

I would like to thank my dedicated and highly capable colleagues across the PIRS Service Area for their commitment to making 2018 a very successful year. Further details on delivery under the Research and Innovation Strategic Focus Area can be found in the report with details of projects and investments in the appendices.

#### Dr. Niall McDonough

Director – Policy, Innovation and Research Support Services





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The advice and services provided to the Department of Agriculture, Food and the Marine (DAFM) and other government departments, agencies and stakeholders are ongoing requirements mandated to the Marine Institute.

These services are essential to achieving a sustainable ocean economy, protecting and managing our marine ecosystems and meeting EU obligations. Our services support a range of commercial activities and important statutory requirements across fisheries, aquaculture, food safety, maritime transport and environmental compliance. Scientific advice and services are key deliverables for our parent department and main client DAFM, drawing on work in other areas of work in the strategic plan.

The Marine Institute conducts a broad range of data collection and monitoring programmes, including research vessel surveys, seabed mapping and laboratory analyses that provide the basis for our advice and services. These data are also crucial for an increased understanding of our oceans and climate, and provide a foundation for applied research and innovation.

The management of these diverse data sets and the ability to combine and use them in different ways is increasingly

important to the delivery and evolution of integrated advice. It also supports implementation of key marine policies and directives such as the Common Fisheries Policy, the Marine Strategy Framework Directive and the Maritime Spatial Planning Directive. Modelling, statistical analysis, spatial analysis and the interpretation of these diverse data sets, enable us to deliver services to our clients and stakeholders.

## MARINE ENVIRONMENT AND FOOD SAFETY SERVICES (MEFS)

Scientific advice provided by MEFS personnel is generated from comprehensive monitoring programmes administered by five integrated 'units' within the service area: shellfish safety, fish health, marine chemistry, environmental review and marine spatial planning. Monitoring conducted by MEFS is largely driven by EU Directive requirements, with national statutory instruments, reflective of these directives, as summarised in the MEFS Director's brief. Below is a summary of the monitoring and advisory services of these units in 2018 in relation to Scientific Advice and Services.

## **Monitoring Services**

## **Shellfish Safety Monitoring**

Under our remit as the EU designated Irish National Reference Laboratory for both marine biotoxins and shellfish microbiology, the Shellfish Safety Unit of MEFS carries out a number of programmes to protect consumers' health and ensure Ireland's compliance with EU regulations on food safety, as outlined in 853/2004/EC and 854/2004/EC. The unit provides a continuous year-round monitoring service that assesses over 100 inshore shellfish production sites and offshore fishing grounds as part of these programmes. The work is carried out in close cooperation with the SFPA and the FSAI with strong industry collaboration as part of national official controls on seafood safety.

Programmes of activity included testing for biotoxins in shellfish flesh, monitoring seawater for harmful phytoplankton species and assessing microbial contamination in classified shellfish production areas – the latter monitoring complimentary to that required under the shellfish waters directive 2006/113/EC. Naturally-occurring biotoxins in shellfish are monitored using chemical analyses, supported by phytoplankton monitoring and molecular biological assays, to detect the presence of toxins and their causative organisms.

In 2018, these analyses identified the presence of these toxins in shellfish in several production areas that resulted in temporary closures, to ensure consumer food safety and comply with EU regulations. In co-operation with the SFPA and shellfish industry, some 3,468 shellfish samples were collected on which 15,944 analyses were completed. These tests included the most important toxin groups in Ireland: Diarrhetic Shellfish Poisoning (DSP), Azaspiracid poisoning (AZA), Paralytic Shellfish Poisoning (PSP) and Amnesic Shellfish Poisoning (ASP). 2018 has had defined periods of toxicity with ASP in April, DSP from May onwards and AZP starting in August. During the year, closures for ASP were required in five shellfish production areas in the southwest for two weeks in April. Following this, a summer closure due to DSP affected 14 areas in the southwest and west between May and October although not all areas were closed for the full duration.

Most areas had reopened by the end of the summer but a short occurrence of AZA resulted in three closures in counties Kerry, Mayo and Donegal for a short period in the autumn. This pattern of toxicity was somewhat similar to the previous two years with a toxic period mainly limited to the summer months but it is in stark contrast to years in the earlier parts of this decade when widespread closures affected all regions for extended periods due to extremely high concentrations of toxins in several shellfish species.

In addition to the analyses of shellfish tissues for toxins, a total of 3,523 seawater samples were analysed for toxic and harmful phytoplankton species in 2018. These data support the biotoxin results from the shellfish samples, by identifying locations with increasing levels of toxic phytoplankton and thereby providing information that is used to determine appropriate frequency of sampling, identify unusual risk and provide predictive advice.

The shellfish safety biotoxin team was also the proficiency test provider for biotoxin analysis for laboratories in the international community in 2018. Under this 'Quasimeme' programme, initiated in 2008, the team prepares reference materials for biotoxin testing by other shellfish safety programmes around the globe—a critical component of both the Marine Institute's quality programme, as well as the external programmes using the service. In addition to designing, preparing and delivering biotoxin reference materials for the Quasimeme programme, technical consultancy services are provided, answering participant questions and addressing technical issues relating to biotoxin analysis and the statistical models used in assessment. In 2018, over 150 participants from labs around the world took part in the proficiency testing programme, an increase of approximately 50 percent in 10 years.

In our role as National Shellfish Microbiology National Reference Laboratory (NRL), ongoing supervision of microbiological test labs of *E. coli* levels in shellfish production areas is carried out and results from this programme are used to update the advice regarding the classification of shellfish production areas where necessary. A testing service for norovirus (NoV) in oysters was also continued in 2018. The vast majority of NoV samples tested (750) in 2018 were associated with a BIM-funded project to analyse the impact, management and prevalence of norovirus in a number of production areas around the coast of Ireland

This project is run in conjunction with the Irish Oyster Packers Group (IOPG) and continues until March 2020. Relatedly, a European Food Safety Authority (EFSA) mandated survey of NoV was also completed in 2018 to provide baseline information on its prevalence in European waters. Through this programme, Ireland tested an additional 540 samples throughout the duration of this baseline survey, which was initiated in November 2016 and ended in October 2018.

#### Fish and Shellfish Health Monitoring

In 2018, the Fish Health Unit investigated 21 reports of abnormal mortality events affecting Pacific oysters compared with 14 in 2017. These mortality events were principally associated with the presence of either the

bacterial pathogen *Vibrio aestuarianus* or with the Ostreid herpes virus-1 µvar (OsHV-1 µvar). In total, 1,711 molluscs were tested for diagnostic, research or surveillance purposes. The reason for the increase in mortality reports in 2018 remains unclear but may be associated with environmental conditions and the increased water temperatures associated with the summer of 2018.

The OsHV-1  $\mu$ var was detected in Poulnasherry Bay, Co. Clare for the first time in September of 2018. This detection was associated with oyster mortalities reported in the Bay. The detection of OsHV-1 in Poulnasherry reduces the number OsHV-1  $\mu$ var free bays in Ireland to only eight. An initial epizootic investigation into the detection was inconclusive and no source of introduction of infection was found. The Fish Health Unit continues to place all remaining OsHV-1  $\mu$ var free bays under surveillance and restrict movements of oysters into these bays in line with current national measures for OsHV-1  $\mu$ var in Ireland.

Over 4,000 finfish, primarily Atlantic salmon (43.5%), but also lumpfish (24.8%), wrasse (19.1%), rainbow trout (5.6%), coarse fish (3.9%) along with brown trout, carp and perch were screened for pathogens in 2018. No diseases listed as notifiable in Council Directive 2006/88/EC were detected. Two clinical cases of cardiomyopathy syndrome (CMS) were diagnosed in April on Atlantic salmon farms in a single bay but overall detections of the causative agent, piscine myocarditis virus, were less frequent than in 2017.

Koi sleepy disease, the carp edema virus (CEV), was confirmed in two coarse angling venues in Co. Cork in May. The disease is widespread in Europe but has previously only been detected once in Ireland in koi carp from a garden pond in Dublin. This detection was associated with high mortalities of common carp in both venues which were less than 20 km from each other and the concurrent outbreaks were clearly linked. The Marine Institute and Inland Fisheries Ireland worked together with the infected sites to successfully control the disease and no further cases were detected in any other sites in the country.

Two outbreaks of crayfish plague (Aphanomyces astaci) were confirmed in 2018 by the NRL following reports of abnormal mortality in white-clawed crayfish (Austropotamobius pallipes) in the River Al in Athlone, and the River Barrow in Moansterevin, Co. Kildare; the outbreak in the River Barrow was further upstream from the last known outbreak in this catchment in 2017. These outbreaks confirm the continued presence and probable spread of Crayfish Plague in Ireland following the first confirmed detection in Ireland in 2015.

The spread of crayfish plague poses a significant threat to the white-clawed crayfish population which is a protected species in Ireland. In response to this threat the Marine Institute and National Parks and Wildlife Services introduced a 2-year national surveillance

programme to monitor for the presence of crayfish plague. The surveillance programme is using newly introduced environmental DNA procedures to screen for the presence of the pathogenic water mould in all river catchments containing white-clawed crayfish.

## Residues and Contaminants Monitoring in Seafood

The chemistry section of MEFS carried out the farmed finfish component of the 2018 National Surveillance Monitoring Programme for Residues to ensure compliance with European Commission legislation 96/23/EC and to ensure farmed fish are fit for human consumption and food practices are being followed. These results will be reported in 2019. The 2017 results were published in 2018, in which the results of more than 775 tests and 2,250 measurements were presented. This report reflected full compliance with European standards and the outcome for aquaculture remains one of consistently low occurrence of residues in farmed finfish.

Additionally, fishery samples from non-EU countries collected at border inspection posts (BIPs) were tested for contaminants and veterinary residues. Monitoring and additional surveys of levels of environmental contaminants in Irish shellfish, crustaceans and wild fish were also undertaken in conjunction with the FSAI and SFPA, demonstrating compliance of Irish seafood with European regulatory limits defined Regulation 1881/2006. These data are reported to FSAI, SFPA and European Food Safety Authority.

## **Environmental Monitoring**

On behalf of the EPA and DHPLG, the Marine Institute conducted environmental monitoring as part of the 2016-2021 cycle of the EU WFD and OSPAR's coordinated monitoring programme. Selected Water Framework Directive (WFD) water bodies and designated shellfish growing waters were sampled for a variety of water quality indicators to determine whether they met 'good ecological and chemical status' as defined in the directive. Specifically, 484 water samples were analysed for physico-chemical parameters: 349 water and biota samples were collected for determination of a wide range of priority samples and other pollutants; and 216 samples were analysed for phytoplankton.

Additionally, 219 grab samples were collected from 16 water bodies and analysed for benthic macro-invertebrates, particle size analysis and loss on ignition. Of these, 86 samples were from seven coastal water bodies collected during the annual winter environmental survey aboard the RV *Celtic Voyager* in January. Marine Institute

monitoring data submitted to ICES was included in OSPAR assessments of the pollution status of the North East Atlantic. These data are also used by MI scientists to assess the annual trends and status of pollutants in the North-East Atlantic for OSPAR, WFD and for the development of common indicators under the MSFD.

The chemistry section in collaboration with NUI Galway and Dublin Institute of Technology undertook an expansive study to evaluate the current status and temporal trends of imposex in dogwhelks around Irish waters. Imposex is a known androgenic response of female dogwhelks due to exposure to tributyl tin (TBT) wherein female dogwhelks develop male reproductive organs. TBS is a highly toxic and once widely used antifoulant in marine paints, and the degree of imposex provides an effective indicator of TBT pollution.

Imposex offers a most clear-cut tool for monitoring of a contaminant-specific pollution effect under the MFSD as required for indicator 8.2.1 of Commission Decision 2010/477/ EC. This Department of Housing, Planning and Local Government (DHPLG) funded project determined the current imposex status and compiled historic survey data to evaluate longer term trends status in 13 locations around Ireland. Results show a substantial overall improvement with respect to TBT contamination of Irish coastal waters, although a few sites still show some evidence of localised TBT contamination. This shows the effectiveness of national, European and global measures to phase out TBT. Final project reports are expected in 2019.

#### **Finfish Farm Monitoring**

The Benthos Ecology Group carried out its annual review of reports from finfish operators arising from benthic surveys to examine seabed conditions below fish cages in accordance with DAFM Benthic Monitoring Protocols. A review is prepared annually by the Benthos Ecology Group and is submitted to DAFM. During 2018, 20 reports were received from 23 operational sites. Of the 20 sites that produced reports, 18 were considered acceptable (i.e conditions were within the environmental standards stated in 'Monitoring Protocol No. 1 for Offshore Finfish Farms – Benthic Monitoring, 2008'), and two sites were considered to have unacceptable environmental conditions. The report has been submitted to DAFM. In addition, farm operators have been informed and a corrective action plan has been received for one of these sites where conditions were considered unacceptable. Non reporting of monitoring results continues to be an issue with Benthic Monitoring of finfish sites.

## **Advisory Services**

## **Shellfish Safety Advice**

The Shellfish Safety team provided advice on shellfish food safety for ongoing official controls under the monitoring programmes for shellfish biotoxins and microbiological classification. This advice is channelled to the SFPA and the FSAI through the Molluscan Shellfish Safety Committee (MSSC) in which the Marine Institute has been a core member since its inception in 2000. As the NRL for Marine Biotoxins and Shellfish Microbiology, we also use this forum to report on EU Reference Laboratory Network issues.

Advisory reports are also produced on an ongoing basis through the production week to indicate the open status of production areas, and where closures are necessary based on biotoxin status in shellfish. These data are also used to produce a weekly online report that gives a synopsis of toxin and harmful algal bloom presence, and a short-term forecast of the likelihood of changes in status. These synoptic reports have been well received by regulatory authorities and aquaculture industry stakeholders and are constantly being improved. In all toxin outbreaks in 2018, these had been predicted by our short-term forecast and that information was published before closures were affected.

In 2018, the Bacterial and Virus laboratory network was disbanded in response to Brexit because the European Reference Laboratory (EURL) for shellfish microbiology had been hosted by CEFAS in the UK. A classification working group will be established through the Vigo EURL for biotoxins when a microbiology network manager is appointed in that establishment. Although the EURL was disbanded, MEFS has continued to provide supportive advice to Competent Authorities in Ireland and at a European level on microbiological food safety issues associated with bivalve shellfish.

Following the review of E. coli monitoring in shellfish production waters by the National Shellfish Microbiology NRL in MEFS, advice was again provided to the SFPA to assign appropriate classification to each shellfish production area for 2018. Similarly, information collected by the NRL on NoV from the BIM and EFSA-directed studies will be used in the future to assess NoV prevalence from across EU coastal counties, and potentially set quidelines and risk thresholds for shellfish destined for human consumption markets. As such, MEFS scientists participated in the EFSA technical group which is providing support for an EU-wide baseline survey to determine the prevalence of NoV contamination in oysters. This survey was an important step towards establishing European regulatory controls. All the Irish data from the exercise has been collated and has been submitted to EFSA to identify the levels of norovirus present in Europe and the impact that various norovirus limits will have on the industry.

## **Competent Authority Advice**

The Marine Institute is the Competent Authority in Ireland for the implementation of Council Directive 2006/88/EC. This directive addresses the health of aquaculture animals and the prevention and control of certain aquatic animal diseases. In this role, the Fish Health Unit directs and monitors the work of the DAFM Veterinary Inspectors who work in the aquaculture field. In 2018, 190 farm inspections were completed; 1,979 movements (imports, exports and internal movements) of live aquatic animals were authorised and seven new Fish Health Authorisations were granted, bringing the total number of authorised aquaculture production businesses in the country to 418. A single Compliance Notice was issued for repeated failure to keep appropriate records at an oyster production site and the issue was satisfactorily dealt with.

There were significant challenges for the Competent Authority around Pacific oyster production in Lough Foyle in 2018. As there is currently no licensing regime for aquaculture in Lough Foyle, it is not possible to issue Fish Health Authorisations for operators in this location. Despite this regulatory challenge, there is significant production of oysters in the Lough. Without a Fish Health Authorisation, operators cannot legally move oysters to other sites for on-growing but only directly for human consumption. To address this concern, in 2018 the Competent Authority wrote to all relevant authorised Aquaculture Production Businesses to remind them that it is an offence to accept oysters for on-growing from a site without a Fish Health Authorisation and acceptance of such material could result in revocation of their licence(s) on approved sites. To address the potential risk operationally, the Fish Health Unit worked with the Department of Agriculture, Environment and Rural Affairs in Northern Ireland and the Loughs Agency to develop a shellfish health surveillance programme in in Lough Foyle to provide added security around shellfish health in the Lough. This programme is now in operation.

In 2018, the Fish Health Unit also received regular requests for information on the activities of the Competent Authority through parliamentary questions and other fora. Therefore, to address these requests, and increase transparency of the work of the Competent Authority in ensuring compliance with Council Directive 2006/88/EC, a detailed report of activities in 2018 is in preparation that will be fully GDPR compliant. This report will be produced on an annual basis, similar to that of the Sea Lice annual monitoring report.

## **Aquaculture Licensing Advice**

MEFS continues to provide advice to DAFM to inform aquaculture licensing decisions that may have implications for marine Special Areas of Conservation (SACs), Special Protection Areas (SPAs) and/or other environmental concerns. 2018 was a particularly busy year, given the Department's goal of making approximately 300 shellfish licence decisions over the course of the year.

In 2018, highlights of MEFS advice and technical support in this area included:

- Completion of 11 full Appropriate Assessments for marine SACs and SPAs at Mulroy Bay SAC, Tralee Bay and Magharees Peninsula, West to Cloghane SAC, Tralee Bay Complex SPA, Ballymacoda (Clonpriest & Pillmore) SAC, Ballymacoda Bay SPA, Mullet/Blacksod Bay Complex SAC, Broadhaven Bay SAC, Glenamoy Bog Complex SAC, Blacksod Bay / Broadhaven SPA. These assessments will allow the progression of approximately 400 licensing decisions. Revisions on foot of requests from DAFM were provided for 3 Natura sites.
- Ongoing monitoring of mitigation measures in relation to oyster culture and bird interactions continues in Dungarvan SPA and the Bannow Bay SPA
- Environmental Impact Assessment screening for non-salmonid licence renewal applications in landbased facilities in Cork, Galway and Donegal
- Advice on 275 aquaculture licence applications, covering 357 individual sites. All advice was provided to DAFM within the 6-week time frame set out in legislation

## **Other Advisory Services**

In addition to the more extensive advice provided for aquaculture licensing and shellfish safety, MEFS also supports other key clients in the provision of advice in other marine arenas. In 2018, this included:

- Technical advice to ports on the disposal of dredge material at sea by providing pre-application technical support (n = 8), assessments of sediment suitability, and byproviding recommendations to the EPA (n = 6). MEFS also participated in the EPA Dumping at Sea Advisory Committee
- Lower action levels for arsenic and nickel in dredged material were reviewed and revised, and adopted by EPA in 2018
- The 2017 annual national report on dredging and dumping at sea was compiled and submitted to OSPAR

- Advice on 33 applications for foreshore leases/licences by way of participation on the DHPLG Marine Licence Vetting Committee.
   Applications included site investigations related to the potential future development of offshore windfarms in the Irish Sea, site investigations related to the development of improved wastewater treatment facilities in a number of coastal areas, the installation of subsea fibre optic cables within landfall sites on both the east and west coast as well as installation of pontoons for the provision of enhanced marine recreational facilities in a number of coastal areas
- Ongoing advice on the environmental aspects of offshore hydrocarbon exploration and production to industry.
- Ongoing advice to, and collaboration with, DCCAE for OSPAR Offshore Industry Committee measures, especially on the use of offshore chemicals and appropriate permit conditions.
- Reporting to OSPAR on the annual discharges, emissions and spills from the offshore oil and gas industry in Irish waters, 2017
- MEFS staff are delegates to a number of OSPAR Committees and working groups.
- Support and advice to Department of Communications, Energy and Natural Resources on the implementation of the Offshore Renewable Energy Development Plan through participation in the steering and environmental working groups

#### Marine Spatial Planning Advice

Ireland's National Marine Planning Framework (NMPF)<sup>[1]</sup> will be a key decision making tool for regulatory authorities and policy makers into the future. The Department of Housing Planning and Local Government (DHPLG) published the National Marine Planning Framework Baseline Report<sup>[2]</sup> in September 2018. The report provides a description of existing activity, policy and regulatory context for development of Ireland's first marine plan. It identifies the key issues the NMPF will need to address. Spatial Data and Evidence about Ireland's Oceans and Coastal communities will greatly support the implementation of the NMPF.

In February 2018, MEFS kicked off a series of projects that will provide relevant and timely Spatial Data and Evidence. These are funded through the European Maritime Fisheries Fund (EMFF) Union Priority 6 - Fostering the Implementation of the Integrated Maritime Policy.

- The NMPF will require environmental, social and economic data including data on all human activities occurring in the marine environment. As part of a data discovery and gap analysis, 1,923 marine datasets were discovered. A detailed quality assurance was carried out on the datasets to assess their relevance to Marine Spatial Planning (MSP) and evaluate the suitability for MSP. Building on the data discovery, we have begun a process of acquiring new and exciting spatial data
- A marine natural capital and ecosystem services framework to inform Ireland's MSP process was developed. The next step is to collate relevant data and map our marine provisioning, regulating/ maintenance and cultural services
- It is not currently known how climate change can be mitigated through the NMPF. To this end, best practices were evaluated by drawing on the National Adaptation Framework and approaches internationally. This project is also mapping vulnerabilities and opportunities that will result from climate change and assess the implications of sea level rise on coastal infrastructure
- Marine planning requires a range of tools to support the plan-making process for example data processing and analysis tools, decision support tools and stakeholder engagement. A review and recommendations on modelling and decision support tools of relevance to MSP was prepared. The next steps are to develop tools for use in the Irish context

In tandem with the data exploratory work, MEFS is ensuring that all MSP data are managed to accredited international standards (IODE and INSPIRE). A Data Management Quality Framework was developed which ensures that there are internal data procedures for spatial data management, use and governance.

## **Review of MEFS Service Quality**

As part of the MEFS Quality Management System, and consistent with strategic initiative 3 of SFA-1 (strengthening customer relationships), a customer satisfaction survey is conducted every two years wherein customers and stakeholders using our laboratory and environmental monitoring outputs are gueried as to the timeliness of the advice, its quality, and its utility to their programmes. Although this survey has been conducted numerous times by the MEFS quality programme over the years, it should not be construed to be fully representative of responses from customers that will be queried in the future as part of a Marine Institute-wide customer satisfaction survey—as per a Key Performance Indicator (KPI) in the Institute's new strategy. Notwithstanding, the results are a useful reflection of some of the perceptions of our advice and services. To this end, the Figure below illustrates the findings from 2018's survey of customer satisfaction distributed by the MEFS Quality Management Programme.

As reflected above, 10 out of 13 customers rated the overall quality of service that the Marine Institute provides as excellent with the balance selecting the "above average" category. Moving forward into 2019, this MEFS-focused survey will be integrated into a broader Marine Institute-wide strategic service questionnaire that captures all service areas.

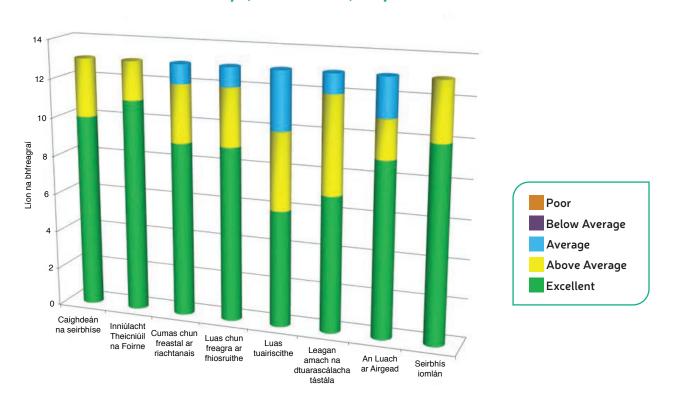
# FISHERIES ECOSYSTEMS ADVISORY SERVICES (FEAS)

#### The Seafood Sector

The seafood sector is a valuable contributor to Ireland's Blue Economy and contributes €1.25 billion annually (BIM Business of Seafood 2018). The landed value of the fisheries resource base is worth €370 million (€270 million from Irish vessels and €100 million from foreign vessels) and providing the scientific advice that ensures the sustainable exploitation of these resources is a key part of Marine Institute work programmes.

The EMFF (European Maritime and Fisheries Fund) is a very important funding mechanism for the Marine Institute service delivery. The Data Collection Multiannual Programme (DCMAP) is funded under EMFF and is a central part of the scientific advice and technical support services provided by the Marine Institute to the Department of Agriculture, Food and the Marine (DAFM) in relation to the Common Fisheries Policy. The Marine Institute has responsibility for Ireland's DCMAP and successfully completed the 2018 programme which was evaluated by the EU. The 2019 programme was also submitted and includes catch sampling at sea and in ports, internationally coordinated research survey programmes, inshore sampling and surveys and socioeconomic evaluation of the fishing, fish processing and aquaculture sectors.

### Customer Survey Question 2018: Quality of the Service Provided



Over 900,000 fish/shellfish were measured during the 2018 DCMAP programme. Age data were collected from over 50,000 individuals across all commercial species sampling programmes to provide data for the aged based models used in stock assessments.

In 2018, under the DCMAP, 17 research vessel surveys were carried out on a variety of commercially exploited species to provide the basic data that supports stock assessment. A total of 2,286 scientist days were spent at sea focused on a broad range of species including mackerel, blue whiting, herring, anglerfish, megrim, Nephrops, cockles, scallop and lobster. The Marine Institute participated in an industry funded mackerel egg survey carried out by UK (Scotland). The western limit of the egg distribution closely followed the Shelf edge up to the south coast of Iceland - the data collected will inform the planning of the 2019 international mackerel egg survey.

The annual sampling at sea programme was completed, with observers trained and deployed throughout the Irish fishing fleet and sample data compiled to contribute to 2019 stock assessments. In 2018, Marine Institute staff spent a total of 535 days collecting data on commercial catches. These data sets are used in national and international stock assessment programmes and provide the advice that is central to the sustainable exploitation of these species.

During 2018, the Marine Institute paid particular attention to anglerfish and megrim which are an important economic species for the Irish fleet. A review of the anglerfish and megrim survey was completed, resulting in 25% cost saving (€200,000) without reduction in the quality of the core data. The Marine Institute also developed a new anglerfish stock assessment, which is now used to provide catch advice to the European Commission. The stock is worth more than €8M annually to the Irish fishery.

The Marine Institute also successfully responded to 25 official DCMAP data calls. These data calls are a key performance indicator for Ireland's DCMAP programme. As well as basic data for stock assessment purposes, data calls also focused on by-catch of endangered species and on Vulnerable Marine Ecosystems, to support decision making under Common Fisheries Policy.

Regional coordination of the DCMAP was achieved through the Regional Coordination Group (RCG) of the North Atlantic through the work of 12 intersessional subgroups.

Providing scientific support to DAFM is central to the work of the Marine Institute. The annual Stock Book was delivered to DAFM in November 2018. This provides the latest scientific advice on over 70 fish stocks exploited by the Irish fishing fleet and is used in negotiations with the EU on fishing opportunities for 2019 at the December Fisheries Council. The data from the Stock Book was also used to develop the annual sustainability assessment which

was presented by the DAFM Minister to the Oireachtas in November 2018. The Stock Book was produced in hard copy format as well as a web based file. In 2018, a new web based application of the Stock Book was finalised. Various briefing materials on a broad range of topics, were prepared for DAFM throughout the year.

In order to gauge client satisfaction, a pilot advisory request register (ARR) was developed in 2018. The ARR records the number of requests received by the Marine Institute, the type of request, the response time and the client satisfaction with the Marine Institute response. The ARR will be a critical tool in developing the performance indicators required to successfully implement the new Marine Institute Strategy.

The Institute completed an analysis on fishing activity within the 6nm for DAFM. The resulting paper was circulated for public consultation on trawling inside 6nm. During 2018, spatial restrictions on fishing gears successfully negotiated with the industry to protect Natura 2000 features in Clew Bay. The Marine Institute had input to the development of a strategy for the Inshore Fishing Industry up to 2023.

The Marine Institute worked closely with Inland Fisheries Ireland (IFI) on the newly formed Technical Expert Group on Salmon (TEGS) which provides catch advice on all Irish salmon rivers.

The Marine Biodiversity Scheme is also an important component of the EMFF programme. This scheme addresses science and policy requirements for species restoration, assessing and mitigating fisheries and aquaculture in Natura sites and supporting implementation of the Marine Strategy Framework Directive. Phase 1 of Biodiversity scheme, comprising of 11 projects, was completed in 2018. A further three projects were initiated in 2018 and will be completed in 2020. EMFF Biodiversity Scheme restoration and management projects on skates and rays, crayfish and native oysters continued. Significant data sets developed to inform restoration. The project on implementation of vessel monitoring systems on vessels under 12m expanded in scope in a number of different fishing fleets. New seabird surveys were commissioned in the Irish Sea.

Outreach and stakeholder communication are very important elements of the DCMAP and Biodiversity scheme. A dedicated MI EMFF website was established in 2018 and regular update meetings were held with Industry and NGOs. Progress updates were also given at the EMFF Monitoring Committee. A dedicated EMFF biodiversity information event was held in October 2018.

## Brexit — Possible impacts on the Irish Seafood Sector

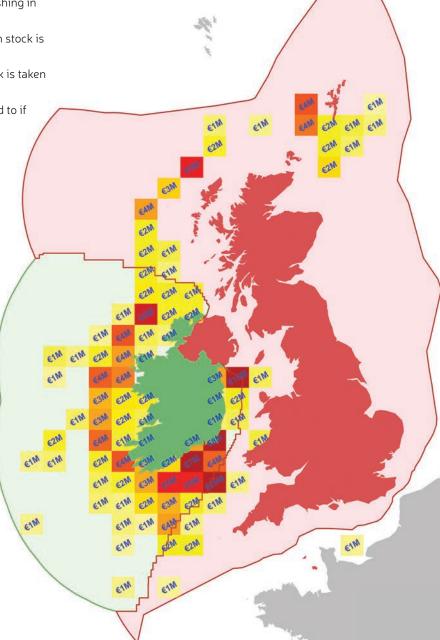
Throughout 2018, the Marine Institute carried out various analyses and provided scientific support to DAFM in relation to Brexit. A broad range of possible scenarios on the impacts of Brexit on the Irish seafood sector were explored. These scenarios focused on access to fishing grounds in UK waters by EU vessels, displacement of EU vessels into Irish waters and changes to the Total Allowable Catch (TAC) shares. A key consideration in the analyses was the delivery of simple, high impact maps and schematics that summarised the findings in a very visual way. The MI analyses focused on the following questions:

- Which countries are fishing in UK waters? Which stocks do they catch?
- Which Irish fisheries are most reliant on fishing in UK waters?
- How much of the Irish landings of each fish stock is taken from UK waters?
- How much of the UK landings of each stock is taken from EU waters?
- Where would EU fishing fleets be displaced to if they have no access to UK waters?

- How would displacement of fishing effort affect the sustainability of the fisheries?
- Which criteria might be used in negotiations on TAC shares between the EU and the UK and possibly other coastal states?

The map below gives a flavour of the type of visual output generated and shows the distribution of Irish landings (expressed as value € millions) for each of the "statistical rectangles" in the waters around Ireland. The green area represents EU waters around Ireland. The red areas represent sea areas that will become UK waters after Brexit. Note the value of fish taken off the west of Scotland (>€40 million) and the key Nephrops grounds in the north west Irish Sea (€15 million) where the UK line cuts right through this key

fishing area for the Irish fleet.



UK EEZ
Irish EEZ

\* Annual value of Irish landings (all species)

## Other key Scientific and Advisory Services during 2018:

- Ongoing developments with a new database,
   Paradigm 3, to implement the more efficient
   management of safety equipment and other FEAS
   records
- Laboratory analyst review with capability statement and final report produced
- Continued support to other projects outside of the DCF such as Bluefin Tuna tagging and the EMFF Reef survey
- Updated atlas of fishing activity based on satellite tracking data of fishing vessels. To be published early 2019
- Scientific support to DAFM, providing advice on various Brexit scenarios and support for EU fisheries council meeting
- FEAS staff played a central role in developing the new ICES fisheries overview on the Celtic Sea. This expands the mixed fisheries information which allows decision makers to compare the consequences of choices on quotas across fish stocks
- Successful completion of the acoustic survey programme including additional effort in the Celtic Sea to investigate the distribution of Celtic Sea herring during summer
- Development of the Celtic Sea herring stock assessment and management plan
- Scientific support to DAFM at Coastal States meetings
- Bursar scholarship programme successfully implemented with 22 students selected in to 16 different bursaries between June and September

## CASE STUDY Marine Institute on the International Stage

The Marine Institute continued to contribute significantly to ICES science and advice at all levels. In January 2018, Dr Colm Lordan from FEAS was appointed as one of the Vice Chairs of the International Council for the Exploration of the Sea (ICES) Advisory Committee.



In his three year term, Dr Lordan has responsibility for all the fisheries advice provided by ICES to its member countries and contracting parties (e.g. the EU). In this role, he is also working to evolve the quality assure framework at ICES to ensure a high quality advisory product.

Dr Lordan was first involved with ICES in 1993 and since then has participated in 60 different ICES expert groups and chaired or co-chaired 16 working groups.

## CASE STUDY

## Aquaculture Research at Marine Institute Newport

In 2018, the Marine Institute continued to invest in the upgrade and linking of the aquaculture research site at Beirtreach Buí (BB) near Carna, Co. Galway, with the hatchery at the Newport Research Facility. A five year business model (2018 to 2022) was developed by the Marine Institute that will build on a range of funded research projects that address the needs of the aquaculture sector. BB is an aquaculture test site that allows for the holding of a range of fish, shellfish and seaweed species for research purposes.



At Newport, a new RAS (Recirculating Aquaculture System) was installed in 2018 and will be fully operational by early 2019, when a project will trial new salmon smolts that spend less time at sea, with the potential to increase production capacity and reduce disease risks. In 2018, research was carried out at BB to examine the behaviour and welfare of cleaner fish (lumpfish) that are used on commercial salmon farms. The results will be used to make recommendations that will reduce the number of cleaner fish required, through improvements to their habitats on salmon farms.

In December 2018, the Marine Institute, in partnership with NUIG, Teagasc and Biomarine Ireland secured funding from DTIF (HYDROFISH project) to produce products for the aquaculture industry that will disrupt current farming practices such as the use of fish protein hydrolysates to boost the salmon immune system and strengthen the gut to improve resistance to bacteria fungal and ectoparasite (e.g. sea lice) pathogens (e.g. amoebic gill disease).

The Marine Institute has partnered with Bord lascaigh Mhara (BIM) and Údarás na Gaeltachta to bring forward initiatives to ensure that the results of the research are transferred to industry and provide practical support to its sustainable development. To achieve this, BIM and the Marine Institute formed a research and development cluster focused on the Marine Institute's BB and Newport research infrastructure and the Páirc na Mara project currently being developed by Údarás na Gaeltachta.

Since the initiation of the Newport Aquaculture Strategy in 2016, the Marine Institute has secured competitive funding of over €2 million from six research projects. The projects range in duration from 24 to 48 months and at present the Marine Institute has significant research funding in place out to 2022. The research funding has enabled us to take on a total of eight researchers over the period of the plan. As of the end of Q3 2018, the Marine Institute have six posts in place fully funded by these projects.

Capital investment in the upgrading of the marine site at Beirtreach Buí and at the hatchery facilities in Newport commenced in 2016 and is due to be completed in 2019. The upgrades include new moorings and cages at the marine site and the refurbishment of hatchery facilities in Newport with the installation of a state of the art RAS system to support the new projects coming on stream through 2018 and into 2019.

# OCEAN SCIENCE AND INFORMATION SERVICES (OSIS)

### Information Services and Development

The information services and development team develops and manages the ICT and data infrastructure across the Marine Institute to provide a robust operational platform for data and information services. The team also continues to develop new technical capabilities and support improvements in the Marine Institute's service delivery.

In 2018, the Institute progressed several strategic initiatives through the IT Strategy, the Data Strategy, and EMFF data integration in support of developing MSP and MSFD programmes, with these activities closely aligned with the Institute's new strategic plan.

These included work on the Irish Digital Ocean digital services platform which aims to make Ireland's marine digital assets more readily available for public services, research and innovation. In collaboration with operational science teams, the Institute has developed new capabilities for marine environmental data processing and a cross-service area Data Management Quality Management Framework in line with international standards.

The information services and development team serviced over 3,000 internal support requests covering hardware, software and data management, and carried out a range of internal training. 2018 saw an increased focus on systems resilience, cyber-security and General Data Protection Regulation (GDPR) compliance, with a number of significant improvements to operational systems being implemented.

Operational programme support was delivered for Fisheries Data Collection, the INFOMAR and Marine Ocean Energy programmes, and the marine environment data processing and spatial analysis activities.

The Marine Institute data request service processed 175 manual data requests in 2018. The new Institute data catalogue was also launched in 2018, allowing the public to search for relevant available datasets at data.marine.ie. Ongoing improvements to Marine Institute data accessibility ensure that more data is available online including through data.marine.ie, atlas.marine.ie, www.oceanenergyireland.ie, and www.digitalocean.ie.

These sites were visited by 54,000 users in 2018. Of particular note is the significant uplift in views of data buoy data for the months of October—December.

Major projects in 2018 included a rework of the Institute's server infrastructure to improve resilience and performance of the ICT systems which underpin the Institute's daily operations, in addition to significant work to improve security of data and IT services.

The Institute has continued to develop new IT and data system capabilities for fish health management and biotoxins data processing, in addition to oceanographic and marine renewable energy data processing, analysis and publication capabilities.

2018 also saw the development of a new Data Management Quality Framework for scientific data processes. The new framework is aligned with the IOC's IODE quality management system and will support improved data quality and reuse. The team has also further developed the Irish Digital Ocean platform with new ways to access information including visualisation of predictive oceanographic model data and data from the INFOMAR seabed survey programme, enabling data reuse across new and developing programmes.

The team was also active in EU data-related research projects connected to the European Marine Observation and Data Network (EMODnet) and SeaDataCloud EU data networks, in addition to continued work on the COMPASS INTERREG project working to coordinate and improve data management and service capabilities with partners in Northern Ireland and Scotland.

#### Modelling

The range of modelling services provided by the Marine Institute expanded further and there has been an addition of three new modellers funded through EU activities in 2018. The Institute is active in an EU operational oceanographic service, the Copernicus Marine Environment Monitoring Service (CMEMS), and will provide validation and a scientific expertise for the development of

biogeochemical numerical models of the Iberia-Biscay-Ireland region.

Other activities include provision of freely available regular ocean, wave and storm surge forecasts and hindcasts to a range of end-users. These datasets include three-dimensional currents, temperature, salinity and the sea surface height.

Tailor-made products were developed in 2018 and highlights include a weather window tool, an aquaculture site selection tool and a guideline on best practice on creating a weekly HAB bulletin published in the BP repository (https://www.oceanbestpractices.net/), maintained by the International Oceanographic Data and Information Exchange (IODE) of the UNESCO-IOC.

EU-funded research projects gained momentum in 2018. Notably, the Institute further developed numerical modelling capacity funded by and in support of: tackling marine litter (CleanAtlantic, Interreg Atlantic Area), Marine Strategy Framework Directive implementation (iFADO, Interreg Atlantic Area), building coastal resilience (MyCOAST, Interreg Atlantic Area), management of Marine Protected Areas Networks (COMPASS, Interreg VA), Integrated Multi-trophic Aquaculture (TAPAS, H2O2O) and development of climate services for aquaculture industry (Co-Clime, Joint Programming Initiative Climate ERA4CS).

In 2018, the Institute continued to work with local and national search and rescue operations. This included membership and continuous support for the Galway Bay inter-agency Search and Rescue initiative and provision of ongoing advice and expertise to An Garda Síochána to assist with ongoing investigations.

## Oceanographic Services

The team further built on observing efforts through active membership of both the European Multidisciplinary Seafloor and Water Column (EMSO) and Euro-Argo European Research Infrastructure Consortia (ERICs). The Institute is Vice Chair of the Euro-Argo Management Board and the team successfully deployed three floats and have added capacity to Ireland's core Argo programme, by procuring Ireland's first ever Oxygen measuring Argo floats, which in addition to the biogeochemical float, offers the Irish research community new opportunities for data collection and analysis. A demonstration Argo float, together with the recently refurbished Glider, proved to be very popular exhibits during SeaFest 2018. Both the EMSO and Euro-Argo ERICs have also enabled the Marine Institute to leverage funding through the H2020 programme.

As a result of this high quality delivery of EU-funded programmes, the entire oceanographic services team had

a very successful year in securing new EU project funding. The end of 2018 also saw success in the award of both Eurofleets+ and EuroArgo-RISE projects to the Institute. The Institute continued to provide input into infrastructure projects including the H2020 EMSO-LINK, Maritec-X and the JPI Climate ERA4CS CoCliME project. Other projects include the INTERREG Atlantic PRIMROSE project and the H2020 TAPAS project.

#### **Ocean Observations**

In 2018, the Institute was particularly active contributing to the development of a strategy for the decade ahead on Atlantic basin-scale ocean observing; a BluePrint Vision for an Integrated Atlantic Ocean Observing System in 2030. The Institute also contributed to a community white paper on "GO-SHIP: A platform for integrated multidisciplinary ocean science" and continued to be actively involved in the GO-SHIP Science Committee. The GO-SHIP SC provide scientific leadership and oversight for the development and implementation of the decadal global survey of hydrographic sections operated by national research institutions. In February, teams from the Institute and NUI Galway undertook the Annual South Rockall Trough Ocean Climate cruise aboard the RV Celtic Explorer.

OSIS continued involvement in the ICES Working Group on Oceanic Hydrography. An output from WGOH is the annual ICES Report on Ocean Climate (IROC) that summarises the most recent status and trends of ocean temperature and salinity, from ship based CTD standard sections, ocean data buoys and inshore long term monitoring stations, in the North Atlantic region.

The Institute was active in the H2020 AtlantOS project in 2018 with a number of reports published. Of particular relevance to funders is the cost and feasibility report on existing ocean observing networks in the Atlantic. The JPI Climate ERA4CS CoCliME research project, coordinated by the Marine Institute, continues a number of activities to codevelop user-driven Climate Services for the Irish seafood sector.

### **Advanced Mapping Services**

Advanced Mapping Services (AMS) provided survey coordination, operational, data, research and development, along with advisory support, both internally within the Marine Institute, and for industry, government and public stakeholders, in Ireland, and internationally.

The strategic approach developed by AMS for the DCCAEfunded INFOMAR offshore mapping has been further refined, with multi-year survey statistics underpinning annual operational survey targets towards mapping completion end 2026. Detailed collective Marine Institute and Geological Survey Ireland progress reporting is now published annually, capturing operational data, and valued-added INFOMAR activities. The 2018 AMS compiled report is undergoing final editorial and is due for publication Q1 2019.

As part of INFOMAR's Value-Added Exploitation programme, the team coordinated and supported research, training, education, outreach and SME R&D activities. Development, delivery and launch of the new INFOMAR website was a key 2018 output. Numerous underlying data, product and web mapping services were developed in parallel. These refined, open and free outputs significantly improve stakeholder access to seabed data and associated information, which is vital equally for management, conservation or development.

As part of the INFOMAR programme undertaken in partnership with Geological Survey Ireland, the Marine Institute's Advanced Mapping Services team and vessels RV *Celtic Explorer* and RV *Celtic Voyager* mapped over 7,685 km² of seabed in the Celtic Sea during 98 allocated vessel days in 2018. The Marine Institute's INFOMAR survey operations involved acquisition of 20,729 line kilometres of multibeam data, mapping of 18 shipwrecks, and collaborative acquisition of 359 seabed samples.

Operationally, mapping focused on survey activities offshore in the Celtic Sea, in what proved to be a complex dynamic oceanographic regime, leading to increased onboard QC requirement and post processing survey effort. 18 shipwrecks were surveyed and a large submarine channel complex was partially mapped, now visibly extending over 80km in length, and up to 3km wide.

In support of national habitat monitoring and fisheries management requirements, the mapping team coordinated the EMFF funded NPWS SeaRover ROV offshore reef habitat mapping project, targeting and investigating an extensive array of features along the shelf break and slope. The project brought together an integrated team to deliver the programme including the Marine Institute, NPWS, Geological Survey Ireland, NUIM, Plymouth University, AquaFact Ltd and the Commissioner of Irish Lights.

Routine INFOMAR groundtruthing was undertaken on Marine Institute vessels, with some samples also acquired on GSI's RV *Keary*. Opportunistic groundtruthing through collaboration with FEAS was facilitated during stock assessment surveys when time and staffing were available onboard. 359 sediment samples were acquired, and results will underpin multiple programmes and reporting requirements, including MSFD, Habitats Directive, MSP and OSPAR reporting, Sediment samples were collected, predominantly in the Celtic Sea, and Particle Size Analysis is ongoing.

Significant progress was made with chart production, with charts delivered for Lough Foyle and Waterford, six sets of coastal series charts generated and 12 seabed classification charts provided. All are available online through a click and download facility - <a href="https://www.infomar.ie/maps/downloadable-maps/charts">www.infomar.ie/maps/downloadable-maps/charts</a>. Several new web mapping viewers are now accessible on the front page of the INFOMAR website.

Sediment classification data are added to a new INFOMAR collated substrate layer which is available as an ArcGIS service, through INFOMAR web mapping viewers, and also through Digital Ocean and the Marine Atlas. These data layers are essential for fisheries management, marine spatial planning, environmental assessment and reporting on EU directives.

Hydrographic data processing for 14 survey logs was completed, including all 2018 Institute acquired data, data collected during supported projects and four historical inshore datasets collected by GSI.

Significant international and Irish research collaboration continued, while also providing education, training and capacity build support (see Strategic Enabler — Engagement and Education). Project work on the EMODnet Habitat project is ongoing, with a decision pending on a two year extension.

For a full brief of research vessels' operations during 2018, see Strategic Enabler 2 – Infrastructure.

## The Irish Marine Data Buoy Observation Network (IMDBON)

Since 2001, the Irish Weather Buoy Network has been generating hourly weather reports consisting of measurements of key near surface marine meteorological data: air temperature, humidity, atmospheric pressure, wind speed and direction also oceanographic data including sea surface temperature, wave height, and wave period. The extreme western synoptic M6 location is a sentinel European monitoring site.

The budget subhead for this programme of activity (renamed the Irish Marine Data Buoy Observation Network [IMDBON] to reflect a wider marine observing ambition) transferred from the Department of Transport, Tourism and Sport (DTTAS) to the Department of Agriculture, Food and the Marine (DAFM) in 2018 with an associated increase in the core operations and maintenance programme budget in 2018.

In recent years, the Marine Institute rolled out a series of modifications to the standard buoy platforms in use to improve reliability and as part of this, a long term research programme involving UK Met and a French company, Mobilis, resulted in what is one of the most advanced weather observing platforms currently available worldwide. The first of these went on test at the historical M1 site (50 nautical miles west of Galway) where the platform was determined as fit for purpose in 2018. During 2018, Marine Institute technical staff developed an advanced data collection system which is based on open source hardware and software solutions which is now ready to roll out from 2019 onwards.

In 2018, the last of the old generation ODAS (Ocean data acquisition platform) data buoys was placed on permanent exhibition at the Cromwell Point Lighthouse Visitors Centre on Valentia Island, a fitting homage to these mighty devices that have given such solid service to mariners for two decades

2018 also saw an increased role by the Marine Institute handling weather observations where incoming data collection and management are to be streamlined with the Marine Institute undertaking not only the acquisition of data to shore, but also its archive and dissemination, plus its formatting into the standard format for onward hourly transmission to EU Met. Services and beyond.

A significant SFI (Science Foundation Ireland) research infrastructure funding award in late 2018 will provide the means to complete the transfer to new technology, placing the network on a sound basis for many years to come. This work will include leveraging additional data acquisition of key climate variables, most notably carbon dioxide exchange across the air-sea boundary.

### The Irish National Tide Gauge Network

Operated by the Marine Institute, the Irish National Tide Gauge Network (INTGN) provides monitoring of sea level around the Irish coast. As sea level relative to land level change is a key ECV (Essential Climate Variable) with regards to climate adaptation and coastal resilience, 2018 saw an increase in interest from universities who are looking to better understand historical observation and trends, this has extended to the formation of a distributed expert group with activities being led by NUI Maynooth.

2018 also saw the conclusion of efforts into completing a round of installations, increasing the permanent monitoring infrastructure to 22 managed nodes. Focus is being given to survey and calibration methodologies to bring all stations to within a certainty of better than 1cm.

A major overhaul of the data handling base station in Galway moved all remote monitoring to true real time, with data being reported into the central base station every five minutes with a much greater level of reliability.

The long-term, ultra-high precision temperature data being collected at Ballycotton (east Cork) and the Portmore Pier (Malin Head) are now well established. These data continue to feed background climatological data into central archives of temperature, the fundamental climate change indicator. Ballycotton is a relatively new station, but in the case of Malin Head this work is building on a time series that started in the late 1950s when the importance of long term monitoring was recognised.

## POLICY, INNOVATION AND RESEARCH SUPPORT (PIRS)

The Marine Institute provides marine research & innovation policy advice to a number of national and international stakeholders including the Department of Agriculture, Food and the Marine (DAFM), the Marine Coordination Group, the Department of Foreign Affairs and Trade and its Maritime Attaché in Brussels. We work closely with the Attaché to coordinate Marine Institute and Irish positions to inform a range of EU marine and maritime policy and strategy development and implementation.

Supporting the CEO, PIRS coordinates engagement with key national Research & Innovation Fora including the Innovation 2020 Steering Group and the Horizon 2020 High-Level Group hosted by the Department of Business, Enterprise and Innovation (DBEI). We also coordinate input to a range of national consultations and formal returns to Government on research activity and expenditure. From 2019, the policy advisory activities of PIRS will be monitored and quantified through the Service Register which is being developed for all Marine Institute scientific and technical advice.

In 2018, DBEI undertook a process to develop a series of briefings on 16 important sectors and the Institute contributed at multiple stages of this process to develop the Focus on Marine and Maritime briefing. This is used as a resource both within DBEI, its offices and agencies, and across other government departments and agencies to inform briefing materials, speeches and policy development. A publicly available version of the Sector Briefs, entitled Focus on Sectors, was also developed and published on the DBEI website. Focus on Sectors is aimed at a wider audience and presents only factual content from the Sector Briefs.

## IRISH MARITIME DEVELOPMENT OFFICE (IMDO)

The advice and services provided to the Department of Transport, Tourism and Sport (DTTAS), and to other stakeholders, are ongoing requirements mandated to the IMDO. The advice offered informs decision makers and supports policy making in the maritime industry. The IMDO gathers data from a variety of industry sources to construct comprehensive, rounded and objective advice for stakeholders. The delivery of advice in this fashion is strategically important to the Marine Institute. In 2018, the IMDO delivered advice in a number of important areas:

## Irish Maritime Transport Economist (IMTE)

The IMDO published the 15th edition of the IMTE in 2018. This publication is a statistical bulletin and a comprehensive source of national maritime traffic, trade and global shipping market data. The IMTE provides an indepth retrospective analysis of maritime freight volumes, cargoes and passenger freight volumes. The publication provides a valuable descriptive statistical analysis for the maritime industry on the dynamic relationship between the national ports, the shipping sector and the Irish economy. Maritime traffic handled by the Northern Irish ports is also included in the annual research as the IMTE reflects the economic impact of maritime passenger and freight traffic from an all island perspective. The value of the publication was highlighted throughout 2018 by the increased demand for reliable industry data that resulted from the decision of the United Kingdom to leave the EU, and the knockon effects that this decision will have on Irish ports and shipping services.

## **Quarterly Trade Bulletins**

The IMDO provides a quarterly market analysis to DTTAS and industry. This analysis enables emerging trends to be detected early and appropriate action to be recommended. In 2018, the Bulletin was a useful monitor of the emerging effects on Brexit on patterns.

## Landbridge Report

The IMDO published a study dealing with the Implications of Brexit on the Use of the Landbridge. The report had two principal objectives. It quantified the volume of traffic using the Landbridge and established the elasticity of demand in response to changes in transit times and increases in cost. The report established the importance of maintaining the Landbridge connection and the damaging effect that any deterioration in the efficiency of the Landbridge would have on certain market sectors.

## **IPORES Report**

The IMDO commissioned an update of the Irish Ports Offshore Renewable Energy Services (IPORES) Report in 2018. The original report was published in 2012. The report comments on the preparedness of Irish ports to support the development of the offshore renewable energy industry and the vitally important role that ports will play in the supply chain, both during the construction phase and later in the maintenance and servicing of devices. The Report also comments on the job creation potential of this strategically important industry sector.

## **Shipping Capacity Report**

The impact that Brexit will have on shipping services to and from Ireland was not resolved during 2018, because of the uncertainty that continued to surround the type of Brexit that would take place. In the scenario planning exercises that took place within DTTAS, the IMDO provided advice on current and future shipping and port capacity, providing policy makers with data to underpin potential responses. The advice took account of current utilisation factors in different maritime transport modes and the ability of Irish ports network to meet emerging challenges.

## **Port Capacity Study**

In 2018, on behalf of DTTAS, the IMDO commissioned a report into the capacity of the Irish ports network. This is an important study for three reasons. It addresses a need identified in National Ports Policy to reassess the capacity of Irish ports from 2018. It is also a timely contribution to the debate on the preparedness of Irish ports to meet the challenges of Brexit. Lastly, it identifies the obstacles that could hinder the ports in the vital role they will play in enabling future economic development. The report is due to be published in Q2 2019.

### Civic Dialogue Fora

In 2018, five All-Island Civic Dialogue Fora on Brexit were held that gave voice to political and civic society interests to comment on the emerging challenges and opportunities relating to the UK's decision to leave the European Union. The IMDO participated in the meetings and contributed to and learned from the debates that took place.

## **EU Policy Advice**

The IMDO provided advice on emerging EU trends in maritime transport and on the funding opportunities that exist for Irish stakeholders. The IMDO participated in Ten-T, Motorways of the Sea, and Connecting Europe Facility events throughout 2018.

In April, IMDO, working with Shannon Foynes Port Company, hosted a funding event in Limerick, with invited guests from the European Commission and European Parliament, as well as guests from throughout the ports and shipping sector. The IMDO is currently working with Irish ports to develop an integrated project that will drive the efficiency of Irish ports by attracting higher levels of EU funding. This initiative will concentrate on digitalisation, Smartports and opportunities to use technologies, such as Blockchain, to improve port performance.

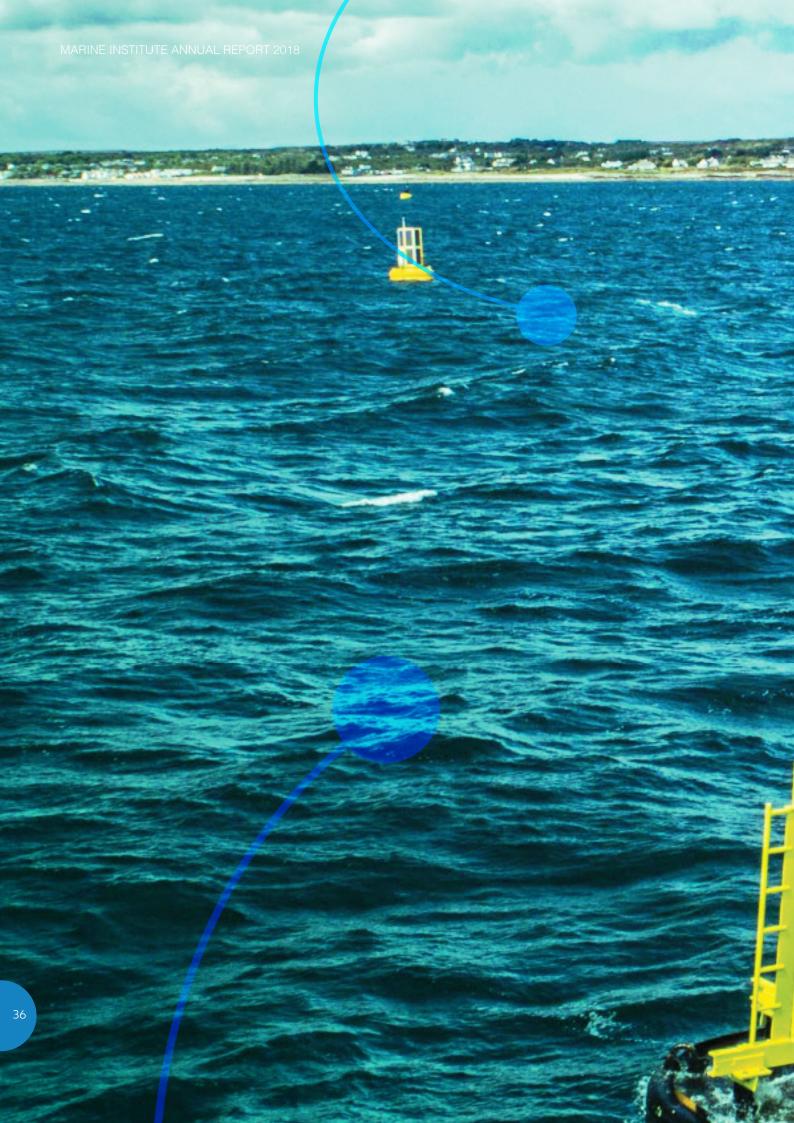
#### Ad Hoc Advice and Brexit Related Issues

The IMDO also responds to ad hoc requests for advice and services, particularly those that arise from DTTAS. 2018 was particularly challenging for the IMDO because of the uncertainty that surrounded Brexit and the increase that occurred in the demand for advice and information. In 2018, more than 400 person hours were spent on the delivery of ad hoc advice relating to Brexit.

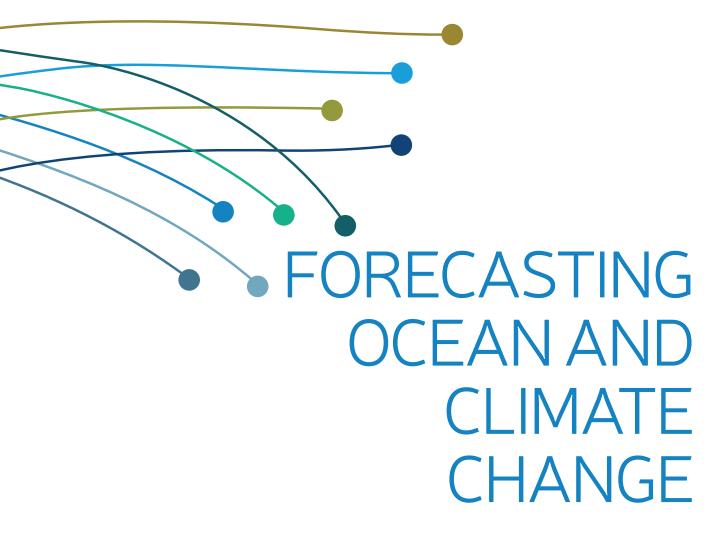
The IMDO delivered on its mandate in quantitative and qualitative terms, by providing timely, objective and informed advice to key stakeholders throughout 2018.



Marine Institute CEO Dr Peter Heffernan, Fishmonger Pat O'Connell and Minister for Agriculture, Food and the Marine, Michael Creed, TD, with the 2018 Marine Institute Annual Stock Book







Adapting to a changing climate is one of the greatest challenges facing society, governments and decision-makers worldwide. The ocean and climate are inextricably linked and marine ecosystems are changing at an unprecedented rate. There is significant demand for greatly enhanced knowledge and services that will allow us to observe the changes in our oceans, project and model likely future scenarios and support adaptation planning.

Forecasting ocean and climate change are vital activities that support our scientific advice relating to many government policies and research initiatives.

The Marine Institute works with national and international partners to observe and understand how our ocean is changing and to determine how to respond to current and future patterns of change that impact Ireland's economy and people. Robust advice and operational forecasting on projections of our changing oceans and climate are essential for government to make effective policies and management decisions to address a range of issues and challenges. These include changing fish distributions, food

security, low carbon economy, sea-level rise, flooding and increasingly, extreme weather events.

Programmes conducted jointly by the Marine Institute and Geological Survey Ireland have mapped much of Ireland's extensive marine territory.

Ireland's 880,000km<sup>2</sup> maritime territory extends far into the Atlantic Ocean. Our climate is regulated by the relatively warm waters of the Atlantic Gulf Stream, protecting us from climatic extremes but leaving us exposed to climate change impacts. Such impacts include rising sea levels, increasingly storm intensity, climatedriven changes in marine ecosystems and the services they provide.

Ireland is uniquely positioned to be at the forefront of efforts to better understand global ocean challenges and to provide essential national services in observing and projecting regional and local impacts.

# OCEAN SCIENCE AND INFORMATION SERVICES (OSIS)

#### Modelling

The range of modelling services provided by the Marine Institute expanded further and there has been an addition of three new modellers funded through EU activities in 2018. The Institute is active in an EU operational oceanographic service, the Copernicus Marine Environment Monitoring Service (CMEMS), and will provide validation and a scientific expertise for the development of biogeochemical numerical models of the Iberia-Biscay-Ireland region.

Other activities include provision of freely available regular ocean, wave and storm surge forecasts and hindcasts to a range of end-users. These datasets include three-dimensional currents, temperature, salinity and the sea surface height.

Tailor-made products were developed in 2018 and highlights include a weather window tool, an aquaculture site selection tool and a guideline on best practice on creating a weekly HAB bulletin published in the BP repository (https://www.oceanbestpractices.net/), maintained by the International Oceanographic Data and Information Exchange (IODE) of the UNESCO-IOC.

EU-funded research projects gained momentum in 2018. Notably, the Institute further developed numerical modelling capacity funded by and in support of: tackling marine litter (CleanAtlantic, Interreg Atlantic Area), Marine Strategy Framework Directive implementation (iFADO, Interreg Atlantic Area), building coastal resilience (MyCOAST, Interreg Atlantic Area), management of Marine Protected Areas Networks (COMPASS, Interreg VA), Integrated Multi-trophic Aquaculture (TAPAS, H2O2O) and development of climate services for aquaculture industry (Co-Clime, JPI Climate ERA4CS).

### Ocean Observations

In 2018, Institute was particularly active contributing to the development of a strategy for the decade ahead on Atlantic basin-scale ocean observing; a BluePrint Vision for an Integrated Atlantic Ocean Observing System in 2030. The Institute also contributed to a community white paper on "GO-SHIP: A platform for integrated multidisciplinary ocean science" and continued to be actively involved in the GO-SHIP Science Committee. The GO-SHIP SC provides scientific leadership and oversight for the development and implementation of the decadal global survey of hydrographic sections operated by national research institutions.

In February, teams from the Institute and NUI, Galway, undertook the Annual South Rockall Trough Ocean Climate cruise aboard the RV *Celtic Explorer*. OSIS continued involvement in the ICES Working Group on Oceanic Hydrography. An output from WGOH is the annual ICES Report on Ocean Climate (IROC) that summarises the most recent status and trends of ocean temperature and salinity, from ship based CTD standard sections, ocean data buoys and inshore long term monitoring stations in the North Atlantic region.

The Institute was active in the H2020 AtlantOS project in 2018 with a number of reports published. Of particular relevance to funders is the cost and feasibility report on existing ocean observing networks in the Atlantic. The JPI Climate ERA4CS CoCliME research project, coordinated by the Marine Institute, continues a number of activities to codevelop user-driven Climate Services for the Irish seafood sector.

#### Oceanographic Services

The team further built on observing efforts through active membership of both the European Multidisciplinary Seafloor and Water Column (EMSO) and Euro-Argo European Research Infrastructure Consortia (ERICs). The Institute is vice chair of the Euro-Argo Management Board and the team successfully deployed three floats and have added capacity to Irelands' core Argo programme, by procuring Ireland's first ever Oxygen measuring Argo floats, which in addition to the biogeochemical float, offers the Irish research community new opportunities for data collection and analysis. A demonstration Argo float, together with the recently refurbished Glider, proved to be very popular exhibits during SeaFest 2018. Both the EMSO and Euro-Argo ERICs have also enabled the Marine Institute to leverage funding through the H2020 programme.

As a result of this high quality delivery of EU-funded programmes, the entire oceanographic services team had a very successful year in securing new EU project funding. The end of 2018 also saw success in the award of both Eurofleets+ and EuroArgo-RISE projects to the Institute. The Institute continued to provide input into infrastructure projects including the H2020 EMSO-LINK, Maritec-X and the JPI Climate ERA4CS CoCliME project. Other projects include the INTERREG Atlantic PRIMROSE project and the H2020 TAPAS project.

### Information Services and Development

The information services and development team at OSIS develops and manages the ICT and data infrastructure across the Marine Institute to provide a robust operational platform for data and information services. The team also continues to develop new technical capabilities and support improvements in the Marine Institute's service delivery.

Information services and development during 2018 relevant to the Strategic Focus Area of Forecasting Ocean and Climate Change include:

- In collaboration with operational science teams, the Institute has developed new capabilities for marine environment data processing and a cross-service area Data Management Quality Management Framework in line with international standards. New IT and data system capabilities for oceanographic and marine renewable energy data processing, analysis and publication capabilities have been developed.
- Operational programme support was delivered for the INFOMAR and Marine Ocean Energy programmes and the marine environment data processing and spatial analysis activities. The team has also further developed the Irish Digital Ocean platform with new ways to access information including visualisation of predictive oceanographic model data and data from the INFOMAR seabed survey programme, enabling data reuse across new and developing programmes.
- The team was also active in EU data-related research projects connected to the EMODnet and SeaDataCloud EU data networks, in addition to continued work on the COMPASS INTERREG project working to coordinate and improve data management and service capabilities with partners in Northern Ireland and Scotland.

# Advanced Mapping Services & Marine Operations

Advanced Mapping Services provide survey coordination, operational data, research and development, along with advisory support, both internally within the Marine institute and for industry, government and public stakeholders, in Ireland, and internationally.

Mapping services – including programmes such as INFOMAR – significantly improve stakeholder access to seabed data and associated information, which is vital equally for management, conservation and development. Advances in mapping our oceans feeds through to forecasting ocean and climate change.

For more on the full range of advanced mapping services undertaken by the Marine Institute during 2018, see Strategic Enabler 3 – Data and IT. Marine operations carried out on the Institute's research vessels included surveys relating to oceanographic, mapping, environmental and hydrographical functions (all of which can contribute to forecasting ocean and climate change) – for more on 2018 marine operations, see Strategic Enabler 2 – Infrastructure.

## The Irish Marine Data Buoy Observation Network (IMDBON)

Since 2001, the Irish Weather Buoy Network has been generating hourly weather reports consisting of measurements of key near surface marine meteorological data: air temperature, humidity, atmospheric pressure, wind speed and direction also oceanographic data including sea surface temperature, wave height, and wave period. The extreme western synoptic M6 location is a sentinel European monitoring site.

The budget subhead for this programme of activity (renamed the Irish Marine Data Buoy Observation Network [IMDBON] to reflect a wider marine observing ambition) transferred from the Department of Transport, Tourism and Sport (DTTAS) to the Department of Agriculture, Food and the Marine (DAFM) in 2018 with an associated increase in the core operations and maintenance programme budget in 2018.

In recent years, the Marine Institute rolled out a series of modifications to the standard buoy platforms in use to improve reliability and as part of this, a long term research programme involving UK Met and a French company, Mobilis, resulted in what is one of the most advanced weather observing platforms currently available worldwide. The first of these went on test at the historical M1 site (50 nautical miles west of Galway) where the platform was determined as fit for purpose in 2018. During 2018, Marine Institute technical staff developed an advanced data collection system which is based on open source hardware and software solutions which is now ready to roll out from 2019 onwards.

In 2018, the last of the old generation ODAS (Ocean data acquisition platform) data buoys was placed on permanent exhibition at the Cromwell Point Lighthouse Visitors Centre on Valentia Island, a fitting homage to these mighty devices that have given such solid service to mariners for two decades.

2018 also saw an increased role by the Marine Institute handling weather observations where incoming data collection and management are to be streamlined with the Marine Institute undertaking not only the acquisition of data to shore, but also its archive and dissemination, plus its formatting into the standard format for onward hourly transmission to EU Met. Services and beyond.

A significant SFI (Science Foundation Ireland) research infrastructure funding award in late 2018 will provide the means to complete the transfer to new technology, placing the network on a sound basis for many years to come. This work will include leveraging additional data acquisition of key climate variables, most notably carbon dioxide exchange across the air-sea boundary.

#### The Irish National Tide Gauge Network

Operated by the Marine Institute, the Irish National Tide Gauge Network (INTGN) provides monitoring of sea level around the Irish coast. As sea level relative to land level change is a key ECV (Essential Climate Variable) with regards to climate adaptation and coastal resilience, 2018 saw an increase in interest from universities who are looking to better understand historical observation and trends, this has extended to the formation of a distributed expert group with activities being led by NUI Maynooth.

2018 also saw the conclusion of efforts into completing a round of installations, increasing the permanent monitoring infrastructure to 22 managed nodes. Focus is being given to survey and calibration methodologies to bring all stations to within a certainty of better than 1cm. A major overhaul of the data handling base station in Galway moved all remote monitoring to true real time, with data being reported into the central base station every five minutes with a much greater level of reliability.

The long-term, ultra-high precision temperature data being collected at Ballycotton (east Cork) and the Portmore Pier (Malin Head) are now well established. These data continue to feed background climatological data into central archives of temperature, the fundamental climate change indicator. Ballycotton is a relatively new station, but in the case of Malin Head this work is building on a time series that started in the late 1950s when the importance of long term monitoring was recognised.

#### Ocean Energy and EU Infrastructure Projects

In December 2017, the Marine Institute was awarded a 35 year foreshore lease for the Galway Bay Marine and Renewable Energy Test Site located 1.5km off the coast of Spiddal. The new lease allows the testing of up to three marine renewable energy devices at any one time on the site, and has expanded the range of technologies that can be tested at the site, including floating offshore wind turbines.

Following the award of the lease and compliance with site specific conditions, the test site was commissioned in July 2018 with four new cardinal marks deployed to delineate the extent of the test site. Within the test site, there are

three berths for ocean energy devices, and a fourth berth for the licensed underwater cabled observatory and associated testing of marine technology projects.

The ocean energy team manage the test and demonstration facilities at the quarter-scale ocean energy test site in Galway Bay along with providing continued operational services at the Belmullet and Westwave ocean energy test sites under a revised Service Level Agreement with the Sustainable Energy Authority of Ireland.

The subsea observatory located within the Galway Bay test site, 1.5km offshore of Spiddal, includes fibre optic data and power connectivity allowing scientific experiments and novel marine sensors and equipment to be tested in a real marine environment with real-time monitoring of performance. The observatory is a regional node of EMSO (European Multidisciplinary SeaFloor Observatory). EMSO is a European Research Infrastructure Consortium (ERIC), legal framework created for pan-European large-scale research infrastructures.

In 2018, 13 projects secured funding through various EU programmes to utilise the Galway Bay test site and subsea observatory; four through the H2020 project JERICO-NEXT for testing novel marine technologies, six through the INTERREG project FORESEA for testing marine renewable energy devices and supporting technologies, and three through the H2020 OceanERANET Co-Fund for research and development in ocean energy. Only projects utilising the observatory were deployed in 2018.

# MARINE ENVIRONMENT AND FOOD SAFETY SERVICES (MEFS)

#### Ocean Observations and Biogeochemistry

In February 2018, MEFS marine chemistry and OSIS teams undertook the southern Rockall Trough oceanographic/climate section survey using the RV *Celtic Explorer* with sampling carried out for a range of essential ocean variables (EOVs). EOVs in coastal and shelf waters were also sampled during south-about Winter Environmental Survey undertaken by Chemistry and Benthos Ecology teams in January/February 2018 on the RV *Celtic Voyager*.

Most of the data from the 2017 Global Ocean Ship-based Hydrography (GO-SHIP) A02 transatlantic survey was processed and submitted to the relevant international data centres. Data generated by the underway pCO2 system on the RV *Celtic Explorer* from transatlantic surveys in 2017 was processed for a first Irish submission to the Surface Ocean Carbon Atlas (SOCAT).







The Marine Institute's role in relation to marine research and innovation in Ireland is dynamic and multifaceted. It serves a broad client base and is aligned with our provision of scientific advice and services.

The organisation is a national funding agency for marine research, running competitive funding programmes guided by national research and innovation strategies, in particular the National Marine Research and Innovation Strategy 2017-2021. Cross-agency collaboration and joint funding initiatives are important aspects of the marine research landscape. Such programmes involving national and European funding bodies are important in addressing regional and national requirements and in maximising the benefits of research investments.

Another key responsibility of the Marine Institute is contributing to the setting of national and international research policy — ensuring the alignment with Ireland's strategic goals, particularly our Integrated Marine Plan and Ireland's strategy on research and development, Innovation 2020.

The Institute has a crucial role in supporting, coordinating and promoting marine research at national and international levels. It provides targeted assistance to marine researchers in Ireland to help them to build partnerships and successfully compete for EU grand-aid.

A key goal of the Institute is to support coherence across the various state funders of marine research, as identified in the National Marine Research and Innovation Strategy.

The Marine Institute is also a research performer, participating in and leading national and international research partnerships that are strategically aligned with and add value to our advice and services. It also partners with academic institutions by hosting scientists that work alongside our scientific and technical staff. This provides essential training, facilitates collaboration and increases the research capacity and knowledge in the Marine Institute.

Marine Institute research covers a wide range of areas such as marine resource management, ecosystem assessments, biodiversity, fish genetics, climate change and its impact on our oceans and catchments, maritime economics, food safety and fish health, biodiversity, seabed mapping and data and spatial technologies. The Institute also generates Intellectual Property arising from the research it funds and performs and from operational programmes it undertakes, allowing the Marine Institute to put publicly-funded research to work for Ireland.

# POLICY, INNOVATION AND RESEARCH SUPPORT (PIRS)

The Marine Institute's Policy, Innovation and Research Support Services (PIRS) division plays a key role in supporting and promoting marine research and innovation both within the Marine Institute and nationally. The role of PIRS is particularly important in delivering the ambitious goals of Strategic Focus Area 3 of the Marine Institute Strategic Plan, which focuses on Research & Innovation.

Within this Strategic Focus Area, there are three strands of actions - the first of which addresses the Marine Institute's role in coordination and support for marine research in Ireland, addressing national and international research & innovation policy. The two other strands seek to optimise the performance of the Institute both as a research active institute and as a research funder against key performance indicators approved by the Marine Institute's Board.

## Strategic Initiative 1: Coordinate and Promote Marine Research & Innovation

One of the key priorities for PIRS was the continued implementation of the National Marine Research and Innovation Strategy (2017-2021), primarily the establishment of two fora identified under the Strategy's 16 implementing actions as key delivery mechanisms for its implementation. The National Marine Research Funders' Forum met twice in 2018 and brings together government departments and research funding agencies with the aim of enhancing national coordination in marine related research funding.

The Marine Infrastructure Providers' Forum was convened in September 2018 with the aim of enhancing national coordination in marine-related infrastructures that support research and innovation. A process to collect and analyse national marine research investment data also commenced during the year.

In addition to the international collaborations carried out by the other services areas in the Marine Institute, PIRS takes the lead in international research coordination and policy support. This function involves representing Ireland at international research fora to ensure that Irish researchers are kept informed and involved in international initiatives and relevant research, technology, development and innovation opportunities.

In conjunction with Department of Agriculture, Food and the Marine (DAFM) representatives, Dr Fiona Grant is national delegate to the Programme Committee for Societal Challenge 2 of the EU Horizon 2020 Programme. In 2018, she continued to act in her role as national contact point for marine aspects of Horizon 2020 funding.

Other representation provided by PIRS included the European Marine Board; EurOcean, the Intergovernmental Oceanographic Commission and the Management Board of the Joint Programming Initiative on Healthy and Productive Seas and Oceans (JPI Oceans). The Institute also hosted the IOC Group 1 Preparatory meeting in Dublin, attended by 20 international delegates from the EU, US and Canada.

The national results for the two-stage Blue Growth (BG) topics in H2020 were issued in December 2018. Three strategically important Research and Innovation Action projects under the All Atlantic Flagship calls have Irish participants. These are NUIG (TriAtlas €101k), UCC (iAtlantic €140k), and GMIT & Cartron Shellfish (AquaVitae €305k & €62k respectively). One of two projects funded under the "Sustainable harvesting of marine biological resources" call is MEESO with the Marine Institute, Teagasc and BIM in the consortium.

Ireland received awards of €1,198,763 across BG topics representing a 61.4% success rate for the ranked list (note two-stage process). The drawdown to Ireland comes in at 2.8% of the available budget, proportionately well in excess of the national 1.67% target of the allocated Horizon 2020 budget and an increase from 2017 figures.

A funding profile from the start of H2020 in 2014 to the end of 2018 indicates that almost €48m in funding has been won for Irish researchers across all pillars and societal challenges of the framework programme. €7.9m of this was in 2018 alone with awards for ERC grants, research infrastructures, SME instrument, Marie Skłodowska-Curie Innovation Training Networks in addition to "traditional" Societal Challenge 2 Blue Growth and Sustainable Food Security topics.

# Strategic Initiative 2: Increasing Marine Institute research capacity and performance

The Marine Institute itself was successful in five projects in 2018, bringing a total EC requested contribution of €2.145m. The projects were IMPAQT (Intelligent management system for integrated multi-trophic aquaculture), CIRCLES (Controlling mIcRobiomes CircuLations for bEtter food Systems), BlueBio (ERA-NET Cofund on Blue Bioeconomy - Unlocking the potential of aquatic bioresources), Eurofleets Plus (An alliance of European marine research infrastructure to meet the evolving needs of the research and industrial communities) and Euro-Argo RISE (Euro-Argo Research Infrastructure Sustainability and Enhancement). Since the beginning of H2020, the Marine Institute has a high success rate of 40% in funded projects (22 projects overall with 55 proposals/ submissions).

The Marine Institute and DAFM have been monitoring the development of Horizon Europe in conjunction with partner agencies, government departments and DBEI. Bridging elements (2020 topics) in H2020 that link to the proposed Cluster 5 on Food and Natural Resources in Horizon Europe were presented by the EC in late 2018. DAFM and the Marine Institute have continued to liaise nationally to ensure alignment with existing and future funding initiatives, e.g. through the SC5 working group and marine research advisory group.

## Implementing the Galway Statement Trans-Atlantic Research Collaboration

The Marine Institute is playing a strong role in the international marine and maritime research and innovation policy agenda through its leadership of the Atlantic Ocean Research Alliance Coordination and Support Action (AORA-CSA). In the last 12 months, the AORA-CSA international partnership has actively worked to foster cooperation between Canada, the European Union and the United States of America, by organising and hosting many dialogues and networking opportunities as well as undertaking an engaging and elegant social media campaign to complement and broadcast the many achievements and direction of the Atlantic Ocean Research Alliance

Two videos to launch the Last Great Exploration Campaign on Earth were produced, along with a suite of animated infographics, brochures and a variety of exhibition stands. The Last Great Exploration Campaign on Earth was publicly launched by the European Commission Horizon 2020 programme, in Brussels in May to mark the five-year anniversary of the Galway Statement. It was subsequently launched on the North American continent on June 6th, in Washington D.C. at the Transatlantic Research Cooperation to Treasure and Protect the Atlantic Ocean event held at the Woodrow Wilson Center, during Capitol Hill Oceans Week.

In early December, early plans to support the AORA in final full year of the AORA-CSA (i.e. 2019) were developed and advanced at a carefully planned and executed workshop with the AORA Leadership Team, the AORA Working Groups and the AORA-CSA partnership in Brussels. This workshop was organised across the current five priority areas of an Ecosystem Approach to Ocean Health & Stressors, Ocean Observation, Aquaculture, Ocean Literacy, and Seabed & Habitat Mapping. Facilitated sessions were held on inputs and buy-in for the Knowledge Sharing Platform and also the Marine Microbiome. It is expected that these latter two areas will be considerably advanced in 2019.

#### **Links to Videos**

www.youtube.com/watch?v=uktwQre4O2M&t=11s www.youtube.com/watch?v=hhCKs14QLug

#### Links to Animated Infographics

https://atlanticresource.org/aora/mapping-our-ocean https://www.atlanticresource.org/aora/ocean-observation https://www.atlanticresource.org/aora/food-ocean https://www.atlanticresource.org/aora/healthy-oceans

#### **Link to Brochure**

https://www.atlanticresource.org/aora/sites/default/files/ GalleryFiles/Publications/AORABrochureWeb.pdf

# Strategic Initiative 3: Optimise our funding programmes

The Research Funding Office managed €9.29m in research investments awarded in 2018 under the Marine Institute's Marine Research Programme: €2.64m for ship-time on the research vessels and remotely operated vehicle; and €6.65m on research projects (full details are provided in Appendices 1 & 2).

The ship-time investment funded the research vessels and the remotely operated vehicle for multi-disciplinary marine research and student training in Irish waters and beyond. Under the programme, 85 days were supported for research, 51 days for policy support and 53 days were provided for training on board RV *Celtic Explorer* and RV *Celtic Voyager*.

Involvement with co-funded programmes continued in 2018, with five new investments totalling €1.75m concluded as follows:

- MarTERA (Maritime and Marine Technologies for a new Era) ERA-NET and JPI Oceans – two projects funded with four Irish partners, with the Institute's investment being €0.69m
- EPA Research Call 2018 (Climate and Water Pillars)

   two awards to be co-funded jointly by EPA/
   MI and one award also to be co-funded with Met
   Éireann, with the Institute's investment amounting to €0.48m
- SFI Investigators Programme MI investment of €0.38m for one award co-funded with SFI and GSI
- BiodivERsA EU JPI one award to be co-funded by the European Commission, EPA and the MI, with our contribution being €0.12m
- SEAI Research Call 2018 one award to be co-funded by SEAI, MI and Met Éireann, with our contribution being €0.08m

Co-funded awards provide an opportunity to establish national and international research collaborations in areas of strategic importance for Ireland and Europe. Co-funding will continue in 2019 with four Joint Programming Initiative (JPI) calls currently open for submission of transnational proposals in microplastics, blue bioeconomy, marine and maritime technologies and climate research.

In May 2018, the Marine Institute launched an Industry-Led call, which was designed to support research and innovation costs for the development of innovative technologies, products and services from existing or new marine-based business and to help marine companies to develop capacity and capability. The call was well subscribed with 22 proposals received. The Institute awarded 12 grants under this call for a total value of €2.38m over 3 years to 12 companies (in collaboration with five Higher Education Institutes). These awards will be cofunded under the European Regional Development Fund (ERDF), resulting in a return to the Irish Exchequer.

In July 2018, the Institute launched a call entitled Oceans in a Changing Climate, with the aim to build national capacity in Ireland in physical oceanography and climate change research that will feed directly into other research themes and topics in the marine, e.g. ocean observation, marine biodiversity, ocean and coupled modelling, and the delivery of policy advice. A consortium led by Maynooth University was successful in this call, in collaboration with Trinity College Dublin and seven international partners from the UK, USA and Germany. The total value of this investment over 5 years will be €2m.

The Marine Institute funded five Cullen Fellowships in 2018, with a total investment of €0.43m, bringing the total number of fellows funded under the programme to 27. Two Masters students successfully completed their thesis during the year. The annual Cullen workshop was held in November 2018, with the fellows presenting oral and poster presentations in an impressively diverse range of marine topics (e.g. ocean observation technologies, assessment of finfish/shellfish species, ocean ecosystems & the food web, fish disease control, marine contaminant & toxins, seaweed assessment, etc.).

Significant demand for the Networking and Travel Grants Programme continued in 2018, with 141 applications received. There were 110 grants awarded with 100 researchers attending conferences/ workshops or carrying out training/working visits overseas, together with 10 conferences held in Ireland showcasing Irish marine research. The total cost of the 2018 programme was €0.09m.

Two final reports under the Beaufort Marine Research Awards were published; Sensors and Communication Systems for the Marine Environment awarded to Dublin City University and Economic and Social Research related to Development Dynamics of the Marine Sector in Ireland awarded to NUI Galway, with total funding of €2.4m and €2m respectively provided by the Marine Institute.

The Marine Research Programme targets funding under the research themes of the National Research & Innovation Strategy 2017-2021 to raise the research capacity in the marine sector and to maximise the impact nationally through co-operation with other state research funders.

This investment also aligns with the Marine Institute's Strategic Plan 2018-2022 under the four strategic focus areas of 1) Scientific Advice and Services, 2) Forecasting Ocean and Climate Change, 3) Research and Innovation and 4) Ireland's Ocean Economy by funding the highest quality peer-reviewed research that provides scientific evidence for government, policy makers and relevant stakeholders to inform their decision-making process.

# MARINE ENVIRONMENT AND FOOD SAFETY SERVICES (MEFS)

The MEFS team, often working with others across service areas, continued their involvement in European and nationally-funded research programmes in 2018, carrying out applied research to support delivery of our monitoring programmes and advisory services.

Collectively across the MEFS sections, 17 papers were published in peer reviewed journals addressing past research, and about 28 presentations and/or posters were given at scientific meetings representing current research projects. This level of research production, on balance with the heavy statutory service support, is a testament to the continued hard work and dedication of the scientists throughout the Marine Institute.

### **Shellfish Safety**

In the area of shellfish safety, research activities in 2018 included: the FoVira project with the Irish Virus Reference Lab on investigations and method developments for Norovirus, Sapovirus, Hepatitis A & E virus detection and quantification in shellfish.

Other research activities included the MARBioFEED project that has carried culture experiments, stable isotope labelling and isolation of marine biotoxins that are problematic for the Irish shellfish industry (azaspiracids, okadaic acid group and domoic acid). The purified toxins are used for the production of certified reference materials (a critical component of biotoxin monitoring programmes)

and for research (e.g. toxicology, development of biosensors and pharmacology). Considerable progress in optimising culture conditions and enhancing methods for the purification of toxins were made in this project and these were presented at conferences during the year.

The ongoing PhD Cullen fellowship on Azadinium Biological Oceanography continued and analysis of samples collected in 2016 and 2017 from research surveys on the *Celtic Voyager* were completed. This fellowship is now entering the final year and preliminary results on the species found, their distribution and their molecular biology were presented at an international conference at the end of the year.

Two new projects were funded under the Interreg Atlantic Area call; 'Alertox Net' looking at new and emerging toxins (MI Total: €254K), this will continue the development of an in-house method to detect tetrodotoxin (TTX) in Irish shellfish. Initial results from early work on TTX are promising: nearly 500 2015-archived samples from Irish coastal waters representing a variety of invertebrate species were analysed and the toxin was not detected.

It is, however, important to develop a robust LC-MS/MS method to be in apposition to detect the toxin and this will be carried out in the coming year in this project. The other project is 'PRIMROSE' which will continue developments in shellfish biotoxin and microbiological contamination forecasting (Marine Institute Total €688K). The Marine Institute is the lead coordinator of this project and to date three partner meetings have been held and there is a steady flow of work emerging in the production and automation of the production of these forecast reports across the project regions.

# AZAHAB Survey Aboard the R/V Heincke (Helgoland)

A team comprising of members of MEFS Shellfish Safety and OSIS Oceanography joined the AZAHAB HE516 survey (funded by the Alfred Wegener Institut in Germany) during the summer of 2018 on a month long survey to investigate why Ireland is most affected by azaspiracid shellfish poisoning (AZP) caused by various phytoplankton of the family Amphidomataceae. The survey transects were from Bremerhaven, Germany across the southern North Sea and the British Channel with detailed sampling initiated in the Celtic Sea and West Irish coastal waters.

Over the whole survey, plankton communities were very different ranging from dense diatom blooms in the English Channel to more dinoflagellate dominated communities in most of the Atlantic and North Sea stations. From the Bantry transect towards Galway, Azadinium/Amphidoma were noticeably found in abundance in the samples. Species of interest were isolated and worked up to mono

cultures for culture library and stored in the Marine Institute.

A large array of lipophilic toxins including azaspiracids (AZA) and hydrophilic toxins were measured directly onboard ship by LC-MS/MS. Together, the toxin analyses of size fractionated samples and manually sorted grazers species, coupled with existing plankton data of the Marine Institute's ongoing analysis from samples collected on the survey is aimed to identify heterotrophic dinoflagellates, ciliates, or other small zooplankton as not yet recognized toxin vectors to further our understanding of the prevalence of AZA in Irish shellfish.

# International Conference on Harmful Algae (ICHA 2018)

A reflection of the shellfish safety team's engagement in research applicable to our core services within MEFS was the sizable contribution to the Bi-annual ICHA conference, held in Nantes, France in October. The Marine Institute team was involved in 10 presentations at the conference, including a quantitative polymerase chain reaction (qPCR)-based biogeographical study of Pseudo-nitzschia biodiversity in Bantry Bay and Killary Harbour (Pseudonitzschia microalgae produce domoic acid, the causative agent for amnesic shellfish poisoning). PCR methods development for the detection of Azadinium spinosum in seawater for routine monitoring were also reported upon, as were presentations to describe the latest findings from the PRIMROSE, MarBiofeed and Cullen research projects. The team also set up a stand at the conference to promote the Marine Institute led International Phytoplankton Intercomparison scheme, which is a unique programme that provides a phytoplankton quality inter laboratory proficiency programme to participating laboratories.

#### **Marine Chemistry Research**

In the marine chemistry unit, ongoing research projects in 2018 included:

- The AsMARA (Arsenic in Marine Algae and implications for Commercial Uses) project with NUI Galway, funded by DAFM under the Food Industry Research Measure initiative was completed in 2018. This research involved establishing a method for determining inorganic arsenic in marine algae of commercial interest, and a study of factors influencing total and inorganic arsenic levels in Irish seaweeds. An end-of-project stakeholders workshop on Arsenic in marine algae took place at the Marine Institute in October 2018.
- The MEFS chemistry team continue to work very closely with NUI Galway on ocean

biogeochemistry/acidification research including in support of the VOCAB project (Variability /vulnerability of Ocean Carbon and Biogeochemistry), and in March 2018, the Marine Institute hosted a successful biogeochemistry workshop.

- The INTERREG COMPASS project (Ireland, Northern Ireland and Scotland) is up and running. The Marine Institute deployed sensors in 2018, which are operating on an oceanographic buoy off Mace Head. Verification sampling and analysis were carried out regularly.
- The GMIT-led project to evaluate seabird eggs
   as higher trophic level indicators of contaminant
   exposure in Irish marine waters completed a
   second season of sampling and analysis during
   2018. Gannet, Guillemot and Common Tern eggs
   have all been collected on both the West and
   East coast of Ireland. Analysis for a range of
   environmental contaminants is currently underway
   with a key aim being to investigate whether such a
   monitoring program can help Ireland achieve Good
   Environmental Status (GES) in accordance with the
   MSFD criteria.
- Throughout 2018, the chemistry section continued its involvement in the INTERREG funded MONITOOL project while additionally initiating research in the global AQUAGAPS project, both of which are aimed to further develop Marine Institute capacity in the area of passive sampling as novel tools to measure pollutants in water.
- A Cullen Fellowship on the 'Vulnerability of life stages of marine calcifiers in Irish coastal waters due to changes in ocean chemistry and other stresses' was awarded to Trinity College Dublin (TCD) in 2018 with an TCD-MI co-supervised PhD to commence in 2019.

#### Fish and Shellfish Health Research

In 2018, the Marine Institute's Fish Health Unit, working with UCC as the project leads, completed work on the DAFM funded Reposus project. This project was aimed at reducing the impact of disease in Irish oysters. The project identified a number of potential management measure to mitigate against the impact of disease caused by both V. aestuarianus and OsHV-1uVar pathogens. This work was further developed by Marine Institute participation in the EU funded VIVALDI project <a href="http://www.vivaldi-project.eu/">http://www.vivaldi-project.eu/</a>. This project, led by IFREMER in France, is generating practical solutions aimed at preventing, controlling and managing diseases of farmed bivalve molluscs. Marine Institute work focused primarily on management factors for V. aestuarianus and is ongoing.

A total of 450 velvet crabs, Necora puber, were sampled as part of a project evaluating the disease status of velvet crab stocks in conjunction with colleagues in Fisheries Ecosystems Advisory Services (FEAS). Velvet crabs were collected from Galway Bay, Howth and Casteltownbere and screened for parasites with a focus on the prevalence of Paramartelia sp. Findings provided a preliminary evaluation of the incidence of parasites in velvet crab stocks in Ireland. The significance of the findings, particularly the relatively high incidence of Paramarteilia sp. detected in Galway Bay, remains uncertain. Further research is underway in conjunction with Galway-Mayo Institute of Technology through a Marine Institute funded Cullen fellowship. The fellowship will further evaluate the parasitic disease status and characteristics of commercially exploited crustacean.

Collaborative work with UCD through the Cullen Fellowship Programme is applying cutting edge next generation sequencing procedures to investigate the genetic diversity of virus pathogens in salmon in Ireland. Whole genome sequence data for Piscine myocarditis virus (Cardiomyocarditis syndrome) and Salmonid alphavirus (Pancreas disease) from Irish salmon sites have been generated. This is providing details of genetic diversity of these viruses which in turn gives an insight into their introduction and spread in Ireland. This project is ongoing.

#### Marine Spatial Planning

The SIMCelt project was completed in Q1 of 2018. This was a two-year pilot project to support the implementation of marine spatial planning in the Celtic Seas. It identified and shared best practice and enhanced understanding of, and address the issues and challenges to MSP implementation in the region.

Looking forward, an MSP Cullen Fellowship on the Future of Coastal Landscapes: Perceptions and Conflicts on the West Coast of Ireland is yielding some interesting results about the different understandings and values associated with blue growth objectives, tourism and communities.

# IRISH MARITIME DEVELOPMENT OFFICE (IMDO)

The IMDO recognises research and innovation as indispensable early stages of business development. The IMDO supports applied research in the maritime sector to drive efficiency and to create competitive advantages. It supports innovation by looking to innovative solutions to address business needed and generate creative responses to EU funding calls in programmes such as Ten-T and Motorways of the Sea.

#### **Maritime Commerce Cluster**

In 2018, the IMDO, through the Marine Institute's Cullen Fellowship Programme, delivered a research project into the establishment of a maritime commerce cluster in Ireland. The research was carried out by a postgraduate student, whose work was in fulfilment of a Masters Degree in Marketing at NUI Galway. The research confirmed the competitive advantages that Ireland possesses in the area of maritime commerce and the opportunity that exists to establish a maritime commerce cluster in Cork.

#### **Port Performance Metrics**

A PhD research project is ongoing into port performance metrics, again under the Marine Institute's Cullen Fellowship Programme. This important work, which will be completed in 2019, was called for in the National Port Policy, which recognised the need to establish port performance metrics in order to maximise the efficiency of the State's port assets. The research constructs a typology of port performance metrics and describes the circumstances and contexts under which different metrics should be applied. The typology will allow the performance of Irish ports to be assessed and benchmarked and will inform DTTAS decisions in relation to future port capacity.

#### **National Marine Innovation Hub**

The IMDO worked with Enterprise Ireland and University College Cork to create a National Marine Innovation Hub. This initiative was funded by Enterprise Ireland and established a national resource to drive the development of the marine industry, not only in Cork, but in other coastal locations, rich in marine resources. The national Marine Innovation Hub Manager was appointed in 2018, who will work through and with the dispersed innovation resources that exist around the country.

# FISHERIES ECOSYSTEMS ADVISORY SERVICES (FEAS)

FEAS undertook many Research & Innovation projects during 2018. Highlights of activities during the year include:

- Completing the DiscardLess project successfully, with publications, maps and apps for fishermen
- Developing methods to appraise the utility and value of various methods for calculating MSY reference points for Fisheries Knowledge for Optimal Sustainable Management
- Receiving top marks on SFI RTI midterm international review
- Developing a working EwE (Ecopath with Ecoism) model for the Irish Sea and working with stakeholders to make use of it (WKIRish – Workshop on an Ecosystem-based Approach to Fishery Management for the Irish Sea)
- A collaborative Irish Sea cod tagging project with Agri-Food and Biosciences Institute (NI) and CEFAS (UK) in the Irish Sea was completed with over 4,500 cod tagged over the project (2016-2018)
- Successful maintenance of core LTER (Long term ecological research) data streams from the Burrishoole catchment in Newport, including the fish census, juvenile fish and eel surveys. The pilot streaming of environmental data from L. Feeagh and the Burrishoole tidal/waterlevel gauges using ERDDAP (Environmental Research Division's Data Access Programme) has improved the efficiency of data transfer and accessibility. It is intended to roll this out to the other stations in Burrishoole in 2019. Successful delivery of more than 40 data requests and additional data provision for the Cullen PhD, CLUSTER and external GLEON (Global Lake Ecological Observatory Network) projects and collaborations.
- Externally funded projects are continuing
   (PROGNOS, Water JPI; <a href="http://prognoswater.org/">http://prognoswater.org/</a>;
   WATEXR, Climate JPI <a href="https://watexr.weebly.com/">https://watexr.weebly.com/</a>;
   MANTEL, MCSA ITN www.mantel-itn.org; EIFAAC
   (European Inland Fisheries and Aquaculture
   Advisory Commission) funded Norway/Ireland Eel
   Project)
- Publication of 11 international collaborative peerreview papers and an additional 8 by the genetics research group using Burrishoole research and data and five datasets (Dol)
- Four Cullen fellowships in Burrishoole are progressing well and producing peer-reviewed publications – see Kelly et al. (2017, 2018a,b)

- Participation in the National Standing Scientific Committee on Eel, Russell Poole chaired the SSCE
- Delivery of the 2018 triennial report on the Implementation of the Eel Management Plans.
   This involved a three year assessment of the production, escapement and mortality of silver eels in Irish inland and transitional waters. The report of the scientific assessment was provided to Inland Fisheries Ireland for inclusion in the National Report to the EU.
- Participation in the international ICES WGEEL
   (Working Group on Eels), WGTRUTTA (Working
   Group with the Aim to Develop Assessment Models
   and Establish Biological Reference Points for Sea
   Trout Populations), WGDAM (Working Group
   on Data Poor Diadromous Fish), WGRECORDS
   (Working Group on the Science Requirements
   to Support Conservation, Restoration and
   Management of Diadromous Species) (by
   correspondence) and the Regional Coordination
   Group (RCG) Mediterranean and Black Sea (RCG
   Med & BS) meeting for Eel (Diadromous Sub Group)
- A large Irish contingent participated in the GLEON 20 meeting in Rottnest Island, Australia, during December 2018, including Mikkel Andersen, Maria Caldero (Beyond2020 and DkIT), Tadhg Moore (PROGNOS), and Harriet Wilson (MANTEL). Elvira de Eyto also participated in GLEON steering committee meetings and one management retreat.
- Both the BEYOND 2020 and Unlocking the Archive CLUSTER projects required considerable support in 2018 from the core teams in Newport. This has enhanced the level of research activity in Newport and is paying dividends in terms of research outputs and publications. Collaborations include topics such as sticklebacks, eels, salmon and sea trout and feature, growth, bionomics, genetics, behaviour, survival and climate change.

- The team continues to give outreach presentations, hold open days, school training days and support external public functions such as SciFest and Mayo Dark Skies
- The 6a herring project started in 2018. The Marine Institute is an important partner in the project (led by UCD) providing samples and leading some of the work packages. This project will give a new insight into the mix of the two herring stocks that are fished and surveyed in 6a7bc and will eventually be used to split the stocks and have two separate assessments.
- Paper presented at ICES Annual Science Conference concerning a recovery plan for spurdogfish (Graham)
- ICES Co-operative Research published in 2019 -Fifty years of marine tag recoveries from Atlantic salmon. Niall Ó Maoiléidigh and Jonathan White were lead editors.
- Two PhDs jointly supervised by the Marine Institute (FEAS) and Irish and international universities completed in 2018 and scientific publications produced in peer reviewed journals.

Scale Growth Analyses of Atlantic Salmon – Unlocking Environmental Histories – Katie Thomas (Marine Institute, Ireland with Galway/ Mayo Institute of Technology, Institute of Marine Research, Bergen, Norway and Loughs Agency)

The distribution of the European sea bass, Dicentrarchus labrax, in Irish waters - Ross O'Neill (Marine Institute, Ireland, University College Cork and Marine Institute Beaufort)

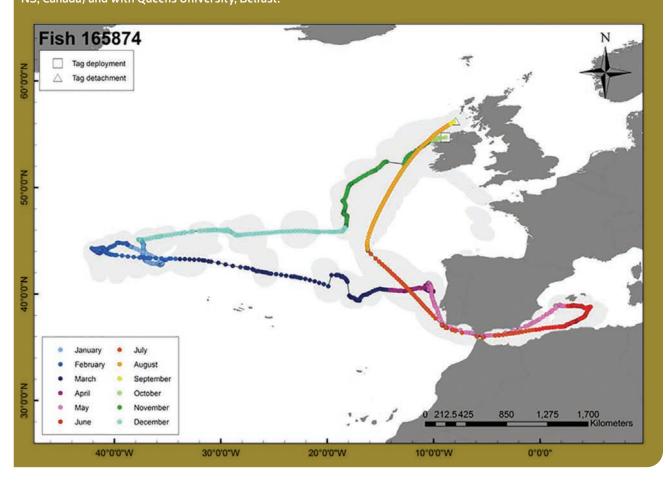
#### **Bluefin Tuna Tagging**

The Marine Institute continued to track the movements of bluefin tuna (BFT) in 2018, when 24 fish were tagged with satellite tags and four with accelerometer tags in the Donegal Bay area. The satellite tags data provide detailed information on the movements of the fish as they disperse from Donegal Bay, into the wider Atlantic and the Mediterranean. The accelerometer tags provide information on how quickly the fish recover from the tagging activity.

In the early 2000's, BFT became very abundant in the waters around Ireland. They subsequently disappeared as the stock declined in the Atlantic. In 2014, they reappeared in large numbers as the stock recovered. In 2018, there were many reports of large numbers of BFT in the waters around Ireland and while there are no scientific population estimates, there is much anecdotal information on increased sightings and interactions with commercial fisheries. Similar reports of increased BFT numbers came from UK, Norwegian and Danish waters during 2016, 2017 and 2018. In response to these increased sightings, the Marine Institute commenced a BFT tagging programme in 2016 with North American partners (Stanford University US and Acadia University NS, Canada) and with Queens University, Belfast.

Bluefin tuna is the largest tuna, and one of the largest fish of all. It is a pelagic, fish-eating species, found from the surface to depths of up to 1,000 metres. BFT is distributed in the pelagic waters of the North Atlantic and adjacent seas from Brazil to Newfoundland in the west Atlantic and from the Canary Islands to North Norway in the east Atlantic. After spawning in the Gulf of Mexico and the Mediterranean Sea in spring/summer, many BFT migrate into the Atlantic Ocean for feeding, heading along the continental slope and into the open sea. The main routes in the east Atlantic are along the Iberian peninsula into the Bay of Biscay and further north along the west of Ireland and as far north as Norway.

The map shows the incredible journey of one BFT over a year extracted from a BFT satellite tag recovered off the west of Scotland in 2018. The track commences in Donegal Bay in October 2017 when the fish was tagged. The BFT moves into the central Atlantic during November 2017 to March 2018 and then enters the Mediterranean in May 2018 (possibly to spawn), returning to Donegal Bay in August 2018.





# OCEAN SCIENCE AND INFORMATION SERVICES (OSIS)

### **RV** Celtic Explorer

The RV Celtic Explorer began 2018 at AP Falmouth, United Kingdom, for a five-year refit. The five-year refit included an overhaul of the bow thruster and an upgrade of the DC propulsion system. The vessel's original fishing sonar was removed and replaced with a new fisheries sonar. The new sonar has an increased range and resolution, which will be a huge advantage for the dedicated acoustic fisheries surveys. The vessel's accommodation also received an upgrade after 15 years of service. Other tasks completed during the refit included painting and antifouling of the hull and a complete painting of the superstructure. Lastly, there was the major 60,000 hour overhaul of one of the main diesel generators.

The RV *Celtic Explorer* had 17 scheduled surveys in 2018. The first survey began at the end of January and was led by BSH (Federal Maritime and Hydrographic Agency) in Germany. The scientific survey operations were oceanographic and environmental in nature and primary operations included CTD casts along a predetermined track. The second survey of 2018 was the annual Rockall oceanography survey, led by the Marine Institute. The survey involved a collaboration between the Marine Institute and NUI Galway scientists for the nine day expedition, which included research into ocean acidification. Three argo floats were deployed in deepwater during the survey which will provide high quality temperature and salinity depth profiles for the next 3-5 years.

Next was the first fisheries survey of 2018, the annual 'Anglerfish and megrim trawl' survey which involved ICES approved bottom trawling in order to obtain biomass estimates for anglerfish and megrim data for setting

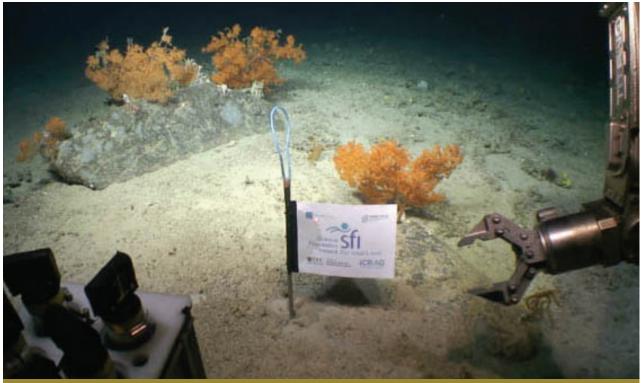
an abundance index. The next survey was the Marine Institute led annual Blue Whiting Acoustic expedition which involved using the new sonar. A key highlight of the acoustic survey was the mapping of the SS Athenia ship wreck off Rockall Bank.

Towards the end of April and into the first two weeks of May was the INFOMAR seabed mapping survey which carried out operations in the Celtic Sea. A feature of the survey was the allocation of berths to two students from the United States as part of the BEnthic Acoustic Mapping & Survey programme (BEAMS) at the College of Charleston, US. The BEAMS programme teaches students how to process raw bathymetric data using specialist softwares. The survey covered 2,400 km² of survey area.

Another 2018 highlight was the 'Tectonic Ocean Spreading at the Charlie-Gibbs Fracture Zone North Atlantic' (TOSCA) survey, led by University College Dublin (UCD), which was also the first ROV Holland 1 survey of 2018. The survey area took place within the Charlie-Gibbs Fracture Zone (CGFZ), which is the longest fracture zone north of the Azores. The 2,000km fracture zone separates and connects the two most important ridges in the North Atlantic, making it a hugely active tectonic zone. TOSCA was a multidisciplinary survey involving ROV dives (10 in total), 3,600 line kilometres of multibeam data acquisition and ground truthing activities.

On completion of the ROV demobilisation the vessel commenced the first leg of the 2018 Western European Shelf Pelagic Acoustic Survey (WESPAS), led by Marine Institute scientists, which lasted 20 days and included the use of acoustic techniques to collect boarfish spawning stock information along a predetermined track in the Celtic Sea. The survey had a break to visit SeaFest 2018 for three days in Galway city, with over 9,000 visitors to the vessel for tours over three open days. The second leg of the WESPAS survey commenced after the public outreach event; with the survey track stretching from Galway through to Malin Head and as far north the Outer Hebrides over 22 days.

The ROV Holland 1 was mobilised once more over a two day period in late July. University College Cork (UCC), led the 'Controls of Cold-Water Coral Habitats in Submarine Canyons II (CoCoHaCa2)' survey. The team included scientists from different disciplines including marine geology, marine ecology, marine biology and oceanography. In addition, the artist Carol Anne Connolly was on-board as part of the Galway2020 'Aerial/Sparks' project. The ROV remained on-board for its final expedition led by NUI Galway assisted by the University of Southern Florida. The biodiscovery survey followed on from the 2017 'Exploiting and Conserving Deep-Sea Genetic Resources'. ROV dives took place along a track on the north western side of the Porcupine Bank. Along with recording video footage at each site, live samples of several invertebrate groups were



A flag planted at the Porcupine Bank Canyon. Photo courtesy UCC

retrieved including species from the Porifera and Cnidaria groups. Once the ROV was demobbed, the vessel sailed to Hamburg to commence a 17-day North Sea oceanographic survey, the final BSH survey of 2018.

Another highlight of the 2018 survey season was the Dublin Institute of Advanced Studies (DIAS) survey, referred to in short as 'SEA-SEIS-D' which stands for the 'Structure, Evolution and Seismic hazard of the Irish offshore: deployment of broadband, ocean-bottom seismometers'. The programme successfully deployed 18 seismometers on the bottom of the North Atlantic Ocean north to Icelandic waters. Tiny vibrations, caused by seismic waves generated by earthquakes and by ocean waves, will be recorded over the next 18 months (recovery, May 2020). The collected data will enable DIAS scientists to create a 3D scan of the Earth's interior, helping them to understand the nature and history of earth beneath the North Atlantic Ocean

One of the unique features of the SEA-SEIS-D survey was the hugely engaging educational element to the survey, including a seismometer naming competition which gained entries from schools all over the country and from as far as Italy. In addition, the use of videoconferencing software allowed scientists onboard the RV *Celtic Explorer* to connect directly to 12 classrooms around the country for live questions and answer sessions. The Marine Institute's Explorers Education Programme worked in tandem with the DIAS scientists also and visited several classrooms to raise awareness and understanding of seismology and of the Real Map of Ireland. More than 200 primary schools have been able to learn about the SEA-SEIS-D survey and the science behind it.

Operations in the final few months of 2018 reverted to fishing with the delivery of the annual Marine Institute Celtic Sea Herring Acoustic survey in October. The survey covered 3,200 nautical miles. CTDs and day grabs were also part of the work programme. The final fisheries expedition was the annual Irish Groundfish survey (IGFS) with four survey legs running consecutively from the end of October to mid-December. The year ended in Galway port with operations that included the commencement of the UL ROV Étaín mobilisation onto the aft deck and integration to the vessel's network, along with a maintenance period and DP (Dynamic Positioning) trials in the bay.

#### **RV** Celtic Voyager

Once again it was a busy year for the RV *Celtic Voyager* with the completion of 33 surveys which ranged from survey operations in Irish waters to stretching as far north as the Shetland Isles and as far south as the Bay of Biscay. The *Celtic Voyager* 2018 season kicked off with the annual 'Winter Environment Survey', which involved a spatial and temporal assessment of winter nutrients in Irish waters. The track route alternates each year between 'north about' and 'south about', heading from east to west. In 2018, it started in Dun Laoghaire and crossed through the Celtic Sea via the southern route back to Galway Bay. Benthic sampling along major bays on the south, southwest and into Galway Bay took place also to acquire data required under the EU Water Framework Directive (WFD).

The next survey was trialling a new underwater TV (UWTV) camera system in Galway Bay and out as far as the Aran Islands. The UWTV surveys are fundamental to determining the stock quota for Nephrops norvegicus. Trials took place on two additional occasions during 2018 and the new camera system was successfully implemented by the end of August.

The vast majority of February and March survey time involved student training from Cork Harbour or Galway Bay, including National Maritime College of Ireland (NMCI) deck and engineering cadets. Other student training surveys included three SMART (Strategic Marine Alliance for Research and Training) surveys which involved collaboration with NUIG SEMRU, UCC MaREI and the GMIT Observer programme. A geophysical survey, led by a team of scientists from Sligo IT, punctuated the student training period in late February. Survey operations included vibrocoring in Liverpool Bay and Cardigan Bay. Sediment samples were collected as the geologists aim to reconstruct and simulate the palaeo-environments of the Irish Sea.

April marked the return of marine biology surveys with a fourteen day multidisciplinary Nephrops larvae survey which involved multinet operations combined with the collection of oceanographic data on the Aran Grounds to the west of Ireland and in the western Irish Sea. The Nephrops theme continued into May as the vessel sailed from Dublin to Lorient mid-April to commence the fifth Langolf UWTV survey, led by scientists from Ifremer, in the Bay of Biscay.

National University of Ireland (NUI) Maynooth continued on with its research in May 2018 on the 'MARA: Malin shelf sediment ReseArch' programme, which involved the use of seismic equipment and multibeam operations, in addition to ground truthing activities off Malin Head. Following on from the geophysical survey was the Marine Institute led BLUEfish 3 expedition which used a multinet to collect seabass and scallop larvae in the Irish and Celtic Sea.

The vessel sailed to the Porcupine Basin in May to carry out a novel research survey on acoustic noise propagation which was led by NUIG. The generation of acoustic noise, and subsequent recording, took place at contrasting locations across the continental margin. The acoustic data measured will be used to quantify the influence of the margin topography on noise attenuation. The 'Laochra na Mara' glider was also deployed and recovered with up to 52 hours completed at different depths.

Three INFOMAR surveys took place on the *Celtic Voyager* in 2018 stretching from late May to the end of September. It was one of the most successful INFOMAR seasons with coverage of up to 5,500km² between the three legs. The good weather combined with the use of the moving vessel profiler (MVP) and surveying in deeper waters were among the factors contributing to the successful season. All three Marine Institute FEAS Nephrops UWTV surveys were completed, including the Porcupine grounds. Another survey led by NUIG carried out a further investigation into the distribution of Dinophysis spp. in the eastern Celtic Sea.

The autumn survey season saw two first time chief scientists on the RV *Celtic Voyager*, from UCC. The first was a geology survey, 'AggreWind' research cruise which was conducted on the continental shelf west and south of Ireland, October 2018. The main goals of the survey were to collect multibeam echosounder data and carry out ground truthing activities in order to de-risk offshore construction aggregate mining and offshore windfarm development.

The preceding survey was a marine mammal expedition which involved a multidisciplinary approach to studying killer whale populations that associate with the Northeast Atlantic mackerel fishery. The survey took place off the Shetland Isles and more than 3,000 photos of killer whales were documented. SMART Sea School had a busy November with five SMART training surveys taking place. The training included collaborations with NUI Maynooth, NUIG and UCC. The UCC Marine Biology Masters programme also chartered the *Celtic Voyager* for their annual two day training programme. The year ended with Marine Institute fisheries trials period with and intercomparison survey with the *Celtic Explorer*.

An important achievement during 2018 was Government approval to build a replacement vessel for the *Celtic Voyager* and the award of the design contract in December 2018.

#### **Charter Vessels & ROV Holland 1**

The ROV Holland 1 took part in four dedicated scientific surveys in 2018, three on the RV Celtic Explorer and one on the charted ILV Granuaile, with 74 survey days in total. An additional 6 days were used by University of Limerick to test and trial their ROV Étáin onboard the Celtic Explorer at the start of May.

The majority of ROV Holland 1 survey time was spent on-board the RV Celtic Explorer in 2018, as previously highlighted. The ROV also spent three weeks on-board the ILV Granuaile in July with a team of scientists from the Marine Institute and National Parks and Wildlife Services (NPWS). The SeaRover3 survey, led by Marine Institute scientist David O'Sullivan, formed part of the three planned expeditions jointly funded by the Irish Government and the EU's European Maritime and Fisheries Fund (EMFF).

The high definition camera mounted on the ROV captured a number of 'firsts' in Irish waters, including a species of octocoral of the genus Corallium, areas of potential 'sponge reef' on the Rockall Bank, a highly unusual accumulation of living and dead sponges forming a complex habitat for many other creatures. Such formations are very rare and have previously only been recorded in Canadian waters. The survey also discovered and filmed a rare shark nursery on a scale not previously documented in Irish waters.

For more information on the research vessel programme 2018, see Appendix 6.









The Marine Institute provides services in partnership with other agencies which underpin and promote sustainable economic development and promote sustainable employment. Most of the activities detailed in other areas of this Annual Report also have a significant economic dimension.

The Institute supports Ireland's ocean and coastal economies through its research, ocean knowledge, infrastructure, advisory and regulatory services and maritime development opportunities. This includes the mandate of the Marine Institute's Irish Maritime Development Office (IMDO), providing dedicated development, promotional and marketing support for the shipping and shipping services sector. The IMDO's remit also includes supporting the development of Irish ports and the education and training needs of the maritime transport industry.

Through broader education, engagement and outreach programmes with stakeholders, the Marine Institute helps to develop an informed consensus about the sustainable development of our ocean economy (see Strategic Enabler 4 – Engagement & Education for more on this).

These enabling services support the Government's economic ambitions and targets as captured in the

Harnessing Our Ocean Wealth programme. The Institute facilitates and funds research that monitors and reports on the Harnessing Our Ocean Wealth targets. Building a socio-economic research capability in the Marine Institute and linking this to a strengthened national capacity is key to achieving this.

The achievement of these economic ambitions relies on the combined efforts of Ireland's development agencies. The opportunity for significant additional growth in our blue economy will continue under this strategy, building on the progress made in recent years under the Government's integrated plan for the sector as a whole. Examples of areas with a national focus for growth include nascent and emerging sectors such as marine biotechnology and advanced marine technologies (SmartOcean).

A critical initiative to drive this growth was the announcement in 2016 of the establishment of a dedicated Marine Development Team to deliver further development of the blue economy. Coordinated by the Marine Institute, the Marine Development Team involves participation by bodies including but not limited to Bord lascaigh Mhara (BIM), Bord Bia, Enterprise Ireland, Fáilte Ireland, Geological Survey Ireland, IDA Ireland, Science Foundation Ireland, Sustainable Energy Authority of Ireland and Údarás na Gaeltachta.

# IRISH MARITIME DEVELOPMENT OFFICE (IMDO)

Port and shipping services are strategically important to the Irish economy, providing the means of connecting Ireland to international markets. More than 90% of Ireland's international trade is carried by sea, with ports also acting as distribution centres and hubs for industry. In Q3 2018, port volumes reached a new high watermark on the IMDO's iShip index at 1053 points, surpassing the previous high of 1042 that was established in 2007. In 2018, the IMDO's work was carried out in a buoyant maritime sector, in which shipping volumes and port traffic grew across all traffic modes. Notwithstanding the uncertainties surrounding Brexit, Ireland's international trade volumes grew by 4% in 2018, as measured by the IMDO's iShip Index.

### Growth in trade by mode

	2017	2018	Variance
Ro/Ro (units)	1,120,387	1,163,872	4%
Lo/Lo teus	731,455	763,862	4%
Bulk (tonnes)	30,440,181	31,332,169	3%

The buoyancy of the market resulted in new services being opened, and additional capacity being added within the existing network. Major development projects were commenced in 2018 in Dublin Port, Port of Cork and Shannon Foynes that will provide the infrastructure needed to sustain the growth of the Irish economy. The IMDO's mandate in the maritime industry positions it well to use the strategic importance of the ports and shipping sectors to forge alliances and partnerships in related areas and to drive the success of the broader Ocean Economy. Some of the projects in which the IMDO was involved in 2018 are described below:

#### **Innovation Hub**

The IMDO worked with Enterprise Ireland and University College Cork to create a Maritime Innovation Hub in Ringaskiddy. This initiative is funded by Enterprise Ireland and established a national resource to drive the development of the marine industry, not only in Cork, but in other coastal locations where the natural resources used in the sectors (such as offshore energy) exist.

### **Cruise Industry Training Centre**

The IMDO supported an initiative, led by Flagship Management, an Irish company, to win Enterprise Ireland funding for a training facility for seafarers in the cruise industry. The funding came from the Regional Enterprise Development Fund and will enable Ireland to train seafarers for the buoyant international cruise industry.

### P&I Clubs Move to Ireland

The arrival of two major P&I Clubs is a watershed in the development of the maritime commerce industry. A Protection and Indemnity or P&I club is a nongovernmental, non-profitable mutual or cooperative association of marine insurance providers to its members, which consists of ship owners, operators, charterers and seafarers under the member companies. This development is indicative of the interest that exists in Ireland as a location for maritime commerce and is testament to the quality of regulation and support that exists for foreign direct investment. The engagement with P&I Clubs was commenced by the IMDO two years ago and continues to bear fruit.

#### **Inward Trade Visit UAE Delegation**

A trade Mission from the United Arab Emirates (UAE) to Ireland, which included the UAE Minister for Infrastructure Development took place in 2018 and was organised by Enterprise Ireland with support from the IMDO. This threeday event involved visits to the National Maritime College of Ireland, MaREI, and Port of Cork. An Irish industry showcase took place at Enterprise Ireland's offices at East Point Business Park, in addition to a series of bilateral meetings with DTTAS, the Commissioners for Irish Lights and some leading Irish maritime businesses. The visit culminated in a Memorandum of Understanding (MOU) being signed between NMCI (CIT) and counterparts in the UAE. A follow up visit of Irish companies to the UAE to meet with organisations, attend UAE Maritime Week and other events will take place later in 2019.

## International Shipping Services Centre (ISSC) in Cork

The IMDO worked with key stakeholders to advance the concept of an ISSC in Cork. The project has the potential to create up to 3,000 jobs in Cork by 2030 and is well aligned with objectives set out in the Government's policy for the marine industry, Harnessing Our Ocean Wealth (HOOW) and ambitions contained in the National Planning Framework. A steering group, comprising representatives of the Port of Cork, Cork City Council, the project promoters, and local business interests has been set up to drive progress. A report has been commissioned by the steering group that will be prepared by PwC, to establish the commercial, economic and strategic feasibility of the project. The IMDO has been involved through all stages of the project.

#### **Business Development**

The IMDO continued to promote and support Digital Ocean initiatives and opportunities. Digital Ocean opportunities occur at the intersection between technology and the marine industry. Within the maritime sector, projects such as Smart Ports and the application of Blockchain technology were advanced. The IMDO preserved the Marine Institute's participation in Digital Ocean at events such as Oceanology, London Shipping Week, and Finance Dublin, and at the Our Ocean Wealth Summit 2018. The IMDO also worked closely with Enterprise Ireland to stage a trade show at the Our Ocean Wealth Summit 2018, at which a number of Marine Tech companies exhibited.

#### Irish Marine Industry Network

The Irish Marine Industry Network (IMIN) was established by industry stakeholders, including the IMDO, in 2016. The network has attracted Enterprise Ireland clients, SEAI clients, Digital Ocean companies, port companies, shipping companies and a broad range of technology companies. The network has gone from strength over the past two years and in 2018 met at SeaFest, offshore renewable energy events, and a variety of other industry fora.

#### Maritime Commerce Forum (MCF)

In 2018, the IMDO continued to organise and host its biannual Maritime Commerce Forum, recognising the strategic importance of this sector for increased jobs and economic growth in Ireland's maritime domain. As the sector continues to move towards new financing models, supported by new forms of technology, Ireland has evolved its value proposition in maritime commerce to meet the needs of the shipping and shipping services sectors, in addition to those of the offshore renewable energy and maritime technologies sectors. Two MCF events were held in 2018, in March and November. These meetings were held in association with PwC and included speakers and delegates from the ICT, finance, professional services, ports and shipping sectors.



# OCEAN SCIENCE AND INFORMATION SERVICES (OSIS)

## Information Services and Development

The information services and development team develops and manages the ICT and data infrastructure across the Marine Institute to provide a robust operational platform for data and information services. The team also continues to develop new technical capabilities and support improvements in the Marine Institute's service delivery.

In 2018, the Institute progressed several strategic initiatives through the IT Strategy, the Data Strategy, and EMFF data integration in support of developing MSP and MSFD programmes, with these activities closely aligned with the Institute's new strategic plan.

These included work on the Irish Digital Ocean digital services platform which aims to make Ireland's marine digital assets more readily available for public services, research and innovation. In collaboration with operational science teams the Institute has developed new capabilities for marine environmental data processing and a cross-service area Data Management Quality Management Framework in line with international standards.

Operational programme support was delivered for the Marine Ocean Energy programmes, and the marine environment data processing and spatial analysis activities. Ongoing improvements to Marine Institute data accessibility ensure that more data is available online including through <a href="http://data.marine.ie">http://data.marine.ie</a>, <a href="http://atlas.marine.ie">http://data.marine.ie</a>, <a href="http://atlas.marine.ie">http://data.marine.ie</a>, <a href="http://atlas.marine.ie">http://atlas.marine.ie</a>, <a href="http://atlas.marine.ie">http://atlas.marine.ie</a>, <a href="http://atlas.marine.ie">http://atlas.marine.ie</a>, <a href="http://atlas.marine.ie">http://atlas.marine.ie</a>, <a href="http://atlas.marine.ie">http://data.marine.ie</a>, <a href="http://atlas.marine.ie">http://atlas.marine.ie</a>, <a

The Institute has continued to develop new IT and data system capabilities for oceanographic and marine renewable energy data processing, analysis and publication capabilities.

2018 also saw the development of a new Data Management Quality Framework for scientific data processes. The new framework is aligned with the IOC's IODE quality management system and will support improved data quality and reuse. The team has also further developed the Irish Digital Ocean platform with new ways to access information including visualisation of predictive oceanographic model data and data from the INFOMAR seabed survey programme, enabling data reuse across new and developing programmes.

### **Advanced Mapping Services**

Advanced Mapping Services (AMS) provided survey coordination, operational, data, research and development, along with advisory support, both internally within the Marine Institute, and for industry, government and public stakeholders, in Ireland, and internationally.

The strategic approach developed by AMS for the DCCAE-funded INFOMAR offshore mapping has been further refined, with multi-year survey statistics underpinning annual operational survey targets towards mapping completion end 2026. Detailed collective Marine Institute and Geological Survey Ireland progress reporting is now published annually, capturing operational data, and valued-added INFOMAR activities. The 2018 AMS compiled report is undergoing final editorial and is due for publication Q1 2019.

As part of INFOMAR's Value-Added Exploitation programme, the team coordinated and supported research, training, education, outreach and SME R&D activities. Development, delivery and launch of the new INFOMAR website was a key 2018 output. Numerous underlying data, product and web mapping services were developed in parallel. These refined, open and free outputs significantly improve stakeholder access to seabed data and associated information, which is vital equally for management, conservation or development.

Significant international and Irish research collaboration continued, while also providing education, training and capacity build support (see Strategic Enabler 4 – Engagement and Education). Project work on the EMODnet Habitat project is ongoing, with a decision pending on a two year extension.

For a full brief of research vessels' operations during 2018, see Strategic Enabler 2 – Infrastructure.

#### Ocean Energy and EU Infrastructure Projects

In December 2017, the Marine Institute was awarded a 35-year foreshore lease for the Galway Bay Marine and Renewable Energy Test Site, located 1.5km off the coast of Spiddal. The new lease allows the testing of up to three marine renewable energy devices at any one time one the site, and has expanded the range of technologies that can be tested at the site, including floating offshore wind turbines.

Following the award of the lease and compliance with site specific conditions, the test site was commissioned in July 2018 with four new cardinal marks deployed to delineate the extent of the test site. Within the test site there are three berths for ocean energy devices, and a fourth berth

for the licensed underwater cabled observatory and associated testing of marine technology projects.

The ocean energy team manage the test and demonstration facilities at the quarter-scale ocean energy test site in Galway Bay along with providing continued operational services at the Belmullet and Westwave ocean energy test sites under a revised Service Level Agreement with the Sustainable Energy Authority of Ireland.

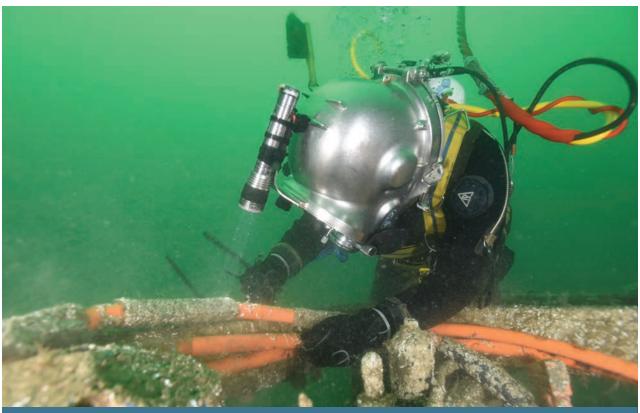
The subsea observatory located within the Galway Bay test site, 1.5km offshore of Spiddal includes fibre optic data and power connectivity allowing scientific experiments and novel marine sensors and equipment to be tested in a real marine environment with real-time monitoring of performance. The observatory was recovered from the seabed for maintenance in June 2018 and was redeployed in July to coincide with the commissioning of the test site. The observatory is a regional node of EMSO (European Multidisciplinary SeaFloor Observatory). EMSO is a European Research Infrastructure Consortium (ERIC), legal framework created for pan-European large-scale research infrastructures.

In 2018, 13 projects secured funding through various EU programmes to utilise the Galway Bay test site and subsea observatory; four through the H2020 project JERICO-NEXT for testing novel marine technologies, six through the INTERREG project FORESEA for testing marine renewable energy devices and supporting technologies, and three through the H2020 OceanERANET Co-Fund for research and development in ocean energy. Only projects utilising the observatory were deployed in 2018.

# POLICY, INNOVATION AND RESEARCH SUPPORT (PIRS)

PIRS continued to fund and work with the Socio-Economic Marine Research Unit (SEMRU) in NUI Galway and colleagues in the IMDO on the ongoing collection and analysis of economic data aimed at valuing Ireland's ocean economy. SEMRU research provides the Marine Institute and policy-makers with trends across 13 marine sectors.

The outputs of the research indicate that in 2017, the direct economic value of Ireland's ocean economy was an estimated €1.97 billion or approximately 1% of gross domestic product (GDP), which represents a 21% increase on 2015 figures. PIRS will also work with SEMRU on another research project titled 'Ireland's ocean economy – A regional and rural analysis of Ireland's ocean and coastal economies', which commenced in 2018 and is funded under the Marine Institute Cullen Fellowship Awards.



Underwater diver working on the Galway Bay SmartBay Subsea Observatory



Marine Institute CEO Dr Peter Heffernan, PwC Partner Yvonne Thompson and CEO of Bord lascaigh Mhara (BIM) Jim O'Toole at photo call for Our Ocean Wealth Summit 2018







The Marine Institute is committed to supporting a culture of high performance, driven by our people, whose skills, experience and passion for the marine are central to the work we perform for government and other stakeholders.

The Strategic Enabler, Our People, has three strategic initiatives – ensuring agility, diversity and flexibility, cultivating the Institute as a great place to work and, building and retaining the capabilities of our staff.

Our people are central to all of the service areas and strategic focus areas outlined in this Annual Report but a number of core sections key to the Strategic Enabler are outlined below. Human Resources, Finance, Communications and Library Services are all part of Corporate Services at the Marine Institute.

### **HUMAN RESOURCES**

In 2018, we focused on aligning our Human Resource Charter and activities to the Marine Institute's Strategic Plan 2018 to 2022, specifically the Strategic Enabler 'Our People'. There was a continued focus on investing in Learning & Development to enable and support the high performance of staff with €718,000 invested in building capacity, essential skills and supporting third level research and training. The focus for Learning and Development in 2018 included developing and implementing strategies, certified leadership programme, project and resource management, effectively managing performance and compliance related training such as GDPR, Cyber Security and Health & Safety.

We continued to work with staff representatives to support the success of our Great Place to Work Group; who delivered initiatives around Staff Engagement, Communications, Recognition, Career & Personal Development, Team Building and Sports & Social activities. In September 2018, we retained our Excellence Through People Certification under the new NSAI (National

Standards Authority of Ireland) Standard ETP 1000:2017, the Marine Institute was awarded the Gold Standard.

25 opportunities were recruited during 2018 primarily for EU and alternately-funded temporary projects across a range of scientific, technical and administration disciplines.

Our very successful Transition Year programme ran for the third time in February offering students from across Ireland the chance to experience a range of roles and receive training in science, technology and interpersonal skills development. The five day programme included Fisheries, Chemistry, Oceanography, Seabed Mapping, Shipping & Maritime Development, Marine Operations, Applications Development, Communications & Teambuilding and presenting a poster.

The Health & Safety Committee representing all locations and programmes held eight meetings in 2018. Risk Assessments were completed across all locations and we completed a full review of our Safety Statement and all related legislation, policies and operating procedures - internally and via an external expert. The high priority placed on Safety and Wellbeing was reflected in the reporting of two minor accidents and three near misses in 2018. We now report near misses separately from accidents to promote awareness and the importance of safe working environments. Health, safety and wellbeing promotions took place throughout the year focusing on mental health, building resilience, safe working, nutrition & exercise, mindfulness and First Aid and AED (Automated External Defibrillator) training.

In line with Risk Management and Business Continuity Policies (BCP), the Board and its Audit and Risk Committee, with the Executive and Risk Officers, reviewed and signed off on the appropriate policies and processes in 2018. The Risk Register and Risk and BCP reports were reviewed quarterly throughout 2018. Risk management and related processes were independently audited during the year. Nine business critical processes had their continuity plans reviewed or tested in 2018.

### **FINANCE**

The Marine Institute operates to best practice corporate governance principles in line with the guidelines set out in the 2016 Code of Practice for the Governance of State Bodies. The Institute has fully adopted this revised Code and affirms its compliance with all sections in the Code. The Marine Institute has in place a range of procedures, policies and guidelines to ensure compliance with the code and it is the policy of the Marine Institute to support the development and strengthening of an effective control environment, risk management system and audit function. The Marine Institute has a properly constituted internal audit and risk function in accordance with the principles set out in the code of practice and has a formal charter which has been approved by the Board of the Marine Institute.

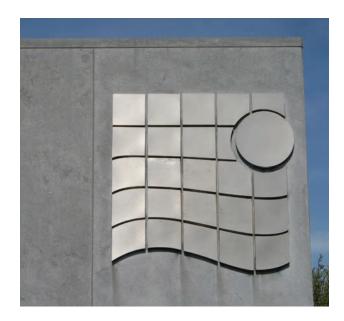
An Audit and Risk Committee, a sub-committee of the Board, is in place to oversee and advise the Board on matters relating to financial, operating and governance risks, including overall risk management and the effectiveness of the internal controls and risk management within the Marine Institute. In line with the internal audit programme, the Internal Audit and Risk Committee met eight times in 2018 and, within that, met with the Comptroller and Auditor General to discuss the audit certification received for 2017.

The internal audit plan for 2018-2019 reflects the risks identified in the Marine Institute Risk Register, Code of Practice for the Governance of State Bodies, requirements of the Comptroller and Auditor General and the internal audit and risk committee. The system of internal controls are reviewed on an annual basis by the outsourced internal auditors and this formed one of nine internal audits undertaken in 2018, affirming the Institute's high standards of governance and ensuring that an effective system of internal control is maintained and operated. Internal audits included an internal financial controls audit, a HR and Payroll Audit, a General IT Controls audit and a Code of Practice audit. All internal audit recommendations arising were actioned and reported to the Internal Audit and Risk Committee and to the Board.

The Marine Institute has an appropriate public procurement process which is compliant with the current value thresholds for the application of EU and national rules. Centralised purchasing and the use of the Office of Government Procurement has proved to be an efficient and effective means of reducing costs and generating savings and will continue into 2019. In 2018, 52 tenders were issued, of which five were published in the Official Journal of the European Communities.

It is Marine Institute policy to ensure that all invoices are paid promptly within the terms of the Prompt Payment of

Accounts Act, 1997 and the European Communities (Late Payment in Commercial Transactions) Regulations 2012. Systems and procedures are in place enabling invoices to be tracked and to ensure that payments are made in a timely and efficient manner. Procedures are in place, however, to ensure that late interest is paid, if required.



## **COMMUNICATIONS**

Our Communications team is responsible for all of the Marine Institute's official communications including media relations, online communications, marketing, engagement and education, events, and library services. Education and engagement with all of our stakeholders was a focus for us in 2018 as we began implementing our new strategy with the ambition of increasing awareness, participation and strengthening our communications across all platforms.

Education and engagement programmes that the Communications team were involved in or led on during 2018 included Our Ocean Wealth Summit, SeaFest, Explorers Education Programme, open days and science and technology events. More details on these activities, along with media, public relations and digital communications, can be found in Strategic Enabler 4 – Engagement and Education.

The Communications team worked with colleagues in the Marine Institute to highlight news, research areas and events both internally and externally during 2018. Amongst these activities was the launch of Maximise your research – Promoting your research and making an impact, a publication created to support Marine Institute staff in the promotion of their research to achieve maximum impact for their work. This was a joint collaboration between the Communications Office and the Library.

## LIBRARY SERVICES

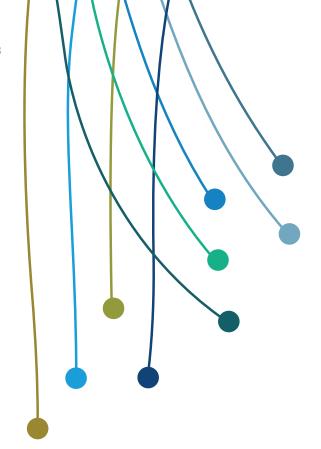
The Oceanus Library supports staff in their research, by providing access to publications and maximising their research impact through Open Access and promotion.

The library also supports queries and visits from interested external members as well as training staff on self-archiving on our Open Access Repository (<a href="http://oar.marine.ie/">http://oar.marine.ie/</a>). The Open Access Repository provides free online access to over a thousand Marine Institute publications and had 13,350 visitors from every continent in 2018. The library is a member of the National Open Research Forum board whose mandate is to deliver an Irish agenda for open research.

The library continues to maintain close relationships with key organisations and collaborates with external libraries when opportunity arises. During 2018, the library undertook some GDPR responsibilities, coordinating and supporting the Institute's compliance with the new regulation.

See Appendices 4 & 5 for information on Marine Institute Publications and Scientific Paper and Publications in 2018.





# INFRASTRUCTURE

The Marine Institute operates national infrastructures that provide essential platforms for its government services, national and international research and early technology development. These national assets include nine Marine Institute facilities nationwide that accommodate staff and laboratory facilities, including the Institute's headquarters in Oranmore, Co Galway, and a research facility in Newport, Co Mayo.

Other infrastructure includes: two multi-purpose research vessels (RV *Celtic Voyager* and RV *Celtic Explorer*), a deep water Remotely Operated Vehicle (ROV), IT infrastructure and data, mobile and fixed oceanographic equipment as well as test and demonstration platforms such as the Galway Bay Observatory.

The Institute also provides technical services and equipment to other national infrastructure operators, which includes supporting ocean energy test sites, the National Weather Buoy Network, as well as coastal protection and flood risk management programmes.

All public bodies are monitored and tracked to achieve a 33 per cent reduction in energy usage by 2020 (from 2009) in line with Ireland's third National Energy Efficiency Action Plan (NEEAP 3). 18 energy goals continue to be targeted through the Institute's Energy Reduction Strategy and Policy 2016–2020, focusing on the operation of the National RV fleet, laboratories, Office/IT equipment and facilities. See the General Administration section for further details on energy efficiency.

#### **FACILITIES**

The Facilities team is primarily based in Galway with the main function of providing safe, efficient, well maintained working environments throughout all Marine Institute facilities and essential platforms for our research services. With a strong customer support focus, we provide a range of services including procurement advice, building operations and maintenance and energy management.

One of the key focuses for 2018 was the optimisation of office/laboratory space and restructuring layouts to accommodate the growing needs of the organisation. A full review of the three main Facilities was undertaken with a register created to enable a fast response to accommodate evolving seating requirements.

The Building Management System (BMS) provides full control of plant and equipment which assists in operating the HQ as efficiently as possible. Audits of both the BMS and maintenance procedures and operations were carried out by an external expert, confirming efficient practices were in place.

The impact of additional service demands within the Institute has led to an increase in the volume of daily services provided by the Facilities team. A key responsibility of the team is to review all Marine Institute tenders prior to advertising on **www.etenders.ie**.

We continue to work on a cross service basis and are involved in Health & Safety, Laboratory Management and Energy Awareness. Administrative support is provided to various units within the organisation as well as the provision of daily operational services including maintenance, reception, stores, cleaning, security and catering. Using modernising and efficient technologies underpins all of our procurement and services to ensuring we are providing the most effective, efficient and responsive service possible.

## MARINE OPERATIONS (RESEARCH VESSELS)

#### **RV** Celtic Explorer

The RV *Celtic Explorer* began 2018 at AP Falmouth, United Kingdom, for a five-year refit. The five-year refit included an overhaul of the bow thruster and an upgrade of the DC propulsion system. The vessel's original fishing sonar was removed and replaced with a new fisheries sonar. The new sonar has an increased range and resolution, which will be a huge advantage for the dedicated acoustic fisheries surveys. The vessel's accommodation also received an upgrade after 15 years of service. Other tasks completed during the refit included painting and antifouling of the hull and a complete painting of the superstructure. Lastly, there was the major 60,000 hour overhaul of one of the main diesel generators.

The RV Celtic Explorer had 17 scheduled surveys in 2018. The first survey began at the end of January and was led by BSH (Federal Maritime and Hydrographic Agency) in Germany. The scientific survey operations were oceanographic and environmental in nature and primary operations included CTD casts along a predetermined track. The second survey of 2018 was the annual Rockall oceanography survey, led by the Marine Institute. The survey involved a collaboration between the Marine Institute and NUI Galway scientists for the nine day expedition, which included research into ocean acidification. Three argo floats were deployed in deepwater during the survey which will provide high quality temperature and salinity depth profiles for the next 3-5 years

Next was the first fisheries survey of 2018, the annual 'Anglerfish and megrim trawl' survey which involved ICES approved bottom trawling in order to obtain biomass estimates for anglerfish and megrim data for setting an abundance index. The next survey was the Marine Institute led annual Blue Whiting Acoustic expedition which involved using the new sonar. A key highlight of the

acoustic survey was the mapping of the SS Athenia ship wreck off Rockall Bank.

Towards the end of April and into the first two weeks of May was the INFOMAR seabed mapping survey which carried out operations in the Celtic Sea. A feature of the survey was the allocation of berths to two students from the United States as part of the BEnthic Acoustic Mapping & Survey programme (BEAMS) at the College of Charleston, US. The BEAMS programme teaches students how to process raw bathymetric data using specialist softwares. The survey covered 2,400 km² of survey area.

Another 2018 highlight was the 'Tectonic Ocean Spreading at the Charlie-Gibbs Fracture Zone North Atlantic' (TOSCA) survey, led by University College Dublin (UCD), which was also the first ROV Holland 1 survey of 2018. The survey area took place within the Charlie-Gibbs Fracture Zone (CGFZ), which is the longest fracture zone north of the Azores. The 2,000km fracture zone separates and connects the two most important ridges in the North Atlantic, making it a hugely active tectonic zone. TOSCA was a multidisciplinary survey involving ROV dives (10 in total), 3,600 line kilometres of multibeam data acquisition and ground truthing activities.

On completion of the ROV demobilisation the vessel commenced the first leg of the 2018 Western European Shelf Pelagic Acoustic Survey (WESPAS), led by Marine Institute scientists, which lasted 20 days and included the use of acoustic techniques to collect boarfish spawning stock information along a predetermined track in the Celtic Sea. The survey had a break to visit SeaFest 2018 for three days in Galway city, with over 9,000 visitors to the vessel for tours over three open days. The second leg of the WESPAS survey commenced after the public outreach event; with the survey track stretching from Galway through to Malin Head and as far north the Outer Hebrides over 22 days.

The ROV Holland 1 was mobilised once more over a two day period in late July. University College Cork (UCC), led the 'Controls of Cold-Water Coral Habitats in Submarine Canyons II (CoCoHaCa2)' survey. The team included scientists from different disciplines including marine geology, marine ecology, marine biology and oceanography. In addition, the artist Carol Anne Connolly was on-board as part of the Galway 2020 'Aerial/Sparks' project. The ROV remained on-board for its final expedition led by NUI Galway assisted by the University of Southern Florida. The biodiscovery survey followed on from the 2017 'Exploiting and Conserving Deep-Sea Genetic Resources'. ROV dives took place along a track on the north western side of the Porcupine Bank. Along with recording video footage at each site, live samples of several invertebrate groups were retrieved including species from the Porifera and Cnidaria

groups. Once the ROV was demobbed, the vessel sailed to Hamburg to commence a 17-day North Sea oceanographic survey, the final BSH survey of 2018.

Another highlight of the 2018 survey season was the Dublin Institute of Advanced Studies (DIAS) survey, referred to in short as 'SEA-SEIS-D' which stands for the 'Structure, Evolution and Seismic hazard of the Irish offshore: deployment of broadband, ocean-bottom seismometers'. The programme successfully deployed 18 seismometers on the bottom of the North Atlantic Ocean north to Icelandic waters. Tiny vibrations, caused by seismic waves generated by earthquakes and by ocean waves, will be recorded over the next 18 months (recovery, May 2020). The collected data will enable DIAS scientists to create a 3D scan of the Earth's interior, helping them to understand the nature and history of earth beneath the North Atlantic Ocean.

One of the unique features of the SEA-SEIS-D survey was the hugely engaging educational element to the survey, including a seismometer naming competition which gained entries from schools all over the country and from as far as Italy. In addition, the use of videoconferencing software allowed scientists onboard the RV Celtic Explorer to connect directly to 12 classrooms around the country for live questions and answer sessions. The Marine Institute's Explorers Education Programme worked in tandem with the DIAS scientists also and visited several classrooms to raise awareness and understanding of seismology and of the Real Map of Ireland. More than 200 primary schools have been able to learn about the SEA-SEIS-D survey and the science behind it.

Operations in the final few months of 2018 reverted to fishing with the delivery of the annual Marine Institute Celtic Sea Herring Acoustic survey in October. The survey covered 3,200 nautical miles. CTDs and day grabs were also part of the work programme. The final fisheries expedition was the annual Irish Groundfish survey (IGFS) with four survey legs running consecutively from the end of October to mid-December. The year ended in Galway port with operations that included the commencement of the UL ROV Étaín mobilisation onto the aft deck and integration to the vessel's network, along with a maintenance period and DP trials in the bay.

#### **RV** Celtic Voyager

Once again it was a busy year for the RV *Celtic Voyager* with the completion of 33 surveys which ranged from survey operations in Irish waters to stretching as far north as the Shetland Isles and as far south as the Bay of Biscay. The *Celtic Voyager* 2018 season kicked off with the annual 'Winter Environment Survey', which involved a spatial and temporal assessment of winter nutrients in Irish waters. The track route alternates each year between 'north about' and 'south about', heading from east to west. In 2018, it started in Dun Laoghaire and crossed through the Celtic Sea via the southern route back to Galway Bay. Benthic sampling along major bays on the south, southwest and into Galway Bay took place also to acquire data required under the EU Water Framework Directive (WFD).

The next survey was trialling a new underwater TV (UWTV) camera system in Galway Bay and out as far as the Aran Islands. The UWTV surveys are fundamental to determining the stock quota for Nephrops norvegicus. Trials took place on two additional occasions during 2018 and the new camera system was successfully implemented by the end of August.

The vast majority of February and March survey time involved student training from Cork Harbour or Galway Bay, including National Maritime College of Ireland (NMCI) deck and engineering cadets. Other student training surveys included three SMART (Strategic Marine Alliance for Research and Training) surveys which involved collaboration with NUIG SEMRU, UCC MaREI and the GMIT Observer programme. A geophysical survey, led by a team of scientists from Sligo IT, punctuated the student training period in late February. Survey operations included vibrocoring in Liverpool Bay and Cardigan Bay. Sediment samples were collected as the geologists aim to reconstruct and simulate the palaeo-environments of the Irish Sea.

April marked the return of marine biology surveys with a 14 day multidisciplinary Nephrops larvae survey which involved multinet operations combined with the collection of oceanographic data on the Aran Grounds to the west of Ireland and in the western Irish Sea. The Nephrops theme continued into May as the vessel sailed from Dublin to Lorient mid-April to commence the fifth Langolf UWTV survey, led by scientists from Ifremer, in the Bay of Biscay.

National University of Ireland (NUI) Maynooth continued on with its research in May 2018 on the 'MARA: Malin shelf sediment ReseArch' programme, which involved the use of seismic equipment and multibeam operations, in addition to ground truthing activities off Malin Head. Following on from the geophysical survey was the Marine Institute led BLUEfish 3 expedition which used a multinet to collect seabass and scallop larvae in the Irish and Celtic Sea.

The vessel sailed to the Porcupine Basin in May to carry out a novel research survey on acoustic noise propagation which was led by NUIG. The generation of acoustic noise, and subsequent recording, took place at contrasting locations across the continental margin. The acoustic data measured will be used to quantify the influence of the margin topography on noise attenuation. The 'Laochra na Mara' glider was also deployed and recovered with up to 52 hours completed at different depths.

Three INFOMAR surveys took place on the *Celtic Voyager* in 2018 stretching from late May to the end of September. It was one of the most successful INFOMAR seasons with coverage of up to 5,500km² between the three legs. The good weather combined with the use of the moving vessel profiler (MVP) and surveying in deeper waters were among the factors contributing to the successful season. All three MI FEAS Nephrops UWTV surveys were completed, including the Porcupine grounds. Another survey led by NUIG carried out a further investigation into the distribution of Dinophysis spp. in the eastern Celtic Sea.

The autumn survey season saw two first time chief scientists on the RV *Celtic Voyager*, from UCC. The first was a geology survey, 'AggreWind' research cruise which was conducted on the continental shelf west and south of Ireland, October 2018. The main goals of the survey were to collect multibeam echosounder data and carry out ground truthing activities in order to de-risk offshore construction aggregate mining and offshore windfarm development.

The preceding survey was a marine mammal expedition which involved a multidisciplinary approach to studying killer whale populations that associate with the Northeast Atlantic mackerel fishery. The survey took place off the Shetland Isles and more than 3,000 photos of killer whales were documented. SMART Sea School had a busy November with five SMART training surveys taking place. The training included collaborations with NUI Maynooth, NUIG and UCC. The UCC Marine Biology Masters programme also chartered the *Celtic Voyager* for their annual two day training programme. The year ended with Marine Institute fisheries trials period with and intercomparison survey with the *Celtic Explorer*.

An important achievement during 2018 was Government approval to build a replacement vessel for the *Celtic Voyager* and the award of the design contract in December 2018.

#### Charter Vessels & ROV Holland 1

The ROV *Holland 1* took part in four dedicated scientific surveys in 2018, three on the RV *Celtic Explorer* and one on the charted ILV Granuaile, with 74 survey days in total. An additional 6 days were used by University of Limerick to test and trial their ROV Étáin onboard the *Celtic Explorer* at the start of May.

The majority of ROV Holland 1 survey time was spent on-board the RV Celtic Explorer in 2018, as previously highlighted. The ROV also spent three weeks on-board the ILV Granuaile in July with a team of scientists from the Marine Institute and National Parks and Wildlife Services (NPWS). The SeaRover3 survey, led by Marine Institute scientist David O'Sullivan, formed part of the three planned expeditions jointly funded by the Irish Government and the EU's European Maritime and Fisheries Fund (EMFF).

The high definition camera mounted on the ROV captured a number of 'firsts' in Irish waters, including a species of octocoral of the genus Corallium, areas of potential 'sponge reef' on the Rockall Bank, a highly unusual accumulation of living and dead sponges forming a complex habitat for many other creatures. Such formations are very rare and have previously only been recorded in Canadian waters. The survey also discovered and filmed a rare shark nursery on a scale not previously documented in Irish waters.

For more information on the research vessel programme 2018, see Appendix 6.

# THE IRISH MARINE DATA BUOY OBSERVATION NETWORK (IMDBON)

Since 2001, the Irish Weather Buoy Network has been generating hourly weather reports consisting of measurements of key near surface marine meteorological data: air temperature, humidity, atmospheric pressure, wind speed and direction also oceanographic data including sea surface temperature, wave height, and wave period. The extreme western synoptic M6 location is a sentinel European monitoring site.

The budget subhead for this programme of activity (renamed the Irish Marine Data Buoy Observation Network [IMDBON] to reflect a wider marine observing ambition) transferred from the Department of Transport, Tourism and Sport (DTTAS) to the Department of Agriculture, Food and the Marine (DAFM) in 2018 with an associated increase in the core operations and maintenance programme budget in 2018.

In recent years, the Marine Institute rolled out a series of modifications to the standard buoy platforms in use to improve reliability and as part of this, a long term research programme involving UK Met and a French company, Mobilis, resulted in what is one of the most advanced weather observing platforms currently available worldwide. The first of these went on test at the historical M1 site (50 nautical miles west of Galway) where the platform was determined as fit for purpose in 2018. During 2018, Marine Institute technical staff developed an advanced data collection system which is based on open source hardware and software solutions which is now ready to roll out from 2019 onwards.

In 2018, the last of the old generation ODAS (Ocean data acquisition platform) data buoys was placed on permanent exhibition at the Cromwell Point Lighthouse Visitors Centre on Valentia Island, a fitting homage to these mighty devices that have given such solid service to mariners for two decades.

2018 also saw an increased role by the Marine Institute handling weather observations where incoming data collection and management are to be streamlined with the Marine Institute undertaking not only the acquisition of data to shore, but also its archive and dissemination, plus its formatting into the standard format for onward hourly transmission to EU Met. Services and beyond.

A significant SFI (Science Foundation Ireland) research infrastructure funding award in late 2018 will provide the means to complete the transfer to new technology, placing the network on a sound basis for many years to come. This work will include leveraging additional data acquisition of key climate variables, most notably carbon dioxide exchange across the air-sea boundary.

## THE IRISH NATIONAL TIDE GAUGE NETWORK

Operated by the Marine Institute, the Irish National Tide Gauge Network (INTGN) provides monitoring of sea level around the Irish coast. As sea level relative to land level change is a key ECV (Essential Climate Variable) with regards to climate adaptation and coastal resilience, 2018 saw an increase in interest from universities who are looking to better understand historical observation and trends, this has extended to the formation of a distributed expert group with activities being led by NUI Maynooth.

2018 also saw the conclusion of efforts into completing a round of installations, increasing the permanent monitoring infrastructure to 22 managed nodes. Focus is being given to survey and calibration methodologies to bring all stations to within a certainty of better than 1cm. A major overhaul of the data handling base station in Galway moved all remote monitoring to true real time, with data being reported into the central base station every five minutes with a much greater level of reliability.

The long-term, ultra-high precision temperature data being collected at Ballycotton (east Cork) and the Portmore Pier (Malin Head) are now well established. These data continue to feed background climatological data into central archives of temperature, the fundamental climate change indicator. Ballycotton is a relatively new station, but in the case of Malin Head this work is building on a time series that started in the late 1950s when the importance of long term monitoring was recognised.

## OCEAN ENERGY AND EU INFRASTRUCTURE PROJECTS

In December 2017, the Marine Institute was awarded a 35-year foreshore lease for the Galway Bay Marine and Renewable Energy Test Site, located 1.5km off the coast of Spiddal. The new lease allows the testing of up to three marine renewable energy devices at any one time one the site, and has expanded the range of technologies that can be tested at the site, including floating offshore wind turbines.

Following the award of the lease and compliance with site specific conditions, the test site was commissioned in July 2018 with four new cardinal marks deployed to delineate the extent of the test site. Within the test site there are three berths for ocean energy devices, and a fourth berth for the licensed underwater cabled observatory and associated testing of marine technology projects.

The ocean energy team manage the test and demonstration facilities at the quarter-scale ocean energy test site in Galway Bay along with providing continued operational services at the Belmullet and Westwave ocean energy test sites under a revised Service Level Agreement with the Sustainable Energy Authority of Ireland.

The subsea observatory located within the Galway Bay test site, 1.5km offshore of Spiddal includes fibre optic data and power connectivity allowing scientific experiments and novel marine sensors and equipment to be tested in a real marine environment with real-time monitoring of performance. The observatory was recovered from the seabed for maintenance in June 2018 and was redeployed in July to coincide with the commissioning of the test site. The observatory is a regional node of EMSO (European Multidisciplinary SeaFloor Observatory). EMSO is a European Research Infrastructure Consortium (ERIC), legal framework created for pan-European large-scale research infrastructures.

In 2018, 13 projects secured funding through various EU programmes to utilise the Galway Bay test site and subsea observatory; four through the H2020 project JERICO-NEXT for testing novel marine technologies, six through the INTERREG project FORESEA for testing marine renewable energy devices and supporting technologies, and three through the H2020 OceanERANET Co-Fund for research and development in ocean energy. Only projects utilising the observatory were deployed in 2018.

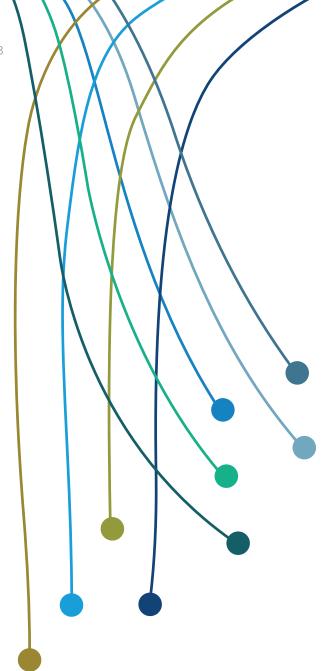
#### OCEANOGRAPHIC SERVICES

The team further built on observing efforts through active membership of both the European Multidisciplinary Seafloor and Water Column (EMSO) and Euro-Argo European Research Infrastructure Consortia (ERICs). The Institute is Vice Chair of the Euro-Argo Management Board and the team successfully deployed three floats and have added capacity to Ireland's core Argo programme, by procuring Ireland's first ever Oxygen measuring Argo floats, which in addition to the biogeochemical float, offers the Irish research community new opportunities for data collection and analysis. A demonstration Argo float, together with the recently refurbished Glider, proved to be very popular exhibits during SeaFest 2018. Both the EMSO and Euro-Argo ERICs have also enabled the Marine Institute to leverage funding through the H2020 programme.

As a result of this high quality delivery of EU-funded programmes, the entire oceanographic services team had a very successful year in securing new EU project funding. The end of 2018 also saw success in the award of both Eurofleets+ and EuroArgo-RISE projects to the Institute. The Institute continued to provide input into infrastructure projects including the H2020 EMSO-LINK, Maritec-X and the JPI Climate ERA4CS CoCliME project. Other projects include the INTERREG Atlantic PRIMROSE project and the H2020 TAPAS project.







# DATA AND IT

Digital technologies and data integration represent both challenges and opportunities that have a profound effect on innovation, competitiveness and scientific research. This is of huge relevance to the Marine Institute and its services as it generates a vast amount of data through data collection, monitoring and research programmes. Data is the foundation for the Institute's evolving integrated advice and services portfolio and how it supports integrated maritime policy at national, EU and international levels.

The Marine Institute develops and promotes open access to national datasets, data integration, online data and information services. This results in the optimal re-use and sharing of data. Open access to data also promotes research and innovation and stimulates new commercial products and services.

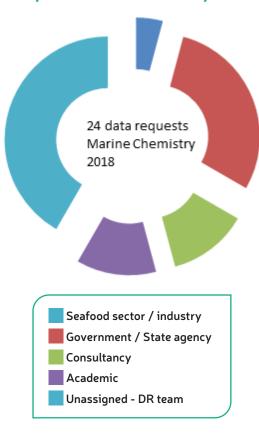
## MARINE ENVIRONMENT AND FOOD SAFETY SERVICES (MEFS)

Numerous actions are ongoing within MEFS to progress data management and quality operations, and establish the appropriate IT systems to support efficiencies. Data stewards from each unit have actively participated in mapping data process flows in accordance with the Marine Institute-wide strategy and initiative to achieve accreditation through the International Oceanographical Data Exchange. Other data and IT actions specific to unit operations have also been greatly progressed in 2018 in support of MEFS Quality Management System and in view of providing improved customer satisfaction. Highlights of these actions are summarised below:

#### **Data Requests**

Although many customers come to MEFS directly for written advice, as summarised earlier, a majority of our services are obtainable through data requests and through accessing websites. These services reflect how the data produced by the technical domain experts must be integrated with data management and IT expertise provided through OSIS colleagues to provide the public interface to the data. For example, data compiled by the Marine Chemistry unit of MEFS was requested on 24 occasions in 2018. Typically these requests are for access to large data sets with tangible uses supporting development (e.g. EIS - Environmental Impact Statements), regulatory or academic use. Customers accessing the data are mostly government or other state bodies (e.g. Irish Water) but consultancies and academics are frequently represented (see figure below):

Customer representation of 2018 data requests to Marine Chemistry Unit



## Harmful Algal Blooms Website and Database Redevelopment

The shellfish safety programme relies on producing rapid results to allow the industry to harvest their product and place it on the market within tight time constraints. The efficient publication of results relies on having a database on which the basis of rapid decisions can be made, and

these can then be published online, again in an efficient quick manner. The system used in the Marine Institute is called HABs—short for Harmful Algal Blooms—and this has been in place since 2002.

Over the past two years, this has been redeveloped in a joint exercise carried out by a team made up of OSIS IS&D developers and Shellfish Safety unit members from MEFS. In 2018, the first stage website upgrade was launched with new graphical and interactive information for the viewer. This improved web-based communication system offers relevant information to producers, food business operators, and customers alike, and has already improved the monitoring efficiency of shellfish production areas to allow the Marine Institute to perform its role in assuring seafood safety in a more efficient and effective manner.

In 2018, a total of 1,959 users visited the HABs website to get information, of which 71% were returning visitors. These visitors generated 48,244 page views making the HABs II website one of the most popular areas on the Marine Institute websites. A further development was the transition of the Phytoplankton IT systems onto the new HABs II platform. This has included a new interface at the microscopes that facilitates a touch screen for counting direct to database, photo documentation reviewing and publication of results. The next modules to be launched through the website will be a Decision Support Application, and Biotoxin Instrument Data Uploader. This will be followed by integration of the shellfish microbiology processes into the system.

## MEFS Data Quality Management System Improvements

As briefly summarised at the beginning of this report, the majority of MEFS data collection and management systems generated from MEFS core laboratory services are conformant with a rigorous Quality Management System. The MEFS quality management system's aspirations align with the Marine Institute's overall data strategy, but require an even more intensive application of systems to ensure that the accreditation of laboratory methods applied is maintained. As such, there is a constant effort to continue to improve data quality management in the service area, and 2018 was no different than past years in advancements that were put into action. The Marine Institute labs now have 34 Test Methods on the scope of accreditation by INAB and are also accredited for residues sampling in the field under ISO17025. Further opportunities to integrate Standard Operating Procedures (SOPs) and allow further efficiencies were also progressed in 2018 and MEFS now has 19 integrated Standard Operating Procedures (SOPs) in place. These efficiency improvements are particularly linked to Initiative 2 of Strategic Focus Area 1 of the Strategic Plan: Delivering Integrated Quality Services.

The implementation of the Paradigm 3 Electronic Document Management system also greatly advanced in 2018. With this software, only one system is required by staff to view documents and records for the management of analytical non-conformances, equipment records, audits, work requests, reference documents, approved product/service provider lists, and change control forms. In 2018, software and excel validation checks were added and are now entirely electronic, reflecting our continued push for efficiencies and integration throughout the service area. The approved product/service providers list was also introduced as an electronic addition to Paradigm 3. Finally, the procedure for complaints/feedback/queries from our customers is now electronic on the system and has resulted in a full paperless system.

In 2018, new ISO17025-2017 requirements were introduced that will require all accredited labs to conform to the new standard's requirements by 2020. In this light, an ISO 17025 Transition Team represented by an integrated team of scientists from each of the programme delivery units within MEFS was established and procedures were progressed such that MEFS will be able to transition over fully to the new standard by the next INAB audit in April 2019, well ahead of the 2020 deadline. In preparation, the quality manual has been rewritten, SOPs have been introduced or amended, and risk and improvement registers introduced to meet the new requirements.

In addition to these actions, an Integrated Risk Assessment template and guidelines for all MEFS test methods and procedures in the laboratory was drafted and introduced in November 2018. This allows MEFS to work off one template, all completed risk assessments will be maintained on Paradigm 3, and all staff will have access to all risk assessments. The Integrated Risk Assessment template and guidelines are a follow-on from the implementation of a paperless electronic system for all Safety Data Sheets introduced Marine Institute-wide in 2017. The paperless system now allows all staff to log in anytime or place and view SDS sheets. The above improvements made by the Quality System in 2018, which will continue in 2019, are in line with the objective of the strategy for further integration of our services across the Marine Institute.

## OCEAN SCIENCE AND INFORMATION SERVICES (OSIS)

#### Information Services and Development

The information services and development team develops and manages the ICT and data infrastructure across the Marine Institute to provide a robust operational platform for data and information services. The team also continues to develop new technical capabilities and support improvements in the Marine Institute's service delivery.

In 2018, the Institute progressed several strategic initiatives through the IT Strategy, the Data Strategy, and EMFF data integration in support of developing MSP and MSFD programmes, with these activities closely aligned with the Institute's new strategic plan.

These included work on the Irish Digital Ocean digital services platform which aims to make Ireland's marine digital assets more readily available for public services, research and innovation. In collaboration with operational science teams the Institute has developed new capabilities for marine environmental data processing and a cross-service area Data Management Quality Management Framework in line with international standards.

The information services and development team serviced over 3,000 internal support requests covering hardware, software and data management, and carried out a range of internal training. 2018 saw an increased focus on systems resilience, cyber-security and General Data Protection Regulation (GDPR) compliance, with a number of significant improvements to operational systems being implemented.

Operational programme support was delivered for Fisheries Data Collection, the INFOMAR and Marine Ocean Energy programmes, and the marine environment data processing and spatial analysis activities.

The Marine Institute data request service processed 175 manual data requests in 2018. The new Institute data catalogue was also launched in 2018, allowing the public to search for relevant available datasets at <a href="http://data.marine.ie">http://data.marine.ie</a>. Ongoing improvements to Marine Institute data accessibility ensure that more data is available online including through <a href="http://data.marine.ie">http://data.marine.ie</a>, <a href="http://data.marine.ie">http://data.marine.ie</a>, <a href="http://data.marine.ie">http://data.marine.ie</a>, and <a href="http://data.marine.ie">www.oceanenergyireland.ie</a>, and <a href="http://www.digitalocean.ie">www.digitalocean.ie</a>. These sites were visited by 54,000 users in 2018. Of particular note is the significant uplift in views of data buoy data for the months of October—December.

Major projects in 2018 included a rework of the Institute's server infrastructure to improve resilience and performance of the ICT systems which underpin the Institute's daily operations, in addition to significant work to improve to security of data and IT services.

The Institute has continued to develop new IT and data system capabilities for fish health management and biotoxins data processing, in addition to oceanographic and marine renewable energy data processing, analysis and publication capabilities.

2018 also saw the development of a new Data Management Quality Framework for scientific data processes. The new framework is aligned with the IOC's IODE quality management system and will support improved data quality and reuse. The team has also further developed the Irish Digital Ocean platform with new ways to access information including visualisation of predictive oceanographic model data and data from the INFOMAR seabed survey programme, enabling data reuse across new and developing programmes.

The team was also active in EU data-related research projects connected to the EMODnet and SeaDataCloud EU data networks, in addition to continued work on the COMPASS INTERREG project working to coordinate and improve data management and service capabilities with partners in Northern Ireland and Scotland.

#### Modelling

The range of modelling services provided by the Marine Institute expanded further and there has been an addition of three new modellers funded through EU activities in 2018. The Institute is active in an EU operational oceanographic service, the Copernicus Marine Environment Monitoring Service (CMEMS), and will provide validation and a scientific expertise for the development of biogeochemical numerical models of the Iberia-Biscay-Ireland region.

Other activities include provision of freely available regular ocean, wave and storm surge forecasts and hindcasts to a range of end-users. These datasets include three-dimensional currents, temperature, salinity and the sea surface height.

Tailor-made products were developed in 2018 and highlights include a weather window tool, an aquaculture site selection tool and a guideline on best practice on creating a weekly HAB bulletin published in the BP repository (<a href="https://www.oceanbestpractices.net/">https://www.oceanbestpractices.net/</a>), maintained by the International Oceanographic Data and Information Exchange (IODE) of the UNESCO-IOC.

EU-funded research projects gained momentum in 2018. Notably, the Institute further developed numerical modelling capacity funded by and in support of: tackling marine litter (CleanAtlantic, Interreg Atlantic Area), Marine Strategy Framework Directive implementation (iFADO, Interreg Atlantic Area), building coastal resilience (MyCOAST, Interreg Atlantic Area), management of Marine Protected Areas Networks (COMPASS, Interreg VA), Integrated Multi-trophic Aquaculture (TAPAS, H2O2O) and development of climate services for aquaculture industry (Co-Clime, JPI Climate ERA4CS).

In 2018, the Institute continued to work with local and national search and rescue operations. This included membership and continuous support for the Galway Bay inter-agency Search and Rescue initiative and provision of ongoing advice and expertise to An Garda Siochána to assist with ongoing investigations.

#### **Ocean Observations**

In 2018, the Institute was particularly active contributing to the development of a strategy for the decade ahead on Atlantic basin-scale ocean observing; a BluePrint Vision for an Integrated Atlantic Ocean Observing System in 2030. The Institute also contributed to a community white paper on "GO-SHIP: A platform for integrated multidisciplinary ocean science" and continued to be actively involved in the GO-SHIP Science Committee. The GO-SHIP SC provide scientific leadership and oversight for the development and implementation of the decadal global survey of hydrographic sections operated by national research institutions. In February, teams from the Institute and NUI Galway undertook the Annual South Rockall Trough Ocean Climate cruise aboard the RV Celtic Explorer.

OSIS continued involvement in the ICES Working Group on Oceanic Hydrography. An output from WGOH is the annual ICES Report on Ocean Climate (IROC) that summarises the most recent status and trends of ocean temperature and salinity, from ship based CTD standard sections, ocean data buoys and inshore long term monitoring stations, in the North Atlantic region.

The Institute was active in the H2020 AtlantOS project in 2018 with a number of reports published. Of particular relevance to funders is the cost and feasibility report on existing ocean observing networks in the Atlantic. The JPI Climate ERA4CS CoCliME research project, coordinated by the Marine Institute, continues a number of activities to codevelop user-driven Climate Services for the Irish seafood sector.

#### Oceanographic Services

The team further built on observing efforts through active membership of both the European Multidisciplinary Seafloor and Water Column (EMSO) and Euro-Argo European Research Infrastructure Consortia (ERICs). The Institute is Vice Chair of the Euro-Argo Management Board and the team successfully deployed three floats and have added capacity to Ireland's core Argo programme, by procuring Ireland's first ever Oxygen measuring Argo floats, which in addition to the biogeochemical float, offers the Irish research community new opportunities for data collection and analysis. A demonstration Argo float, together with the recently refurbished Glider, proved to be very popular exhibits during SeaFest 2018. Both the EMSO and Euro-Argo ERICs have also enabled the Marine Institute to leverage funding through the H2020 programme.

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#### **Advanced Mapping Services**

Advanced Mapping Services (AMS) provided survey coordination, operational, data, research and development, along with advisory support, both internally within the Marine Institute, and for industry, government and public stakeholders, in Ireland, and internationally.

The strategic approach developed by AMS for the DCCAE-funded INFOMAR offshore mapping has been further refined, with multi-year survey statistics underpinning annual operational survey targets towards mapping completion end 2026. Detailed collective Marine Institute and Geological Survey Ireland progress reporting is now published annually, capturing operational data, and valued-added INFOMAR activities. The 2018 AMS compiled report is undergoing final editorial and is due for publication Q1 2019

As part of INFOMAR's Value-Added Exploitation programme, the team coordinated and supported research, training, education, outreach and SME R&D activities. Development, delivery and launch of the new INFOMAR website was a key 2018 output. Numerous underlying data, product and web mapping services were developed in parallel. These refined, open and free outputs significantly

improve stakeholder access to seabed data and associated information, which is vital equally for management, conservation or development.

As part of the INFOMAR programme undertaken in partnership with Geological Survey Ireland, the Marine Institute's Advanced Mapping Services team and vessels RV *Celtic Explorer* and RV *Celtic Voyager* mapped over 7,685 km² of seabed in the Celtic Sea during 98 allocated vessel days in 2018. The Marine Institute's INFOMAR survey operations involved acquisition of 20,729 line kilometres of multibeam data, mapping of 18 shipwrecks, and collaborative acquisition of 359 seabed samples.

Operationally, mapping focused on survey activities offshore in the Celtic Sea, in what proved to be a complex dynamic oceanographic regime, leading to increased onboard QC requirement and post processing survey effort. 18 shipwrecks were surveyed and a large submarine channel complex was partially mapped, now visibly extending over 80km in length, and up to 3km wide.

In support of national habitat monitoring and fisheries management requirements, the mapping team coordinated the EMFF funded NPWS SeaRover ROV offshore reef habitat mapping project, targeting and investigating an extensive array of features along the shelf break and slope. The project brought together an integrated team to deliver the programme including the Marine Institute, NPWS, Geological Survey Ireland, NUIM, Plymouth University, AquaFact Ltd and the Commissioner of Irish Lights.

Routine INFOMAR groundtruthing was undertaken on Marine Institute vessels, with some samples also acquired on GSI's RV Keary. Opportunistic groundtruthing through collaboration with FEAS was facilitated during stock assessment surveys when time and staffing were available onboard. 359 sediment samples were acquired, and results will underpin multiple programmes and reporting requirements, including MSFD, Habitats Directive, MSP and OSPAR reporting, Sediment samples were collected, predominantly in the Celtic Sea, and Particle Size Analysis is ongoing.

Significant progress was made with chart production, with charts delivered for Lough Foyle and Waterford, six sets of coastal series charts generated and 12 seabed classification charts provided. All are available online through a click and download facility - <a href="https://www.infomar.ie/maps/downloadable-maps/charts">https://www.infomar.ie/maps/downloadable-maps/charts</a>. Several new web mapping viewers are now accessible on the front page of the INFOMAR website.

Sediment classification data are added to a new INFOMAR collated substrate layer which is available as an ArcGIS service, through INFOMAR web mapping viewers, and also through Digital Ocean and the Marine Atlas. These

data layers are essential for fisheries management, marine spatial planning, environmental assessment and reporting on EU directives.

Hydrographic data processing for 14 survey logs was completed, including all 2018 Institute acquired data, data collected during supported projects and four historical inshore datasets collected by GSI.

Significant international and Irish research collaboration continued, while also providing education, training and capacity build support (see Strategic Enabler 4 – Engagement and Education). Project work on the EMODnet Habitat project is ongoing, with a decision pending on a two year extension.

For a full brief of research vessels' operations during 2018, see Strategic Enabler 2 – Infrastructure.

### The Irish Marine Data Buoy Observation Network (IMDBON)

Since 2001, the Irish Weather Buoy Network has been generating hourly weather reports consisting of measurements of key near surface marine meteorological data: air temperature, humidity, atmospheric pressure, wind speed and direction also oceanographic data including sea surface temperature, wave height, and wave period. The extreme western synoptic M6 location is a sentinel European monitoring site.

The budget subhead for this programme of activity (renamed the Irish Marine Data Buoy Observation Network [IMDBON] to reflect a wider marine observing ambition) transferred from the Department of Transport, Tourism and Sport (DTTAS) to the Department of Agriculture, Food and the Marine (DAFM) in 2018 with an associated increase in the core operations and maintenance programme budget in 2018.

In recent years, the Marine Institute rolled out a series of modifications to the standard buoy platforms in use to improve reliability and as part of this, a long term research programme involving UK Met and a French company, Mobilis, resulted in what is one of the most advanced weather observing platforms currently available worldwide. The first of these went on test at the historical M1 site (50 nautical miles west of Galway) where the platform was determined as fit for purpose in 2018. During 2018, Marine Institute technical staff developed an advanced data collection system which is based on open source hardware and software solutions which is now ready to roll out from 2019 onwards.

In 2018, the last of the old generation ODAS (Ocean data acquisition platform) data buoys was placed on permanent exhibition at the Cromwell Point Lighthouse Visitors Centre

on Valentia Island, a fitting homage to these mighty devices that have given such solid service to mariners for two decades.

2018 also saw an increased role by the Marine Institute handling weather observations where incoming data collection and management are to be streamlined with the Marine Institute undertaking not only the acquisition of data to shore, but also its archive and dissemination, plus its formatting into the standard format for onward hourly transmission to EU Met. Services and beyond.

A significant SFI (Science Foundation Ireland) research infrastructure funding award in late 2018 will provide the means to complete the transfer to new technology, placing the network on a sound basis for many years to come. This work will include leveraging additional data acquisition of key climate variables, most notably carbon dioxide exchange across the air-sea boundary.

#### The Irish National Tide Gauge Network

Operated by the Marine Institute, the Irish National Tide Gauge Network (INTGN) provides monitoring of sea level around the Irish coast. As sea level relative to land level change is a key ECV (Essential Climate Variable) with regards to climate adaptation and coastal resilience, 2018 saw an increase in interest from universities who are looking to better understand historical observation and trends, this has extended to the formation of a distributed expert group with activities being led by NUI Maynooth.

2018 also saw the conclusion of efforts into completing a round of installations, increasing the permanent monitoring infrastructure to 22 managed nodes. Focus is being given to survey and calibration methodologies to bring all stations to within a certainty of better than 1cm. A major overhaul of the data handling base station in Galway moved all remote monitoring to true real time, with data being reported into the central base station every five minutes with a much greater level of reliability.

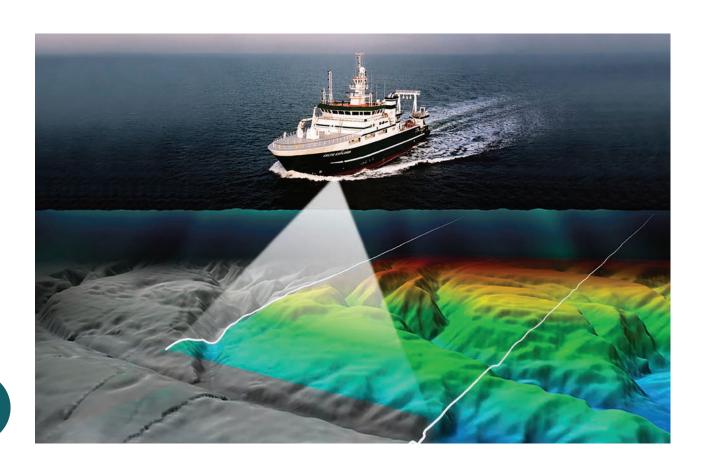
The long-term, ultra-high precision temperature data being collected at Ballycotton (east Cork) and the Portmore Pier (Malin Head) are now well established. These data continue to feed background climatological data into central archives of temperature, the fundamental climate change indicator. Ballycotton is a relatively new station, but in the case of Malin Head this work is building on a time series that started in the late 1950s when the importance of long term monitoring was recognised.

## FISHERIES ECOSYSTEMS ADVISORY SERVICES (FEAS)

FEAS worked on several Data & IT projects during 2018 – here are some of the significant projects and activities during the year:

- Led FEAS participation in the Data Management Quality Management Framework - the Marine Institute will be formally accredited by the IODE in February.
- 20 FEAS applications and their respective databases were supported and developed. 51 software releases were performed during year and 126 support calls were resolved.
- Heavily involved in the development of the new ICES Regional Database via three workshops, a number of Skype meetings, and the Steering Committee - this will become the source of commercial fisheries data for ICES assessment working groups in the coming years.
- Phase 1 of the cross services EMFF Informatics project (with colleagues from FEAS and IS&D) was completed with four applications live, along with knowledge transfer resources produced.

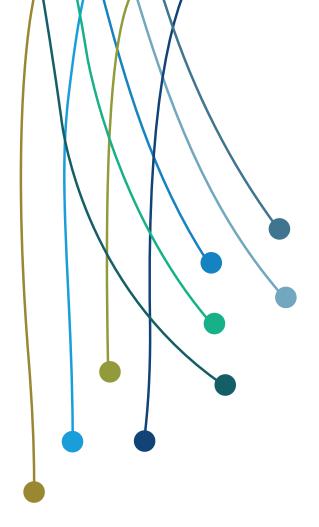
- Fulfilled data calls including FDI, RDB (Regional Database), WGCEPH (Working Group on Cephalopod Fisheries and Life History), and contributed towards fulfilment of WGBYC (Working Group on Bycatch of Protected Species), WGCSE (Working Group on Celtic Seas Ecoregion), WGMIXFISH (Working Group on Mixed Fisheries Advice), WGEF (Working Group on Elasmobranch Fishes) data calls.
- The Underwater TV Survey team successfully completed all planned surveys trialled a new high resolution imaging system which significantly improves our capacity to take advantage of new and emerging technologies to automate Nephrops burrow identification.
- The groundfish team completed the annual survey, procured and tested a new electronic measuring board system, and played a leading role in the ICES WKSEATEC (Workshop on Technical Development to Support Fisheries Data Collection) group which is developing technical solutions for the collection and quality assurance of fisheries data at sea and in ports.











# ENGAGEMENT AND EDUCATION

Harnessing Our Ocean Wealth calls for a strengthening of our maritime identity, increased awareness of the value, opportunities and societal benefit of our oceans, as well as raising engagement with the ocean.

The Institute's strategic initiatives in engagement and education are particularly focused on increasing awareness and participation, communicating science and ocean knowledge and, encouraging a new generation of ocean professionals who will become leaders and champions for the marine environment.

Through government-led initiatives such as SeaFest, Ireland's national maritime festival, and other outreach and educational activities, the Marine Institute works in partnership with government departments, other agencies and local organisations to promote our ocean wealth and increase ocean literacy amongst our citizens.

#### COMMUNICATIONS

Education and engagement with all of our stakeholders was a focus for the Communications team in 2018 as it began implementing the new strategy with the ambition of increasing awareness, participation and strengthening Marine Institute communications across all platforms.

The Marine Institute hosted and supported a number of events throughout the year including Our Ocean Wealth Summit and SeaFest 2018 - Ireland's national maritime festival — both of which were held in Galway this year. On behalf of the Government's Marine Coordination Group's implementation of Harnessing Our Ocean Wealth, the Marine Institute coordinated the SeaFest festival and led the communications.

SeaFest 2018 attracted 103.416 visitors over the weekend - the biggest visitor numbers for the festival to date. Local, national and international media coverage of the festival also reached record levels. Over €1.6 million in media coverage was secured - a 110% increase in media value on 2017. SeaFest 2018 generated 408 media clips, with an estimated audience reach of 16.5 million and included a full episode of RTÉ Nationwide. In addition, SeaFest was awarded the accolade of 'Best Cultural Event' at the national 2018 Event Industry Awards.

An important programme in encouraging a new generation of ocean professionals, the Marine Institute Explorers Education Programme delivered its marine themed modules to primary schools in Sligo, Donegal, Mayo, Galway, Clare, Kerry, Cork, Waterford, Dublin and Wicklow reaching up to 13,000

The outreach teams including Leave No Trace, Galway Atlantaquaria, Loop Head Summer Hedge School, Sea Synergy, Lifetime Lab, Oceanic Surf School and Marine Education Centre, and Marine Dimensions covered key topics including marine biodiversity, ocean literacy, and the impact of plastics on our ocean. In 2018, we ran a 'Science of the sea through sailing' pilot programme with selected Irish Sailing clubs and primary schools. The Explorers team worked with 500 teachers in schools as well as through teachers training workshops supported by the ATECI regional education centres in Galway, Kerry and Dublin, where teachers gained hands on experience of how to integrate marine into their

teaching practices. The Explorers team also worked with 200 pre-service teachers at Dublin City University highlighting how marine themes can be easily incorporated in the national curriculum.

The Marine Institute participated in a number of awareness events in 2018 including the Galway Science and Technology Festival Exhibition, and the Mayo Science and Technology Festival during November. An open day held in Newport research facility included over 400 members of the public and primary school students visiting the centre to learn about the research on wild salmon, climate, and aquaculture. The Marine Institute also continued to support the Sea Science – The Wild Atlantic interactive exhibit that focuses on the wonders of the marine world at Galway City Museum. New additions to the gallery included a cinematic experience that allows visitors to take the plunge with the Marine Institute's ROV Holland 1.

The Communications team manages the Marine Institute's online channels to maximise the reach of our messages and target key audiences. Our website (www.marine.ie) continues to be a key information source, where we published 136 news stories throughout 2018. We received over 162,158 unique visits with an increase of 11% in new visitors over 2017.

We continued to develop social media engagement on platforms such as Facebook, LinkedIn and Twitter with our content reaching over 50,000 people per week. In 2018, the Marine Institute was recognised for Best Facebook



Engagement of 173 public sector profiles in Ireland. The Scientists@Sea blog is an important communication tool for scientists to share their experience about the work they do on our research vessels. In 2018, the blog included 81 posts from 17 surveys.

In 2018, a video on the discovery of the rare shark nursery from a SeaRover survey, is now the most watched video on the Marine Institute YouTube Channel, with more than 192,000 views. Access to this video content enabled the news story to receive media coverage across Ireland, UK and the USA, and drive an international audience to our website and social media channels.

The Marine Institute complied fully with our policy in responding promptly to queries from Members of the Oireachtas.

#### LIBRARY SERVICES

The Oceanus Library supports staff in their research, by providing access to publications and maximising their research impact through Open Access and promotion.

The library also supports queries and visits from interested external members as well as training staff on self-archiving on our Open Access Repository (<a href="http://oar.marine.ie/">http://oar.marine.ie/</a>). The Open Access Repository provides free online access to over a thousand Marine Institute publications and had 13,350 visitors from every continent in 2018. The library is a member of the National Open Research Forum board whose mandate is to deliver an Irish agenda for open research.

The library continues to maintain close relationships with key organisations and collaborates with external libraries when opportunity arises. During 2018, the library undertook some GDPR responsibilities, coordinating and supporting the Institute's compliance with the new regulation.

See Appendices 4 & 5 for information on Marine Institute Publications and Scientific Paper and Publications in 2018.

## POLICY, INNOVATION AND RESEARCH SUPPORT (PIRS)

In 2018, PIRS continued to provide services to the Bureau of the Marine Coordination Group. This included supporting the annual Our Ocean Wealth Summit held in Galway as part of the SeaFest 2018 programme of events and the publication of the Harnessing Our Ocean Wealth (HOOW) Review of Progress 2017. Implementation of HOOW and integrated maritime policy in Ireland was also supported through hosting and maintaining a dedicated ouroceanwealth.ie website and social media platform.

## IRISH MARITIME DEVELOPMENT OFFICE (IMDO)

The Marine Institute's Strategic Plan identifies the importance of Education and Engagement to strategic success. Recognising this, and in pursuit of its mandate, the IMDO participates in a range of educational and outreach initiatives.

#### **ISEAS Programme**

The IMDO works with stakeholders in the maritime industry to promote training and education for seafarers. Through the ISEAS Programme, the IMDO funds the training of cadets in the National Maritime College of Ireland (NMCI). Under this programme, some of the most prestigious shipping companies in the world provide on-board training for Irish cadets. Over 80 cadets came through the ISEAS Programme in 2018 at a cost of €186K and graduated from the NMCI.

#### **Professional Education**

The IMDO sits on the Advisory Board of the National Maritime College of Ireland (NMCI) and works with other industry professionals on the Board to advance the ambitions of the College and to promote it nationally and internationally as a centre of excellence in maritime education. The IMDO sponsors the Chartered Institute of Shipbrokers, which provides professional training for shipbrokers and works with third level institutions to develop degree programmes in maritime law and commerce.

#### **Outreach Programmes**

In order to create awareness about opportunities and careers in the maritime sector, the IMDO engaged with transition year students who participated in the Marine Institute's Transition Year Programme. Our participation exposed students to the wide range of opportunities that exist in the shipping industry, the ports industry and various ancillary sectors. Shipping is a global industry and offers international opportunities for Irish maritime professionals, whose skills and qualifications are highly regarded.

## OCEAN SCIENCE AND INFORMATION SERVICES (OSIS)

#### Marine operations (research vessels)

Once again, it was a busy year on board the Marine Institute's research vessels *Celtic Explorer*, *Celtic Voyager* and ROV *Holland I*. A comprehensive summary of the research vessels' activities are documented in Strategic Enabler 2 – Infrastructure but below are captured the key engagement and education activities undertaken during the year:

- Surveys on the Celtic Explorer were undertaken in conjunction with third level institutions including UCD, UCC and NUI Galway
- Another highlight of the 2018 survey season was the Dublin Institute of Advanced Studies (DIAS) survey, referred to in short as 'SEA-SEIS-D'. One of the unique features of the survey was the hugely engaging educational element to the survey, including a seismometer naming competition which gained entries from schools all over the country and from as far away as Italy.
- In addition, the use of videoconferencing software allowed scientists aboard the RV Celtic Explorer to connect directly to 12 classrooms around the country for live questions and answers sessions. The Marine Institute's Explorers Education programme worked in tandem with the DIAS scientists also and visited several classrooms to raise awareness and understanding of seismology and the Real Map of Ireland. More than 200 primary schools have been able to learn about the SEA-SEIS-D survey and the science behind it.
- The *Celtic Explorer* docked in Galway for SeaFest 2018 and was open to visitors over the three day event. More than 9,000 people toured the vessel and found out more about its key operations.
- The 'Controls of Cold-Water Coral Habitats in Submarine Canyons II (CoCoHaCa2)' survey in late July involved the use of ROV Holland I. The team included scientists from different disciplines along with artist Carol Anne Connolly who was on board as part of the Galway 2020 'Aerial/Sparks' project.
- Survey time on the Celtic Voyager during the majority of February and March involved student training from Cork Harbour or Galway Bay, including National Maritime College of Ireland (NMCI) deck and engineering cadets. Other student training surveys aboard the Celtic Voyager included three SMART (Strategic Marine Alliance for Research and Training) surveys which involved collaboration with NUIG SEMRU, UCC MaREI and

the GMIT Observer programme. A geophysical survey, led by a team of scientists from Sligo IT, punctuated the student training period in late February. Survey operations included vibrocoring in Liverpool Bay and Cardigan Bay. Sediment samples were collected as the geologists aimed to reconstruct and simulate the palaeo-environments of the Irish Sea.

- The Celtic Voyager worked with NUI Maynooth on the continuation of its research in May 2018 on the 'MARA: Malin shelf sediment ReseArch' programme. A novel research survey on acoustic noise propagation was led by NUIG in May. Another survey led by NUI carried out a further investigation into the distribution of Dinophysis spp. in the eastern Celtic Sea.
- Several surveys in the autumn were operated in conjunction with scientists from UCC – one of these was a multidisciplinary approach to studying killer whale populations that associate with the Northeast Atlantic mackerel fishery.
- SMART Sea School had a busy November with five SMART training surveys taking place. The training included collaborations with NUI Maynooth, NUIG and UCC. The UCC Marine Biology Masters programme also chartered the Celtic Voyager for their annual two day training programme.

#### **Advanced Mapping Services**

AMS presented and exhibited at public awareness events, science fairs, community engagement events (Cuan Beo) and national and international trade shows and conferences, including a Keynote at the European Marine Educators Association conference in Newcastle.

There were 162 INFOMAR related articles covered by the media in 2018. Most coverage was online with 116 articles or news stories carrying INFOMAR. Additionally, there were 25 print articles, 11 radio segments and 10 TV appearances.

Onboard training was provided to undergraduate students, Transition Year training was delivered, and Scoilnet digital INFOMAR content was further developed and featured in opening the 2018 INFOMAR annual seminar.

### **GENERAL ADMINISTRATION**

#### **AUDIT RISK COMMITTEE**

#### Membership

During the year ended 31st December 2018, the Audit and Risk Committee (ARC) comprised the following non-executive members of the Board: Patricia Barker (Chairperson), Dermot Clohessy, Donal Kelly and David Owens.

#### Meetings

Eight meetings were held during 2018 and member attendance was as follows:

	Patricia Barker	Dermot Clohessy	Donal Kelly	David Owens
30th January	$\sqrt{}$	√	$\sqrt{}$	√
27th February	$\sqrt{}$	V		V
19th February	$\sqrt{}$	V		
20th April	$\sqrt{}$	√		√
26th June	$\sqrt{}$	V	$\sqrt{}$	√
25 <sup>th</sup> September	$\sqrt{}$	√		
30th October	√	√	√	√
4th December	V	√	V	V

<sup>\*</sup>The meeting of 19th February was a pre-audit planning meeting with the external auditors and did not require a quorum.

## The Role of the Audit and Risk Committee (ARC)

The role of the ARC is to oversee and advise the Board and the Chief Executive Officer on matters relating to:

- Financial, operating and governance risks, including overall risk management
- Effectiveness of the internal controls and risk management
- Effectiveness of internal audit function
- Communication with the Comptroller and Auditor General
- Matters raised by the Internal Auditor
- The adequacy of governance procedures, and
- Value for money issues

While audit and risk committees in general have a duty to appoint and monitor the work of, and receive reports from, the External Auditor, the Marine Institute is audited by the Comptroller and Auditor General (C&AG). The ARC does not, therefore, have a role in appointing the external auditor. However, one of the main duties of the ARC in exercising oversight of the relationship with the external auditor includes meeting with the Comptroller and Auditor in advance of the commencement of the audit and again following completion of the audit. It was not possible to have a post-audit meeting due to the C&AG's scheduling commitments but it was understood that there were no material matters of concern arising from the audit. The management letter had not been received by the ARC by the close of 2018 but will be dealt with in the 2019 work programme.

The Committee also monitored the integrity of the financial statements prepared by the Institute.

#### Areas identified for focus during 2018

In addition to completing the work related to the roles outlined above, the ARC focused on the following areas:

- Following the review of the Internal Audit
  effectiveness in 2017 and the agreement of the
  Board to increase the resources available for
  Internal Audit, the ARC considered in 2018 the
  options available in terms of employing a Marine
  Institute Internal Audit professional, using an
  outsourced facility or using a mix of both.
- It was the view of the ARC, approved by the Board, that the use of an outsourced professional service which has the capacity to understand the business of the Marine Institute and its portfolio of controls and risks is the most effective value for money. This would also allow for flexibility and nimbleness in the changing governance and business environment. This approach allowed for an expanded work programme during 2018.
- A review of the effectiveness of Internal Audit during 2018 concluded that there was a satisfactory output during the year with good assurance for the Board on the systems of control and management of risk and governance. Additionally, there were useful recommendations arising from the audits conducted which management has agreed to implement.

- There were some areas of learning relating to the need for better understanding of the role of the Internal Auditor amongst Marine Institute staff.
   This has been addressed by management during 2018.
- Appropriate planning and execution with regards to GDPR was undertaken. During the year, the ARC sought regular updates from the Director of Corporate Affairs on the steps being taken to plan and execute data protection policies, procedures and processes to meet the requirements of GDPR. A briefing session on the regulations was provided to the Board. The ARC tracked the changes in procedures including the training of staff. The Committee concluded that the operation had been executed meticulously and with due care given the fact that this was a significantly increased burden in this area. The ARC will continue to review compliance and to receive reports of any breaches.
- The ARC reviewed the financial statements for compliance with the Code of Practice for Guidance on Annual Financial Statements.
- During the year, the ARC met with members of the management team in order to receive briefings and have an opportunity to have all queries and suggestions discussed in relation to the following areas: Risk Management, Health and Safety, Procurement, Cyber Security and Data Protection.

- Additionally, ARC sought specific reports to assure the committee on the following areas: Prompt Payments, Electronic Contract Management Systems, State Agency Claims, Capital Expenditure, New PAYE System Compliance and Fraud, Corruption and Bribery.
- The ARC considered and offered recommendations on the following new or amended policies which were drafted, discussed and approved during 2018: Policy on Hospitality and Entertainment, Financial Approval Limits, Grant Funding Due Diligence Policy and Ethics Policy.

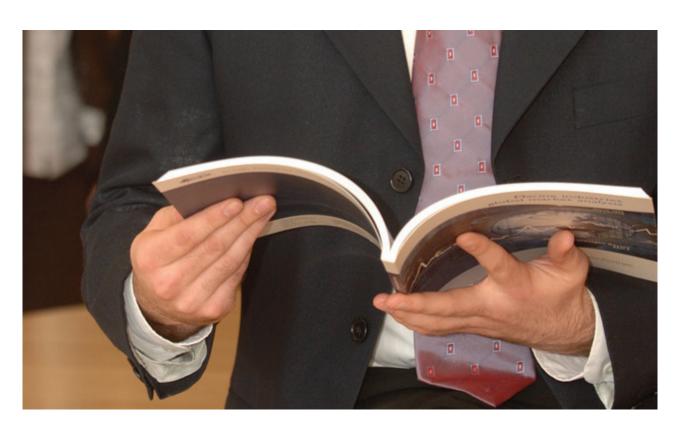
#### **Terms of Reference**

Terms of reference of the Audit and Risk Committee have been approved by the Board and are reviewed on an annual basis and amended as appropriate.

#### **Conflicts of Interest**

At each of its meetings, the ARC considers the possibility of conflicts of interest arising in relation to its agenda and such conflicts are dealt with in accordance with the Board's policy.

Having considered all relationships between the Marine Institute and the internal audit firm, the ARC does not consider that these relationships impair the auditor's judgement or independence.



#### RISK MANAGEMENT REPORT

The Board of the Marine Institute has established and maintains a robust risk management framework that supports the ongoing management of risk in accordance with the established risk appetite and corporate strategy. The risk framework addresses all the requirements of the Code of Practice for the Governance of State Bodies (2016) and is a practical process for the formal management of organisational risks.

The risk policy, which is reviewed annually by the Board, sets out the organisation's risk management objectives; the organisation's risk appetite; and the risk management framework which details the roles and responsibilities of staff and Board members, and the process for identifying, categorising and escalating risk.

### Marine Institute Risk Management Framework

A Risk Register is in place which identifies the key risks facing the Marine Institute and details the controls and actions needed to mitigate risks and assigns responsibilities for operation of controls to specific risk owners. The Risk Register is reviewed and updated by the joint Risk Officers quarterly, and reported to both the Audit and Risk Committee and the Board.

The Marine Institute confirms that it has carried out an assessment of the organisation's risks and the following principal risks were identified:

Reporting Templates and

Risk Management Reports

#### Marine Institute Risk Management Framework

#### THE BOARD · Approve the **Risk Management Policy** (including Code requirements) AUDIT AND RISK COMMITTEE Review risk reports and monitor effectiveness of MANAGEMENT TEAM (HEADED BY CEO) risk management Approve Risk Based Internal Audit Plan Provide guidance to Internal Audit Function focusing on key areas for review INTERNAL AUDIT **CHIEF RISK OFFICER** Carry out internal audits on a risk basis Provide assurance re adequacy of controls across specific risk areas (including risk management) **RISK AND ACTION OWNERS RISK MANAGEMENT TOOLS** Enterprise Risk Register Risk Management Policy (Appetite, Roles and Responsibilites, Skills, Competencies, Processes,

Comply with controls as stated in the Risk Register and report any control gaps/weaknesses

Risk	Mitigations
Maintaining the trust and confidence of the Department of Agriculture, Food and	Implementation of the Marine Institute's Strategy 2018-2022 Building Ocean Knowledge. Delivering Ocean Services;
the Marine (DAFM), other Government Departments and State Agencies, clients, key stakeholders, local communities, and	Implementation and reporting on an Oversight and Performance Delivery Agreement with DAFM;
the general public.	Service Level Agreements with State Agencies
Risk of failure or loss of significant infrastructure including vessels, facilities	Implementation of maintenance and safety policies and procedures, adhering to ISM codes for the vessels;
and equipment deployed at sea.	A Health, Safety, Environment, & Quality plan is in place. In the event of a total loss the high value items are covered by insurance;
	Training for seafarers including sea survival training;
	Business Contingency Plans are in place to access alternate research vessels and laboratories
Adequate security controls and	Implementation of ICT data and security policies and procedures;
procedures in place to protect against cyber-attacks and loss of functionality	Investment in training for staff and continuous updating of security defences;
and protection of data.	Implementation of IT disaster recovery plans for the Marine Institute as part of overall business continuity planning

#### **BOARD STRATEGY SUB-GROUP**

The Board Strategy Sub-Group, comprising of Lorcán Ó Cinnéide, Alan Dobson and Dermot Clohessy, was tasked with leading the development of the Marine Institute Strategic Plan, in conjunction with the senior management of the Institute.

An extensive programme of work led to the adoption by the Board of the Strategic Plan 2018-2022: Building Ocean Knowledge, Delivering Ocean Services.

#### LIAISON

The programme of the Marine Institute covers a wide range of activities that require close liaison and cooperation with many individuals and organisations. These include the Department of Agriculture, Food and the Marine; the Department of Finance; the Department of Housing, Planning and Local Government; the Department of Transport, Tourism and Sport as well as other governmental departments and State agencies, private enterprises and the higher education sector. The Institute acknowledges the continued support and cooperation of all concerned.

#### **HEALTH AND SAFETY**

In accordance with the Health and Safety and Welfare Act (2005), the Marine Institute has updated all Health and Safety Statements. The Institute continues to implement appropriate measures to protect the safety and health of all employees and visitors to its premises.

#### ETHICS AND PUBLIC OFFICE ACT

All persons holding a designated position within the Marine Institute complied with the requirements of the Public Office Commission in accordance with Sections 18 and 20 of the Ethics in Public Office Act, 1995.

#### **EMPLOYMENT EQUALITY**

The Marine Institute is committed to a policy of equal opportunity and adopts a proactive approach to equality. The Institute operates a number of schemes that provide staff with options in relation to meeting their career and personal needs such as job sharing, study leave and educational programmes.

## CODE OF PRACTICE (REPORTING)

The Marine Institute adheres to the statutory Codes of Practice for Governance of State Bodies as laid down by the Department of Finance. The Institute can confirm that Directors and employees have adopted and are trained on:

- Formal code of conduct on conflict of interest and customer charter
- Properly constituted audit committees
- Procurement procedures
- Sensitive issues

# ENERGY EFFICIENCY REPORTING BY PUBLIC SECTOR BODIES (S.I. 542 OF 2009)

The energy consumed by the Institute is divided into two main users: 70% by the research vessels *Celtic Explorer* and *Celtic Voyager* and 30% by buildings. The Institute has achieved an overall reduction of 27.3%, with a target of 33% reduction by 2020.

The Energy Strategy had previously concentrated on the HQ in Oranmore. However, 2018 saw a strong focus on Research Vessel operations and how energy could be reduced in this area. An independent audit was undertaken which identified behaviour and procedural changes along with retrofit opportunities to improve efficiencies and reduce the energy consumption of the RVs.

The Get Greener Energy team was once again very proactive in 2018. A Sustainability subgroup was established, reviewing and implementing suggestions given by staff. The Institute has signed up to the Pollinator Plan, reduced waste bins significantly throughout the HQ, implemented composting waste streams and continue to encourage effective recycling through education and knowledge transfer.

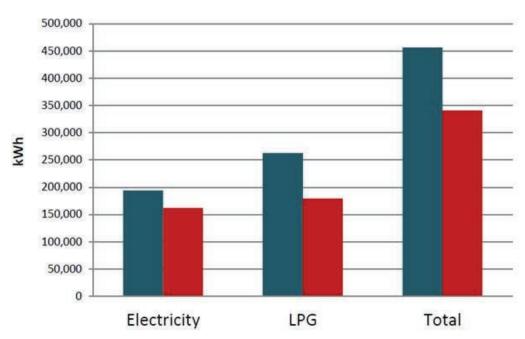
The team has also:

- Undertaken three out of hours office audits in Oranmore, three in Wilton Park House and one in Newport
- Undertaken the annual review of the Energy Strategy and Action Plan
- Engaged with Marine Institute Strategy group to include energy efficiency and sustainability in the new strategic plan
- Continued the "Switch off' campaign
- Held Sustainability Week in September 2018 and Energy Awareness Day in January
- Provided BMS Fume Cupboard controls to labs
- Installed Chemtrap filtration units in the lab

Achievements to date have seen a reduction of 27.3% in the overall energy consumed by the Institute from 2009 baseline (December 2018). The glide path shows we are on target to achieve the 33% reduction required by 2020.

The bar chart below shows the savings made in Oranmore HQ building only for 2018, and reflects the overall reduction we made between 2017-2018.

#### Annualised energy usage



<i>/</i>	_
	December 2017
	December 2018

Description	Electricity	LPG	TOTAL	
December 2017	193,947	262,419	456,365	
December 2018	161,730	179,099	340,828	
% Difference	-16.6%	-31.8%	-25.3%	

In 2018, the Marine Institute consumed:

- 2,494,721kWh of electricity
- 16,000 litres of kerosene
- 300,369 litres of LPG (purchased by volume)
- 10,528 litres of road diesel
- 1,743,499 litres of marine gasoil for Marine Institute funded research surveys

The Marine Institute was awarded certification from the Optimising Power @Work Scheme for achieving the benchmark 20%

The Marine Institute was awarded certification from the Optimising Power @Work Scheme for achieving the benchmark 20% reduction in overall energy consumption for the HQ in Oranmore.

#### **UPDATE OF SCÉIM GAEILGE 2018**

Grúpa Gaeilge was established to prepare the Marine Institute's Irish Language Scheme/Scéim Foras na Mara under Section 11 of the Official Languages Act 2003. The second period of the scheme was overseen by the Grúpa Gaeilge from 2015 to 2018 and the third phase is soon to commence. This builds on the extensive efforts to implement the requirements under the Act that were brought about under the first period following identification of areas for enhancement of Irish language services by the Institute.

Following the satisfactory review of the Irish Language Commissioners in 2017, Grúpa Gaeilge continued to implement the recommendations of the Commissioners during 2018 by updating Institute web pages and continuing with arrangements to celebrate Seachtain na Gaeilge in the Marine Institute.

Events included organisation of Irish language courses, an Irish morning in the canteens of the Marine Institute locations around the country, a blog in Irish from the Marine Institute Monkfish surveys, a series of translations on the Institute's intranet of many marine animal and plant names and the updating of the Marine Institute's Irish language handbook for staff as well as other web-based activities.

The second period of the Irish language scheme maintained the Marine Institute's commitment to continually assess the level of demand for services through Irish, and to ensure that the Institute continues to meet this demand in a planned, coherent and accessible way. Under the third scheme which is due to start imminently, the Marine Institute will continue to gauge the level of demand for its services in the Irish language by carrying out regular audits and review the level of queries and requests for services through Irish in a given period, documenting and promoting awareness among staff and clients as to which services the Institute should provide in Irish.



# **APPENDIX 1**

## MARINE RESEARCH PROGRAMME 2014 – 2020 SHIP-TIME PROGRAMME AWARDS 2018

Research Theme	Project Type	Project Reference	Project Title	Grantee/ Lead	Total Grant-
Ocean Literacy and Education	Dedicated Training Programme	CV18002/ CV18004	National Maritime College of Ireland Training  Training	National Maritime College of Ireland	€16,000
Ocean Literacy and Education	Dedicated Training Programme	CV18005	Undergraduate shipboard training in methods of oceanographic, benthic, megafauna and fisheries research	Galway- Mayo Institute of Technology	€56,000
Ocean Literacy and Education	Dedicated Training Programme	CV18006	SMART Science at Sea 2018	Galway- Mayo Institute of Technology	€16,000
Ocean Literacy and Education	Dedicated Training Programme	CV18008	SMART Observer Programme 2018	Galway- Mayo Institute of Technology	€32,000
Ocean Literacy and Education	Dedicated Training Programme	CV18009	SMART NUIG SEMRU 2018	Galway- Mayo Institute of Technology	€8,000
Ocean Literacy and Education	Dedicated Training Programme	CV18010	SMART MaREI Ocean Energy 2018	Galway- Mayo Institute of Technology	€8,000
Ocean Literacy and Education	Dedicated Training Programme	CV18024	NUIG Post-Graduate Training	NUI Galway	€32,000
Ocean Literacy and Education	Dedicated Training Programme	CV18025	SMART NUIG BSc EOS & MS 2018	Galway- Mayo Institute of Technology	€48,000
Ocean Literacy and Education	Dedicated Training Programme	CV18026	SMART UCC BSc Practical Offshoreence 2018 Offshore Marine Science 2018	Galway- Mayo Institute of Technology	€32,000

Research Theme	Project Type	Project Reference	Project Title	Grantee/ Lead	Total Grant- Aid
Ocean Literacy and Education	Dedicated Training Programme	CV18027 CV15028	SMART UCC MSc Offshore Experimental Geology 2018 Experimental Geology 2018	Galway- Mayo Institute of Technology	€48,000
Ocean Literacy and Education	Dedicated Training Programme	CV18028	Multidisciplinary Survey Planning  — A Peer Assisted  Learning exercise led by  postgraduates	Galway- Mayo Institute of Technology	€64,000
Ocean Literacy and Education	Dedicated Training Programme	CV18029	UCC MSc Marine Biology 2018	University College Cork	€24,000
Ocean Literacy and Education	Dedicated Training Programme	CV18032	SMART NUI Maynooth Post-Graduate Training	Galway- Mayo Institute of Technology	€16,000
Ocean Literacy and Education	Dedicated Training Programme	CE18014	URready40S	Irish Coast Guard	€54,000
Bioresources: Wild Resources	Integrated Research Survey	CV18012	Distribution of nephrops larvae and associated oceanographic conditions	NUI Galway	€112,000
Ocean Observation and Seabed Mapping	Integrated Research Survey	CV18016	MAlin shelf sediment ReseArch 2: MMARA2 MARA2	NUI Maynooth	€80,000
Integrated Policy: Planning and	Integrated Research	CV18019	Acoustic noise at the continental M margin margin	NUI Galway	€64,000
Biodiversity, Ecosystems & Food- webs	Integrated Research Survey	CV18020	DINO18 - Bloom dynamics of the harmful dinoflagellate Dinophysis on the continental shelf	NUI Galway	€56,000
Renewable Energy	Integrated Research Survey	CE18003	MRE-ROV Maiden Ops Integration and Trialling	University of Limerick	€108,000
Ocean Observation and Seabed Mapping	Integrated Research Survey	CE18008	Tectonic Ocean Spreading at the Charlie-Gibbs Fracture Zone (TOSCA)	University College Dublin	€639,000
Subsea Resources	Integrated Research Survey	CE18011	Controls of Cold-water coral Habitats in submarine Canyons II (CoCoHaCa2)	University College Cork	€336,000

Research Theme	Project Type	Project Reference	Project Title	Grantee/ Lead	Total Grant- Aid
Climate Change	Policy Support Survey	CV18001	Winter Environmental Survey of Irish Coastal Waters	Marine Institute	€104,000
Climate Change	Policy Support Survey	CE18001	Ocean Climate Section: South Rockall	Marine Institute	€234,000
Bioresources: Wild Resources	Policy Survey Survey	CE18004/ CE18006	Irish Anglerfish and Megrim Survey	Marine Institute	*€302,400
Bioresources: Wild Resources	Policy Support Survey	CE18010	WESPAS Survey (Boarfish Acoustic Survey)	Marine Institute	*€151,200
TOTAL					€2,640,600

**Note:** \* This represents the Marine Institute contribution of 40% (with 60% funded under EMFF - European Maritime and Fisheries Fund).



# MARINE RESEARCH PROGRAMME 2014 – 2020 FUNDED RESEARCH PROJECTS 2018

Research Theme	Project Type	Project Reference	Project Title	Grantee/ Lead	Total Grant- Aid
Renewable Energy	Industry- Led Award	IND/18/01	OWSC - Designing for Manufacture, Deployment, Operation, Maintenance and Decommissioning	Resolute Marine	€199,955
Renewable Energy	Industry- Led Award	IND/18/02	Floating Solar Hybrid Energy Project	SolarMarine Energy Ltd	€195,465
Renewable Energy	Industry- Led Award	IND/18/03	Eureka-SeaWind: A lighter, more more cost-effective solution for floating offshore wind	Marine Materials Ireland Ltd	€199,816
Advanced Technologies	Industry- Led Award	IND/18/10	The IDS Smart buoy Project	IDS Monitoring Ltd	€196,275
Advanced Technologies	Industry- Led Award	IND/18/12	Development of the next generation fisheries surveys using a "swarm" of Unmanned Surface Vessels	Xocean Limited	€199,739
Renewable Energy	Industry- Led Award	IND/18/13	1kW Inline Gator - aquaculture Application	Exceedence Ltd	€199,532
Bioresources: Aquaculture		IND/18/16	Aquamoor - reducing mooring loads on fish farms	Technology from Ideas Ltd	€199,960
Renewable Energy	Industry- Led Award	IND/18/17	Development of Micropile Technology for Subsea Environment	Subsea Micropiles Ltd	€199,902
Renewable Energy	Industry- Led Award	IND/18/18	A Morphodynamic Study of the Irish Sea	Gavin & Doherty Geosolutions Ltd	€199,957
Bioresources: Processing for food and other use	Industry- Led Award	IND/18/20	Development of marine functional food to support muscle health and healthy aging in older adults	Bio-marine Ingredients Ireland Ltd	€200,000
Engineering	Industry- Led Award	IND/18/21	Engineering Advanced Materials for Marine Energy and Aquaculture Applications	Ocean Energy Ltd	€195,565

Research Theme	Project Type	Project Reference	Project Title	Grantee/ Lead	Total Grant- Aid
Renewable Energy	Industry- Led Award	IND/18/22	Marine EcoPowa Project	w1Da Experience Ltd	€198,763
Bioresources: Processing for food and other use	Postgraduate Fellowship	CF/18/01/01	Cullen Fellowship (PhD): Next generation sequencing to determine the occurrence of Norovirus Genotypes	Cork Institute of Technology	€92,000
Bioresources: Aquaculture	Postgraduate Fellowship	CF/18/02/01	Cullen Fellowship (PhD): Vulnerability of life stages of marine calcifiers to changes in ocean chemistry	Trinity College Dublin	€96,000
Biodiversity, Ecosystems & Food-webs	Postgraduate Fellowship	CF/18/03/01	Cullen Fellowship (PhD): Culture optimisation, and bioactivity of selected toxic Irish microalgae	NUI Galway	€92,000
Biodiversity, Ecosystems & Food-webs	Postgraduate Fellowship	CF/18/04/01	Cullen Fellowship (PhD): Evaluate the disease status of velvet crab, brown crab, lobster and shrimp	Galway- Mayo Institute of Technology	€96,000
Integrated Policy: Socio Economics	Postgraduate Fellowship	CF/18/05/01	Cullen Fellowship (MSc): A regional and rural analysis of Ireland's Ocean and Coastal Economies	NUI Galway	€46,000
Climate Change	Project-Based Award	PBA/ CC/18/01	Oceans in a Changing Climate A4: Aigéin, Aeráid, agus Athrú Atlantaigh (Oceans, Climate, and Atlantic Change)	NUI Maynooth	€1,991,556
Advanced Technologies	Transnational Project	PBA/BIO/ 18/01	FLEXAQUA: Aquaculture operations with reliable flexible shielding Technologies	Trinity College Dublin	€185,000 Note A
Advanced Technologies	Transnational Project	PBA/BIO/ 18/02	FLEXAQUA: Aquaculture operations with reliable flexible shielding Technologies	University College Dublin	€156,000 Note A
Advanced Technologies	Transnational Project	PBA/AT/ 18/01	RoboVaaS: Robotic Vessels as-a Service	University of Limerick	€170,000 Note A
Advanced Technologies	Transnational Project	PBA/AT/ 18/02	RoboVaaS: Robotic Vessels as-a Service	SonarSim Ltd	€180,000 Note A
Ocean Observation and Seabed Mapping	SFI Investigators Programme (managed by SFI)	16/IA/4520 MI (N)	Integrating multidisciplinary geoscientific data into forecasting models to monitor and predict coastal change: Proof of concept in Dublin Bay	Dublin City University	€380,343 Note B
Climate Change	EPA Research Investigators Programme (managed by EPA)	2018-CCRP MS.56	Ireland's contribution to CMIP6 and High-Res Regional Climate Projections for Ireland	NUI Galway	€116,396 Note C

Research Theme	Project Type	Project Reference	Project Title	Grantee/ Lead	Total Grant- Aid
Climate Change	EPA Research Investigators Programme (managed by EPA)	2018-CCRP- MS.59	Achieving Resilience in the Marine and Coastal Environment of Ireland	University College Cork	€119,811 Note D
Climate Change	EPA Research Investigators Programme (managed by EPA)	2018-W- LS-19	Physico-chemical Cycling of Nutrients and Carbon in Marine Transitional Zones	NUI Galway	€250,000 Note D
Climate Change	Transnational Project (managed by EPA)	2018-NC- LS-3	Land2Sea: Integrated Modelling of Terrestrially Derived and Climatic Impacts on Freshwater and Marine Ecosystems	University College Dublin	€116,176 Note E
Climate Change	SEAI RD&D Investigators Programme (managed by SEAI)	RDD 268	CAO IRL Coupled Atmosphere Ocean Wave Forecasts for Ireland	NUI Galway	€80,598 Note F
Various	Networking and Travel Grants	NT/18/01 to NT/18/141	Hosting/Attending Marine Conferences, Workshops and Events	Various (111 awards granted in 2018)	€97,823
TOTAL					€6,650,632

#### Notes:

- A. Funded under the 2017 Call for Transnational Research Projects within the EU ERA-NET MarTERA (Maritime and Marine Technologies for a new Era). The Marine Institute is the national funder for Ireland under this call, which is cofunded by the European Commission.
- B. This represents the Marine Institute contribution to the project (one third), which is also funded by Science Foundation Ireland and Geological Survey Ireland.
- C. This represents the Marine Institute contribution to the project (one third), which is also funded by the Environmental Protection Agency and Met Éireann
- D. This represents the Marine Institute contribution to the project, which is jointly funded with the Environmental Protection Agency.
- E. This represents the Marine Institute contribution to the project. Project awarded under the 2017-18 Joint BiodivERsA-Belmont Forum Call on "Scenarios of Biodiversity and Ecosystem services", and is co-funded by the Environmental Protection Agency and the European Commission.
- F. This represents the Marine Institute contribution to the project, which is jointly funded with the Sustainable Energy Authority of Ireland.

## APPENDIX 3

### H2020 PROJECTS

#### **PROJECT TITLE:**

Circles - Controlling Microbiomes
Circulations For Better Food Systems

Innovation Action

ALMA MATER STUDIORUM - UNIVERSITA DI BOLOGNA (Coordinator)

MARINE INSTITUTE (Irish Partner)

Value to Marine Institute: €81.875

#### **Project Abstract:**

CIRCLES aims to discover and translate innovative microbiomes-tailored circular actions into concrete applications that will ultimately enhance EU food system performances and their overall sustainability. The setup of real-world labs in the field of 6 food systems relevant to the EU market – tomatoes, spinach, poultry, pigs, Atlantic salmon and seabream aquacultures – will, first, enable CIRCLES to increase knowledge on the importance of food system microbiomes as determinants of productivity, quality, safety and sustainability.

This discovery phase will nurture the design and implementation of food system-specific microbiomestailored circular actions. Relying on an integrative usage of different Smart Microbiome (SM)-modulators, circular actions aim to optimize the microbiomes of food systems, from farm to fork, for an overall improvement of food system performances. The effectiveness of actions will then be tested in the labs in the field. This real-world validation phase will allow CIRCLES to translate the project results into concrete products, applications, procedures and tools, ready to be exploited and communicated to penetrate the EU market. In particular, CIRCLES will conceptualize and create SM-food systems for the 6 CIRCLES food chains, defined as food systems with optimized microbiome configurations. CIRCLES will also provide innovative, newly defined SM-food products, as foods derived from the SM-food systems and certified by Microbiome Transparent (MT)-labels.

Finally, a vast panel of food system-specific SM-modulators will be provided as new agro-biotech applications to be integrated into circular actions to reach the status of SM-food system. In conclusion, the conceptualization, creation, and dissemination of SM-food systems, as well as all connected procedures, products, and tools, will allow CIRCLES to endow the EU food systems with new, cost-effective commercial applications for improved productivity, quality, safety and sustainability.

#### **PROJECT TITLE:**

SEABOAT - Sustainable Environmentally-friendly Advanced -Composite Zero-Emission Boats

SME-Phase 2

EIRECOMPOSITES TEORANTA (Coordinator)

W1DAEXPERIENCE LIMITED (Irish Partner)

Value to Eirecomposites: €1,321,250

Value to W1DA: €323,750

#### **Project Abstract:**

The SEABOAT concept will tackle inherent issues in the recreational boat manufacturing industry, with a particular focus on addressing outdated, inefficient, costly and environmentally inferior hull-manufacturing processes that will not meet new legislation. It will also address the demand by recreational boat users for improved performance and sustainability advantages, comparable to those delivered by electric cars. In response, SEABOAT will deliver significant positive impacts in terms of industry/ EU competitiveness, scalable company growth in revenue & jobs, and a wide array of performance & environmental benefits

This will be achieved by commercialisation of the Composite Powder Epoxy Technology (C-PET) manufacturing process within the recreational boat manufacturing segment and by introducing a revolutionary

E-Boat design incorporating the C-PET manufactured hull into the market, enabling the partners ÉireComposites (composites manufacturing technology expert) and W1Da (recreational boat OEM and electric-boat innovator) to achieve in excess of €45m combined cumulative revenue and 260 jobs from 2021-2023.

Originally conceived for aerospace/renewable energy applications, C-PET is a high-performing, cost-effective manufacturing technology that will lower the cost of boat hulls by 30%, eliminate toxic Volatile Organic Compounds & reduce hull weight by 45%. Reduced hull weight will allow extra batteries and enhance boat range/performance, so that for the first time ever, battery-powered boats will be able to compete with fuel-powered alternatives. C-PET will be demonstrated & tested in W1Da's advanced electric boat, reducing operational costs by 60% & delivering O emissions, with tangible benefits along the whole life-cycle.

SEABOAT will enable wider adaptation of electrical boats (replacing fuel powered engines), helping drive growth in the market for electric boats estimated to achieve global worth of \$20bn by 2027 and rejuvenate peripheral, coastal economies

#### PROJECT TITLE:

## e-ARISE - Euro-Argo Research Infrastructure Sustainability and Enhancement

Infrastructures – Research and Innovation Action

EURO-ARGO ERIC (coordinator)

Marine Institute (Irish Partner)

Value to Marine Institute: €134,720

### **Project Abstract:**

The core Argo system is based on an array of profiling floats which measure every 10 days temperature and salinity throughout the deep global oceans, down to 2000 meters, and deliver data both in real time for operational users and, after careful scientific quality control, for climate change research and monitoring. Argo data policy is fully open and guarantees a free access of the data to all interested users. A new phase of the Argo programme is now being implemented at international level. This new phase has two main objectives: 1/ sustain the existing global array and 2/ extend its capabilities to greater depths and to biogeochemistry. The present target is to maintain a network of at least 4000 floats, with ½ carrying biogeochemical parameters and ½ going to abyssal oceans.

There is more than ever a pressing need to better observe the oceans. This is recognised at the highest political levels (G7, IPCC and its Special Report on the ocean and cryosphere). Developing Argo and its extensions is, in particular, one of the top priorities of the G7 Future of Oceans. The overarching objective of Euro-Argo RISE (Euro-Argo Research Infrastructure Sustainability and Enhancement) is to enhance and extend the capabilities of the Argo network to provide essential ocean observations to answer new societal and scientific challenges. Euro-Argo RISE project is needed now to allow Europe to timely develop the European contribution to this new phase of Argo and engage with new teams. Euro-Argo RISE aims to secure and improve the current network as well as to set up and organise on the long term the new components of the network, extending Argo observations towards biogeochemistry, greater depth, partially ice-covered and shallower water regions within a long-term sustainability plan supported by Member States and funding agencies.

#### **PROJECT TITLE:**

Eurofleets+ - An alliance of European marine research infrastructure to meet the evolving needs of the research and industrial communities.

Research Infrastructures - RIA

MARINE INSTITUTE (coordinator)

VOYAGERIP INTERNATIONAL SERVICES LIMITED (Irish Partner)

Value to Marine Institute: €1,045,375

Value to Voyagerip: €28,500

## **Project Abstract:**

EurofleetsPlus will facilitate open access to an integrated and advanced research vessel fleet, designed to meet the evolving and challenging needs of the user community. European and international researchers from academia and industry will be able to apply for several access programmes, through a single-entry system. EurofleetsPlus will prioritise support for research on sustainable, clean and healthy oceans, linking with existing ocean observation infrastructures, and support innovation through working closely with industry.

The project will enable access to a unique fleet of 27 state-of-the-art research vessels from European and international partners. Through competitive calls,

researchers will be able to access the entire North Atlantic, Mediterranean, Black Sea, North Sea, Baltic Sea, Pacific Southern Ocean and Ross Sea. In addition to ship time, researchers will also have access to new Autonomous Underwater Vehicles and Remotely Operated Vehicles. A unique portable telepresence system will enable remote access by researchers and diverse end users including the public; a first for Europe. In addition to comprehensive transnational activities, the project will undertake joint research activities to meet the evolving challenges of marine research, in particular, deep ocean research and exploration, data management, and virtual access.

Multiple networking activities will ensure robust Call processes; wide stakeholder engagement; development of a strategic roadmap and long-term sustainability plan; diverse training and education activities; management of innovation; and widespread dissemination and communication. EurofleetsPlus will facilitate access to unique marine infrastructure, enabling excellent research, increasing ocean literacy, and providing a clear road map for the continued integration and advancement of the European research fleet.

## **PROJECT TITLE:**

CO-SUSTAIN - Collaborative Sustainable Innovation: co-designing governance approaches for a sustainable and innovative small-scale fishing industry in the Irish islands

Marie Sklodowska-Curie Actions - Individual Fellowship

Trinity College Dublin (Coordinator)

Value to TCD: €175,866

#### **Project Abstract:**

The aim of this Fellowship is to provide Dr Ruth Brennan with advanced interdisciplinary training and new skills and experience in order to enhance her innovative and creative potential, increase her knowledge base, expand her career possibilities and enable her to reach professional maturity commensurate with a leading researcher in Ireland and internationally. The researcher will be based at the Centre for Environmental Humanities (CEH), School of Histories and Humanities, Trinity College Dublin, working under the supervision of Professor Poul Holm.

Research training will be implemented through an interdisciplinary project to investigate whether, and how, the Irish small-scale fishing industry can develop

innovative fishing models that promote good governance, foster marine stewardship and contribute to climate change goals while meeting the need of fisheries-dependent coastal communities to flourish. The specific aim of the project is to co-design and test innovative governance approaches that address the needs of fisheries-dependent island communities and meet national and European marine planning and conservation objectives. The researcher is trained in marine social science, environmental governance and law. CEH expertise is focused on positioning the Environmental Humanities (including social science) as having a crucial role to play in understanding human motivation and behaviour in the face of the challenges of global environmental change.

The researcher's continued exposure to the CEH will provide her with advanced interdisciplinary training necessary for advancement of her career and project success. The resources of the host institution will facilitate the development of an Irish and international academic network, as well as career mentoring, and will firmly establish the researcher as a science-policy expert in addressing the societal challenge of sustainable and socially inclusive marine resource management while conserving the marine environment.

#### **PROJECT TITLE:**

## GAIN - Green Aquaculture Intensification in Europe

UNIVERSITA CA' FOSCARI VENEZIA (coordinator)

IBM IRELAND LIMITED (Irish Partner)

LONGLINE ENVIRONMENT LIMITED (Irish Partner)

Value to IBM: €599,000

Value to Longline: €580,000

## **Project Abstract:**

GAIN is designed to support the ecological intensification of aquaculture in the European Union (EU) and the European Economic Area (EEA), with the dual objectives of increasing production and competitiveness of the industry, while ensuring sustainability and compliance with EU regulations on food safety and environment. Eco-intensification of European aquaculture is a transdisciplinary challenge that requires the integration of scientific and technical innovations, new policies and economic instruments, as well as the mitigation of social constraints. Successful eco-intensification of aquaculture

will provide more and better aquatic products, more jobs, and improve trade balance by reducing imports.

GAIN, besides looking at innovative ways of integrating cultured species, will seek integration with other sectors, in order to promote the implementation of the principles of circular economy in Aquaculture. The GAIN Consortium includes a wide range of complementary expertise and a well blended mix of research institutes and industrial partners, which will ensure the achievement of the following specific objectives:

- i. Develop and optimize sustainable feeds, without increasing the pressure on land and fish stocks;
- ii. Add value to cultivation, by means of innovative processes, which turn both by-products and side-streams into valuable secondary materials, thus increasing profits and minimizing the environmental footprint;
- iii. Improve the management of finfish and shellfish farms, in terms of FCR, fish welfare and reduction of wastes, through the use of sensors, biomarkers, Big Data, IoT (Internet of Things) and predictive mathematical models;
- iv. Support integrated policies and address current barriers to the implementation of the principles of circular economy in aquatic production.

#### PROJECT TITLE:

IMPAQT - Intelligent management system for integrated multi-trophic aquaculture

Research and Innovation Action

MARINE INSTITUTE (Coordinator)

UNIVERSITY COLLEGE CORK (Irish partner)

Value for Marine Institute: €557,907

Value for UCC: €412.925

## **Project Abstract:**

The Integrated Multi-Trophic Aquaculture (IMTA) is acknowledged as a promising solution for the sustainable development of aquaculture. However, IMTA has been only tested at very small scale in Europe, while management of large-scale IMTA areas remains difficult.

The high level ambition of IMPAQT project is to drive a paradigm shift in the EU Industry and its, paving the way to both a more environmentally friendly and more efficient/higher yielding European Industry. To that respect, IMPAQT

proposes an intelligent management platform for IMTA. IMPAQT will develop and deploy novel sensors and data sources, together with smart systems required for long term autonomous monitoring in the field.

An advanced IMTA model will be provided which yields spatially explicit information on how the different farm components interact with the environment on the scale of an ecosystem and that can be used for planning decisions by both farmers and regulators. Last but not least, an integrated management system, operating at the scale of an IMTA farm and comprising analytics and decision support functionalities, will be developed to enable enhanced operational decisions for animal welfare, production optimization, environmental protection and food quality assessment.

IMPAQT systems and models will be validated in 6 pilots (Scotland, The Netherlands, Ireland, Turkey and China), addressing inland, coastal and offshore aquaculture. IMPAQT will demonstrate the eco-intensification of EU aquaculture, by demonstrating the eco-efficiency and the environmental impacts minimized, the socioeconomic benefits and ecosystem services enabled, as well as the transition towards a circular economy business model. IMPAQT brings together a considerable range of partners including 14 academic/research organizations, 4 SMEs and 3 large industries, all leaders in their respective fields/business, while aims to effectively transfer the project's results to relevant stakeholders through training activities.

#### **PROJECT TITLE:**

Hexafly Black Soldier Fly Protein and Oils for Fishfeed

SME Instrument – Phase 1

TOGGAM ENTERPRISES LIMITED (Coordinator)

Value to Irish Partner: €50,000

## **Project Abstract:**

Hexafly's innovative solution provides the proteins and oils needed for nutritious feed profiles through the bioconversion of agricultural waste with little or no nutritional value into a viable feedstock through the breeding of Black Soldier Fly larvae. These are then processed into a protein meal rich in amino acids, and a nutritious oil loaded with omega 3, 6 and 9, this oil has recently been verified as having a nearly identical profile to coconut oil. Within the very same process, the shells of the insects are separated from the insect proteins in order to increase

their digestibility, which is then converted into the valuable chitin commodity. Hexafly use their innovative Bio-Conversion technology to up-cycle low value vegetative waste from various industries converting it into high value sustainable natural commodities providing an environmentally friendly cleantech solution to many of the serious problems and issues facing the Animal Feed and Fertiliser Markets. Hexafly's insect based oils and protein provide a much more ecologically friendly feed source than fishmeal or soymeal, providing more nutritional value, and without requiring the use of any arable land. It is a highly sustainable procedure utilising bio-conversion of agricultural waste to produce a high quality source of nutrition with a minimum carbon footprint. Hexafly's innovative solution contributes to the green circular economy by reducing reliance on wild fish stocks, while promoting the sustainable growth of existing aquaculture to meet growing human consumption demands. In addition, its adoption will reduce reliance on soy which takes up excessive amounts of arable land, of which may be channelled instead to alternative crops or directed for human consumption. When compared to current market solutions Hexafly can deliver a 90% reduction in greenhouse emissions.

#### **PROJECT TITLE:**

AQUASENSE - Innovative Network for Training in wAter and Food QUality monitoring using Autonomous SENSors and IntelligEnt Data Gathering and Analysis

Marie Sklodowska-Curie Actions - Innovative Training Network

UNIVERSITY OF GLASGOW (Coordinator)

UNIVERSITY COLLEGE CORK (Irish Partner)

Value to Irish Partner: €549,368

## **Project Abstract**

The deterioration of water quality, caused by climatic/ seasonal changes, or industrial waste etc. is a major global concern. Over the last decade, water quality observing technology has risen to the challenge of scientists to identify and mitigate poor water quality by providing them with cost-effective tools that can take measurements of essential biogeochemical variables autonomously. Yet, despite these options becoming more readily available, there is a gap between the technology and the end-user (including the investigators and technicians that deploy these technologies) due to a collective lack of training, indepth knowledge, and skilled workers who can meet new and emerging challenges.

There is also a disconnect between data quality, data gathering by autonomous sensors and data analysis, which is a major obstacle, as the sensors are already being deployed (e.g. through buoys, boats etc.). AQUASENSE will address these challenges through 15 early stage researchers (ESRs), who will receive 540 person-month of unparalleled multidisciplinary training in the field of water quality monitoring. Each ESR will be mentored by carefully selected experts from academia and industry in 9 European countries (UK, Germany, Ireland, Serbia, Sweden, Italy, Poland. Austria. Estonia) and will have access to stateof-the-art equipment to develop autonomous sensors for improved data quality. The autonomous underwater robots and drones will be used to improve the data gathering and AI methods will be used to improve the data analysis. Hands-on project training will be supplemented with formal training courses in relevant fields such as new materials, sensors fabrication, wireless communication, system integration, and robotics, and a variety of complementary courses such as IPR, grant writing and exploiting the scientific results. Mobility within the network will ensure exposure to complementary academic and industrial research environments.



# **APPENDIX 4**

# CATIONS

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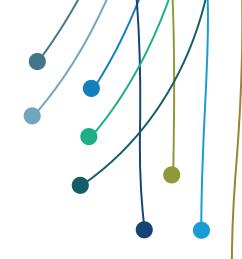
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# APPENDIX 5

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#### INTERNATIONAL COUNCIL FOR THE EXPLORATION OF THE SEAS (ICES) PUBLICATIONS

Key to ICES abbreviations:

CM Conference and Meeting Document

ACOM Advisory Committee
HQ Headquarters
SCICOM Science Committee

WGECO Working Group on Ecosystem Effects of Fishing Activities

WGMHM Working Group on Marine Habitat Mapping
WGOH Working Group on Oceanic Hydrography

WKMESO Workshop on Monitoring Technologies for the Mesopelagic Zone

WKSEATEC Workshop on Technical Development to Support Fisheries Data Collection

AORA. (2018). Working Group on the Ecosystem Approach to Ocean Health and Stressors. Mandates for Ecosystem-based

Ocean Governance across Canada, the EU, and the US March 2018. London, UK. 58 pp. (Contributing author: Margaret Rae)

González-Pola, C., Larsen, K. M. H., Fratantoni, P., Beszczynska-Möller, A., and Hughes, S. L. (Eds). (2018). ICES Report on Ocean Climate 2016. ICES Cooperative Research Report No. 339. 110 pp. https://doi.org/10.17895/ices.pub.4069 (Contributing author: Caroline Cusack)

González-Pola, C., Larsen, K. M. H., Fratantoni, P., and Beszczynska-Möller, A. (Eds). 2018. ICES Report on Ocean Climate 2017. ICES Cooperative Research Report No. 345. 119 pp. <a href="http://doi.org/10.17895/ices.pub.4625">http://doi.org/10.17895/ices.pub.4625</a> (Contributing authors: Caroline Cusack and Kieran Lyons)

ICES. (2018). Report of the Workshop on stakeholder input to, and parameterization of, ecosystem and foodweb models in the Irish Sea aimed at a holistic approach to the management of the main fish stocks (WKIrish4), 23–27 October 2017, Dún Laoghaire, Ireland. ICES CM 2017/ACOM:54. 35 pp. (Contributing authors: **Paul Bouch, Debbi Pedreschi** and **Dave Reid**)

ICES. (2018). Minutes of the Meeting of the Advisory Committee (ACOM), 28 November – 1 December 2017, ICES HQ, Copenhagen, Denmark. ICES CM 2017/ACOM:02. 41 pp. (Contributing author: **Maurice Clarke**)

ICES. (2018). Report of the Working group on Improving use of Survey Data for Assessment and Advice (WGISDAA) 11-13 July 2017. Copenhagen, Denmark. 38 pp. (Contributing author: **David Stokes**)

ICES. (2018). Interim Report of the Working Group on Oceanic Hydrography (WGOH), 21–23 March 2018, Norwich, UK. ICES CM 2018/EPDSG:08. 131 pp. (Contributing authors: **Caroline Cusack** and **Kieran Lyons**)

ICES. (2018). Report of the International Bottom Trawl Survey Working Group (IBTSWG), 19 - 23 March 2018, Oranmore, Ireland. ICES CM 2018/EOSG:01. 233 pp. (Contributing author: **David Stokes**)

ICES. (2018). Report of the Working Group on Acoustic and Egg Surveys for Sardine and Anchovy in ICES Areas 7, 8 and 9 (WGACEGG). 19-23 November. Nantes, France. ICES CM 2018/EOSG:03. 355pp. (Contributing author: **Ciaran O'Donnell**)

ICES. (2018). ICES Compilation of Microtags, Finclip and External Tag Releases 2017 by the Working Group on North Atlantic Salmon, 4–13 April 2018, Woods Hole, MA, USA. ICES CM 2018/ACOM:21. 28 pp. (Contributing authors: **Mary Dillane** and **Niall O'Maoiléidigh**)

ICES. (2018). Report of the Working Group on International Pelagic Surveys (WGIPS), 15–19 January 2018, Den Helder, the Netherlands. ICES CM 2018/EOSG:14. 340 pp. (Contributing authors: **Ciaran O'Donnell** and **Michael O'Malley**)

ICES. (2018). Report of the Workshop on egg staging, fecundity, and atresia in horse mackerel and mackerel (WKFATHOM2). 8-12 October and 19-23 November. Bremerhaven, Germany and IJmuiden, Netherlands. ICES CM 2018/EOSG:22. 74pp. (Contributing author: **Brendan O'Hea**)

ICES. (2018). Report of the Working Group on Beam Trawl Surveys (WGBEAM). Working Group on Beam Trawl Surveys (WGBEAM) 4-7 April 2017. Galway, Ireland. 121 pp. (Contributing author: **Hans Gerritsen**)

ICES. (2018). Report on the Working Group on Beam Trawl Surveys (WGBEAM). 10-13 April 2018. IJmuiden, Netherlands. ICES CM 2018/EOSG:05. 105 pp. (Contributing author: **Sara-Jane Moore**)

ICES. (2018). Workshop on Age reading of Horse Mackerel, Mediterranean Horse Mackerel and Blue Jack Mackerel (Trachurus trachurus, T. mediterraneus and T. picturatus) (WKARHOM3), 5–9 November 2018. Livorno, Italy. ICES CM 2018/EOSG:28. 186pp. (Contributing author: **Eugene Mullins**)

ICES. (2018). Report of the Joint EIFAAC/ICES/GFCM Working Group on Eels (WGEEL), 3–10 October 2017, Kavala, Greece. ICES CM 2017/ACOM:15. 99 pp. (Contributing author: **Russell Poole**)

ICES. (2018). Report of the Joint EIFAAC/ICES/GFCM Working Group on Eels (WGEEL), 5–12 September 2018, Gdańsk, Poland. ICES CM 2018/ACOM:15. 152 pp. (Contributing author: **Russell Poole**)

ICES. (2018). Report of the Working Group on Data Poor Diadromous Fish (WGDAM), 12–16 March 2018, ICES HQ, Copenhagen, Denmark. ICES CM 2018/EPDSG:20. 12 pp. (Contributing authors: **Niall O'Maoiléidigh** and **Russell Poole**)

ICES. (2018). Interim Report of the Working Group on Data Poor Diadromous Fish (WGDAM), 20 September 2017, Fort

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ICES. (2018). Working Group on Biological Parameters (WGBIOP), 1–5 October 2018. Ghent, Belgium. ICES CM 2018/EOSG:07. 186pp. (Contributing authors: **Gráinne Ní Chonchúir, Jonathan White, Claire Moore** and **Guillaume Bal**)

ICES. (2018). Workshop on scoping for benthic pressure layers D6C2 - from methods to operational data product (WKBEDPRES1), 24–26 October 2018, ICES HQ, Copenhagen, Denmark. ICES CM 2018/ACOM:59. 62 pp. (Contributing author: **Maurice Clarke**)

ICES. (2018). Report of the Scallop Assessment Working Group (WGScallop), 10–12 October 2018, York, UK. ICES CM 2018/EPDSG:13. 52 pp. (Contributing author: **Michael Sheridan**)

ICES. (2018). Report of the Workshop on new data model for the Regional Database (WKRDB-SPEC), 3 – 6 April 2018, ICES HQ, Copenhagen, Denmark. ICES CM 2018/ACOM:62, 55 pp. (Contributing author: **David Currie**)

ICES. (2018). Report of the Workshop on new data model for the Regional Database (WKRDB-MODEL), 15 – 18 January 2018, ICES HQ, Copenhagen, Denmark. ICES CM 2018/ACOM:41, 44 pp. (Contributing author: **David Currie**)

ICES. (2018). Report of the Working Group on Data Needs for Assessments and Advice (PGDATA), 7-10 February 2017, Nantes, France. ICES CM 2017/SSGIEOM: 03. 69 pp. (Contributing author: **David Currie**)

ICES. (2018). Report of the Planning Group on Data Needs for Assessments and Advice (PGDATA), 13 – 16 February 2018, Nantes, France. ICES CM 2018/EOSG:02. 77 pp. (Contributing author: **David Currie**)

ICES. (2018). Report of the Working Group on Mackerel and Horse Mackerel Egg Surveys (WGMEGS), 9 - 13 April 2018, Marine Institute, Dublin, Ireland. ICES CM 2018/EOSG:17 70 pp. (Contributing author: **Brendan O'Hea**)

ICES. (2018). Report of the Working Group on Commercial Catches (WGCATCH), 6-10 November 2017, Kavala, Greece. ICES CM 2017/SSGIEOM:09. 132 pp. (Contributing author: **Hans Gerritsen**)

ICES. (2018). Report of the Workshop on Monitoring Technologies for the Mesopelagic Zone (WKMESO). ICES WKMESO REPORT 2017 6-10 November 2017. Bergen, Norway. 28. pp. (Contributing authors: **David Reid** and **Ciaran O'Donnell**)

ICES. (2018). Report of the Workshop on Integration and Visualisation Technology of ICES Data (WKINVITED), 29-30 May 2018, ICES Headquarters, Copenhagen, Denmark. ICES CM 2018/SCICOM:03. 22 pp. (Contributing authors: **David Currie, Hans Gerritsen, Caoimhin Kelly, Shawna Sanfey, Dave Stokes** and **Deirdre Wall**)

ICES. 2018. Interim Report of the Benthos Ecology Working Group (BEWG), 14–18 May 2018, Banyuls-sur-mer, France. ICES CM 2018/EPDSG:03. 29 pp. (Contributing author: **Louise Healy**)

ICES. (2018). Report of the Data and Information Group (DIG), 30 May to 1 June 2018, ICES Headquarters, Copenhagen, Denmark. ICES CM 2018/SCICOM:02. 32 pp. (Contributing author: **David Currie**)

ICES. (2018). Report of the Workshop on Technical Development to Support Fisheries Data Collection (WKSEATEC). ICES WKSEATEC Report 2017, 12 - 14 September 2017. ICES HQ, Denmark. 81 pp. (Contributing authors: **David Stokes** and **David Currie**)

ICES. (2018). Report of the Workshop on DATRAS surveys in Greater North Sea and Celtic Sea (WKDATR-NSCS). 11–13 June 2018, Copenhagen, Denmark. ICES CM

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ICES. (2018). Minutes from the Meeting of the ICES Science Committee (SCICOM), 23 and 28 September 2018. ICES CM 2018/SCICOM:03. 41 pp. (Contributing author: **Francis O'Beirn**)

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ICES. (2018). Report of the Working Group on Pathology and Diseases of Marine Organisms (WGPDMO), 13-17 February 2018, Riga, Latvia. ICES CM 2018/ASG:01. 42 pp. (Contributing author: **Neil Ruane**)

ICES. (2018). Interim Report of the Working Group on SOCIAL indicators (WGSOCIAL). 25-29 June 2018. ICES Headquarters, Denmark. ICES CM 2018/IEASG:13. 19 pp. (Contributing author: **Debbi Pedreschi**)

ICES. (2018). Interim Report of the Working Group on Marine Habitat Mapping (WGMHM), 22–24 May 2018, Hamburg, Germany. ICES CM 2018/HAPISG:17. 8 pp. (Contributing author: **Fergal McGrath**)

ICES. (2018). Report of the Working Group on Marine Benthal and Renewable Energy Developments (WGMBRED), 6–9 March 2018, Galway, Ireland. ICES CM 2018/HAPISG:02. 66 pp. (Contributing author: **Francis O'Beirn**)

ICES. 2018. Report of the Workshop on extinction risk of MSFD biodiversity approach (WKDIVExtinct), 12–15 June 2018, ICES HQ, Copenhagen, Denmark. ICES CM 2018/ACOM:48. 43 pp. (Contributing author: **David Reid**)

ICES. (2018). Report of the Working Group on Ecosystem Effects of Fishing Activities (WGECO), 12–19 April 2018, San Pedro del Pinatar, Spain. ICES CM 2018/ACOM:27. 69 pp. (Contributing author: **David Reid**)

ICES. (2018). Report of the Working Group on Elasmobranch Fishes (WGEF), 19–28 June 2018, Lisbon, Portugal. ICES CM 2018/ACOM:16. 1306 pp. (Contributing Authors: **Graham Johnston** and **Maurice Clarke**)

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ICES. (2018). Report of the Benchmark Workshop on Anglerfish Stocks in the ICES Area (WKANGLER), 12–16 February 2018, Copenhagen, Denmark, 177pp. (Contributing Author, **Hans Gerritsen**)

ICES. (2018). Report of the Working Group for the Bay of Biscay and the Iberian Waters Ecoregion (WGBIE), 3–10 May 2018, Copenhagen, Denmark. 642 pp. (Contributing Authors, **Hans Gerritsen** and **Eoghan Kelly**)

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ICES. (2018). Report of the Working Group on Celtic Seas Ecoregion (WGCSE).9-18 May 2018, Copenhagen, Denmark.ICES CM 2018/ACOM:13.(Contributing authors: **David Stokes, Jennifer Doyle, S-J Moore, Jonathan White, Katie Thomas, Paul Coleman** and **Claire Moore**)

ICES. (2018). Interim Report of the Working Group on Nephrops Surveys (WGNEPS). WGNEPS 2017 Report 28 November - 1 December 2017. Heraklion, Greece. ICES CM 2017/SSGIEOM:19. 78 pp (Contributing author: **Jennifer Doyle**)

ICES. (2018). Report of the Working Group on Nephrops Surveys (WGNEPS). 6-8 November. Lorient, France. ICES CM 2018/EOSG:18. 226 pp. (Contributing authors: **Jennifer Doyle** and **Mikel Aristegui**)

ICES. (2018). Report of the Workshop on Nephrops Burrow Counting (WKNEPS). 2-5 October. Aberdeen, UK. ICES CM 2018/EOSG:25. 44 pp. (Contributing authors: **Jennifer Doyle, Mikel Aristegui, Sinéad O'Brien, Gráinne Ryan** and **Rose Butler**)

ICES. (2018). Interim Report of the ICES - IOC Working Group on Harmful Algal Bloom Dynamics (WGHABD), 24–28 April 2018, Tarragona, Spain. ICES CM 2018/EPDSG:11. 45 pp. (Contributing author: **Joe Silke**)

ICES. (2018). Report of the Working Group on Phytoplankton and Microbial Ecology (WGPME). 26-29 March 2018 Aberdeen, UK. ICES CM 2018/EPDSG:05. 15 pp. (Contributing author: **Rafael Salas**)

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ICES. (2018). Report of the Working Group on Spatial Fisheries Data (WGSFD). ICESWGSFDREPORT 2018 11-15 June 2018. Aberdeen, Scotland, the UK. ICES CM 2018/HAPISG:16 81 pp. (Contributing authors: **Yves Reecht**)

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Leocádio, A., Weetman, A., and Wieland, K. (Eds). 2018. Using UWTV surveys to assess and advise on Nephrops stocks. ICES Cooperative Research Report No. 340. 49 pp. <a href="http://doi.org/10.17895/ices.pub.4370">http://doi.org/10.17895/ices.pub.4370</a> (Contributing authors: Jennifer Doyle and Colm Lordan)

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# SCIENTIFIC, TECHNICAL AND ECONOMIC COMMITTEE FOR FISHERIES (STECF) PUBLICATIONS

Scientific, Technical and Economic Committee for Fisheries (STECF) (2018). Evaluation of Work Plans & Data Transmission failures (STECF-18-18). Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-79401-8, doi:10.2760/031311, JRC114724 (Contributing author: **Helen McCormick**)

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**Bailey, C., Duffy, C., & Silke, J.** (2018). Survey of Historical Irish Shellfish Samples for Tetrodotoxin (TTX). Poster presentation, International Conference on Harmful Algae, Nantes, France.

Bastardie, F., Rufener, MC., Nielsen, J.R., Maina, I., Kavadas, S., Vassilopoulou, V., ..., **Pedreschi, D., Reid, D.**, ... & Grati, F. (2018). Modelling spatial interactions among fish communities, fishers and other marine activities: comparing five European case-studies. Abstract from IIFET 2018, Seattle, United States.

Bresnan, E., Andersen, P., Anderson, D., Angles, S., Arin, L., Belin, C., Branco, M., ..., **Silke, J., ...,** & Enevoldsen, H. (2018). Regional changes in harmful algal events in the North Atlantic area over the last two decades documented using the HAEDAT database. 18<sup>th</sup> International Conference on Harmful Algae, Nantes, France.

**Burrell, S., Kilcoyne, J.** Tillman, U., & **Miles, C.O.** (2018). Stable isotopic labelling of AZA and OA-group toxins. Poster presentation, International Conference on Harmful Algae, Nantes, France.

**Bouch, P.J.** & **Reid, D.** (2018). Stock Assessment Models for data poor scenarios: A comparison of SPICT (Stochastic Surplus Production Model in Continuous Time) and CMSY (Catch-MSY). Presentation at American Fisheries Society Annual Conference, Atlantic City, New Jersey, USA and the ICES Annual Science Conference, Hamburg, Germany.

**Calderwood, J.** & **Reid, D**. (2018). Improving understanding of the influence of Ireland's monthly quota system on discarding behaviour and how such behaviour might change under the Landing Obligation. Presented at ICES Annual Science Conference, Hamburg, Germany.

**Calderwood, J.** & **Reid, D**. (2018). Equipping the Irish demersal fleet with appropriate tools and knowledge to extend fishing opportunities under the Landing Obligation. Presented at American Fisheries Society Annual Meeting, Atlantic City, USA.

**Calderwood, J.** & **Reid, D**. (2018). What can Ireland's monthly quota system on discarding behaviour tell us in light of the introduction of the Landing Obligation? Presented at American Fisheries Society Annual Meeting, Atlantic City, USA.

**Calderwood, J.** & **Reid, D**. (2018). Simulations showing how the use of discard hotspot maps could help reduce the economic impact of the landing obligation for Irish vessels. Presented at MARTEC18, Vigo, Spain.

Calvino, C. (2018). Coupled Ocean-Wave Models. Oral and poster presentation at the Cullen Fellowship Open Day, Galway, Ireland. (Supervisors: Dias, F., **Dabrowski, T.**)

**Clarke**, **D.** (2018). Real Time PCR methodologies as a routine monitoring tool for the detection of Pseudo-nitzschia, Azadinium & Alexandrium species in Irish waters. Oral presentation, Workshop on morpho-molecular methods for the study of dinoflagellate cysts, Cawthron Institute, Nelson, New Zealand.

**Clarke**, **D.**, **Salas**, **R.**, **Hynes**, **P.**, **McCarthy**, **A.**, & **Walsh**, **D.**. (2018). Molecular probes for the qPCR detection of ASP, DSP, PSP and AZP toxigenic producing phytoplankton in Irish waters. Oral presentation, International Conference on Harmful Algae, Nantes, France.

Clarke, D., Salas, R., Hynes, P., McCarthy, A., Walsh, D., Kelly, J., & Devilly, L. (2018). Validating and accrediting a real time PCR method for the detection of Azadinium spinosum for rapid routine monitoring. Poster presentation, International Conference on Harmful Algae, Nantes, France.

**Dabrowski, T., Cusack, C., Lyons, K., Silke, J.,** & O'Rourke, E. (2018). Societal benefits from observing and modelling systems –pilot actions in Ireland in the framework of the AtlantOS project. Operational Oceanography serving Sustainable Marine Development. In *Proceedings of the Eight EuroGOOS International Conference, 3-5 October 2017*, Bergen, Norway. E. Buch, V. Fernádez, D. Eparkhina, P. Gorringe and G. Nolan (Eds.). EuroGOOS. Brussels, Belgium. 2018. D / 2018 / 14.040 / 1

**Hegarty, A.** (2018). Ocean Observation Technologies. Oral and poster presentation at the Cullen Fellowship Open Day, Galway, Ireland. (Supervisors: **Westbrook, G.**, Toal, D., Omerdic, E.)

**Hegarty, A.** (2018). Ocean Observation Technologies. Oral presentation at the OFSRC & CRIS Annual Colloquium 2018, Limerick, Ireland. (Supervisors: **Westbrook, G.**, Toal, D., Omerdic, E.)

**Johnston, G.**, De Oliveira, J., Dobby, H., Ellis, J. & **Clarke, M**. (2018). Managing the recovery of spurdog. ICES CM 2018/K. Presented at the ICES Annual Science Conference, Hamburg, Germany.

**Kilcoyne, J.,** McCoy, A., **Burrell, S.,** Gaiani, G., **Salas**, **R**. & Tillmann, U. (2018). Effects of Light, Temperature and Nutrients on Growth and Toxin Production of *Azadinium spinosum*, *Prorocentrum lima*, and *Pseudonitzchia australis*. Oral presentation, Irish Algal Researchers conference, NUIG, Galway, Ireland.

**Kilcoyne, J.,** McCoy, A., **Burrell, S.,** Gaiani, G., **Salas,R**. & Tillmann, U. (2018). Effects of Light, Temperature and Nutrients on Growth and Toxin Production of *Azadinium spinosum*, *Prorocentrum lima*, and *Pseudonitzchia australis*. Oral presentation, International Conference on Harmful Algae, Nantes, France.

**Kelly, S.** (2018). Wind-forced upwelling, deep anoxia and dead eels in a coastal basin. Oral presentation at the 18th Biennial Conference of the Challenger Society for Marine Science, Newcastle, UK. (Supervisors: White, M., **Poole, R.**)

**Kelly, S.** (2018). Hydrographic maintenance of deep anoxia. Poster Presentation at NETLAKE/GLEON Meeting, Dundalk, Ireland. (Supervisors: White, M., **Poole, R.**)

**Kelly, S.** (2018). Marine and Freshwater Influences on Estuarine Physics, Oxygen Dynamics and Ecology. Oral and poster presentation at the Cullen Fellowship Open Day, Galway, Ireland. (Supervisors: White, M., **Poole, R.**)

**Kennedy, A.** (2018). Semantic Fisheries Data Integration and Analytics. Oral and poster presentation at the Cullen Fellowship Open Day, Galway, Ireland. (Supervisors: **Currie, D.**, Howley, E., Duggan, J.)

Mamoutos, I., **Dabrowski, T., Lyons, K.**, & McCoy, G. (2018). A two-way nested high resolution coastal simulation in a tidally dominated area: Preliminary results. Operational Oceanography serving Sustainable Marine Development. In *Proceedings of the Eight EuroGOOS International Conference, 3-5 October 2017*, Bergen, Norway. E. Buch, V. Fernández, D. Eparkhina, P. Gorringe and G. Nolan (Eds.). EuroGOOS. Brussels, Belgium. 2018. D / 2018 / 14.040 / 1.

**McCarthy, A., Clarke, D.,** McGirr, S., **Silke, J., Salas, R.** & **Hynes P.** (2018). Molecular detection of Azadinium spinosum in Irish waters. Poster presentation, International Conference on Harmful Algae, Nantes, France.

- **McCormick, H., Allsop, C., & Doyle, J.** (2018). NEMESYS: An electronic data collection application for on-board fisheries observers on the Irish *Nephrops* directed fishery. Presented at 9th International Fisheries Observer and Monitoring Conference, Vigo, Spain. In, Kennelly, S.J. & Borges, L. (eds.) (2018). *Proceedings of the 9th International Fisheries Observer and Monitoring Conference*, Vigo, Spain.
- **McGeady, R.** (2018). Distribution of *Nephrops* larvae in Irish waters. Oral and poster presentation at the Cullen Fellowship Open Day, Galway, Ireland. (Supervisors: Power, A. M. & **Lordan, C.**)
- McGirr, S. M., **Clarke, D., Kilcoyne**, **J.**,Koehler, H., **Silke**, **J.**, & Touzet, N. (2018). New insights into the diversity of Azadinium spp. and distribution of azaspiracids along the South and West coasts of Ireland. Oral presentation, International Conference on Harmful Algae, Nantes, France.
- **Miles, C.O.** Beach, D., Kerrin, E., McCarron, P., **Kilcoyne, J.**, Giddings, S., ... &. Løvberg, K.L.E. (2018). Boronate techniques for clean-up and concentration of diol-containing algal toxins. Oral presentation, International Conference on Harmful Algae, Nantes, France.
- **Moore, S-J,** (2018). Effective Communication with Observers. Presented at 9th International Fisheries Observer and Monitoring Conference, Vigo, Spain. In, Kennelly, S.J. & Borges, L. (eds.) (2018). *Proceedings of the 9th International Fisheries Observer and Monitoring Conference*, Vigo, Spain.
- **Pedreschi, D.,** Höffle, H., Kraak, S.B.M., Barkai, A., Farnsworth, K.D. & **Reid, D.G**. (2018). Co-design, Testing and Buy-In of Stakeholders for Real-time Incentive Fisheries Management. American Fisheries Society Annual Conference, Atlantic City, New Jersey, USA.
- **Pedreschi, D.,** Bouch, P., Moriarty, M., Nixon, E., Knights, A.M. & **Reid, D.G**. (2018). Interactive Visualisation of an Integrated Ecosystem Assessment in the Celtic Sea. American Fisheries Society Annual Conference, Atlantic City, New Jersey, USA.
- **Reid, D.G., Pedreschi, D.,** Bouch, P., Bentley, J., O'Donnell, F., Thorpe, R., Beggs, S., Schuchert, P. & Heymans, S. (2018). WKIRISH: Harnessing Fisher Knowledge. An Example of Positive Collaborative Research. American Fisheries Society Annual Conference, Atlantic City, New Jersey, USA.
- **Salas, R.,** Lefran, A., **Siemering, B. A., Cusack, C., Silke, J.** (2018). Pseudo-nitzschia biogeography combining qPCR analysis and oceanographic models to investigate long term trends of ASP toxicity. Oral presentation, International Conference on Harmful Algae, Nantes, France.
- Samdal, I. A., Van Nieuwenhove, I., Løvberg, K.L.E., **Kilcoyne, J.,** Wright, E.J., Sandvik, M., Uhlig, S. & **Miles, C.O.** (2018). Immunoaffinity columns for clean-up and concentration of algal toxins. Poster presentation, International Conference on Harmful Algae, Nantes, France.
- **Siemering, B. A.,** O'Rourke, E., **Cusack, C., Dabrowski, T.,** Garcia-Jove, M., **Silke, J.** (2018). Co-development for HAB climate services. Poster presentation, International Conference on Harmful Algae, Nantes, France.
- **Silke, J., Schmidt, W., Hastie, L.,** Maguire, J., Davidson, K., Henderson, R., Miller, P., ..., & Ferrer, L. (2018). Integrating various data products to predict risk and impact of HAB events on the Aquaculture Sector (PRIMROSE). Poster presentation, International Conference on Harmful Algae, Nantes, France. DOI: 10.13140/RG.2.2.29182.02886
- Sotillo, M.G., Cailleau, S., Aouf, L., Toledano, C., **Dabrowski, T.,** Rey, P., Aznar, R., ... **P. Bowyer, P.,** ..., &. Álvarez-Fanjul, E. (2018). Evolution of the IBI MFC Services along the CMEMS Phase I (2015-2018): Success stories and Future Challenges. Operational Oceanography serving Sustainable Marine Development. In *Proceedings of the Eight EuroGOOS International Conference, 3-5 October 2017*, Bergen, Norway. E. Buch, V. Fernández, D. Eparkhina, P. Gorringe and G. Nolan (Eds.). EuroGOOS. Brussels, Belgium. 2018. D / 2018 / 14.040 / 1.
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- Subrt, M., **Kilcoyne, J., Silke, J.,** Elliott, C. & Campbell, K. (2018). Detection of azaspiracids using an immunosensor. Poster presentation, International Conference on Harmful Algae, Nantes, France.
- Wietkamp, S., Tillmann, U., **Clarke**, **D.**, & Toebe. K. (2018). New real-time PCR assay for toxigenic Amphidoma languida. Poster presentation, International Conference on Harmful Algae, Nantes, France.

## **REPORTS**

Copernicus Marine Environment Monitoring Service (2018). Product User Manual For Atlantic -Iberian Biscay Irish- Biogeochemical Analysis and Forecast Product: IBI\_ANALYSIS\_FORECAST\_ BIO\_005\_004. <a href="http://marine.copernicus.eu/documents/PUM/CMEMS-IBI-PUM-005-004.pdf">http://marine.copernicus.eu/documents/PUM/CMEMS-IBI-PUM-005-004.pdf</a> (Contributing authors: Tomasz Dabrowski & Peter Bowyer)

Copernicus Marine Environment Monitoring Service (2018). Quality Information Document for Atlantic -Iberian Biscay Irish- IBI Production Centre IBI\_ANALYSIS\_FORECAST\_ BIO\_005\_004. <a href="http://marine.copernicus.eu/documents/QUID/CMEMS-IBI-QUID-005-004.pdf">http://marine.copernicus.eu/documents/QUID/CMEMS-IBI-QUID-005-004.pdf</a> (Contributing authors: Tomasz Dabrowski & Peter Bowyer)

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http://marine.copernicus.eu/documents/QUID/CMEMS-IBI-QUID-005-003.pdf (Contributing authors: Tomasz Dabrowski & Peter Bowyer)

International Phytoplankton Intercomparison (IPI). (2018). Proficiency testing in the abundance and composition of marine microalgae 2018 Report. (Contributing authors: **Rafael Salas**, **Debbie Walsh** and Jacob Larson)

**Leadbetter, A., Silke, J., & Cusack, C.** (2018). Creating a weekly Harmful Algal Bloom bulletin. Marine Institute, Galway, Ireland. <a href="http://hdl.handle.net/10793/1344">http://hdl.handle.net/10793/1344</a>

RCG NA (2018). Report of the Regional Coordination Group for the North Atlantic (RCG NA) Annual Meeting 2018. IEO, Vigo, Spain. (Contributing authors: **Andy Campbell, David Currie, Helen McCormick** & **Leonie O'Dowd**)

RCG NA (2018). Report of the 15th Liaison Meeting between the Chairs of RCGs, PGECON, STECF Meeting on EU-MAP, RDB Steering Groups, key end users (ICES, STECF, GFCM), JRC and the Commission. DG MARE, Brussels, Belgium 1 - 2 October 2018. (Contributing authors: **David Currie** & **Leonie O'Dowd**)

## **THESES**

**Dromgool-Regan, C**. (2018). Social Marketing in a Systems Setting: Examination of barriers and solutions to ocean literacy in Irish primary schools, MSc (Marketing) by Research. National University of Ireland, Galway.

**Thomas, K.** (2018). Scale Growth Analysis of Atlantic Salmon (*Salmo salar Linnaeus*) Unlocking Environmental Histories, PhD. Galway-Mayo Institute of Technology



Research Vessel: Celtic Explorer Start Date: 01/01/2018 End Date: 31/12/2018

No. of Surveys: 17

Survey Code	Survey Name	Start Date	End Date	Survey Days	No. of Scientists	Scientist Days
CE18002	BSH monitoring	29/01/2018	06/02/2018	9	10	90
CE18001	Ocean Climate Section - extended S Rockall Trough section	10/02/2018	18/02/2018	9	10	90
CE18004	Anglerfish and megrim trawl survey	19/02/2018	19/03/2018	29	11	319
CE18005	Blue whiting acoustic survey	20/03/2018	09/04/2018	21	11	231
CE18006	Anglerfish and megrim trawl survey	10/04/2018	21/04/2018	12	12	144
CE18007	INFOMAR Seabed Mapping	22/04/2018	13/05/2018	22	4	88
CE18008	Tectonic Ocean Spreading at the Charlie Gibbs Fracture Zone (TOSCA)	14/05/2018	08/06/2018	26	8	208
CE18009	WESPAS Leg 1	09/06/2018	28/06/2018	20	8	160
CE18010	WESPAS Leg 2	03/07/2018	24/07/2018	22	9	198
CE18011	Controls of Cold-Water Coral Habitats in Submarine Canyons II (CoCoHaCa2)	28/07/2018	10/08/2018	14	7	98
CE18012	Exploiting and conserving deep-sea genetic resources: SFI cruise II	11/08/2018	23/08/2018	13	6	78
CE18019	BSH Summer	28/08/2018	13/09/2018	17	12	204
CE18015	SEA-SEIS-D (Structure, Evolution And Seismic hazard of the Irish offshore: deployment of broadband, ocean-bottom seismometers)	17/09/2018	07/10/2018	21	9	189
CE18016	Celtic Sea Herring Acoustic Survey	08/10/2018	28/10/2018	21	15	315
CE18017	IGFS 2018	29/10/2018	08/11/2018	11	14	154
CE18018	IGFS 2018 Leg II_IV	09/11/2018	14/12/2018	36	15	540
CE18003	MRE-ROV Maiden Ops Integration and Trialling	15/12/2018	19/12/2018	5	5	25
Totals				308		3131

# Research Vessel: Celtic Voyager Start Date: 01/01/2018 End Date: 31/12/2018

No. of Surveys: 33

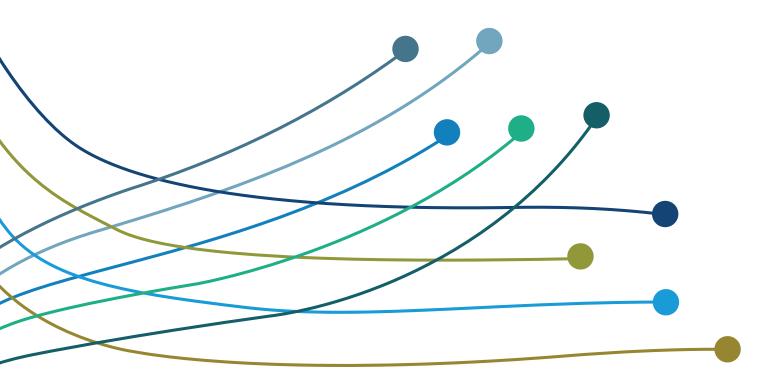
No. of Surv	eys. 33
Survey Code	Survey Name
CV18001	Winter Environmental Survey
CV18030	CV Trials
CV18002	NMCI - Shipboard familiarisation and training
CV18003	Irish Sea Palaeolandscape Investigation
CV18004	NMCI - Shipboard familiarisation and training
CV18005	Undergraduate shipboard training in methods of oceanographic, benthic, megafauna and fisheries research
CV18009	2018 SMART NUIG SEMRU
CV18010	2018 SMART UCC MaREI Ocean Energy
CV18008	SMART GMIT Observer Programme: Applied Marine Biological Sampling and Data Collection 2017
CV18031	UWTV Trials - March 2018
CV18012	Distribution of nephrops larvae and associated oceanographic conditions
CV18013	Langolf TV 2018
CV18016	MAlin shelf sediment ReseArch 2: MARA 2
CV18014	BLUEfish 3
CV18015	INFOMAR
CV18019	Acoustic noise at the continental margin
CV18017	Aran-Porcupine Nephrops UWTV
CV18018	Celtic Sea UWTV Survey 2016 Leg 1
CV18020	DINO18
CV18021	INFOMAR
CV18022	Celtic Sea UWTV Survey 2018 Leg 2
CV18023	INFOMAR
CV18024	NUIG Post-Graduate Training 2018
CV18028	Multidisciplinary Survey Planning â€" A Peer Assisted Learning exercise led by postgraduates
CV18034	AggreWind
CV18033	A multi-disciplinary survey to study offshore killer whales that associate with the Northeast Atlantic mackerel fishery
CV18032	SMART and NUI Maynooth Oceanography and Climate Change Training Survey.
CV18006	2018 SMART Science@Sea
CV18025	2018 SMART NUIG MS & EOS
CV18029	UCC MSc Marine Biology 2018 (Annual Request)
CV18026	2018 SMART UCC BSc Practical Offshore Marine Science
CV18027	2018 SMART UCC MSc Offshore Environmental Geology
CV18036	GOV Trials
Totals	

Start Date	End Date	Survey Days	No. of Scientists	Scientist Days	No. of Students	Student Days	Student Days & Scientists Days
27/01/2018	08/02/2018	13	6	78	0	0	78
09/02/2018	11/02/2018	3	6	18	0	0	18
19/02/2018	19/02/2018	1	2	2	12	12	14
20/02/2018	25/02/2018	6	5	30	0	0	30
26/02/2018	26/02/2018	1	2	2	12	12	14
03/03/2018	09/03/2018	4	6	24	14	56	80
12/03/2018	12/03/2018	1	4	4	12	12	16
13/03/2018	13/03/2018	1	3	3	12	12	15
20/03/2018	23/03/2018	4	5	20	12	48	68
26/03/2018	30/03/2018	5	9	45	0	0	45
03/04/2018	16/04/2018	14	2	28	0	0	28
19/04/2018	02/05/2018	14	10	140	0	0	140
06/05/2018	15/05/2018	10	6	60	0	0	60
17/05/2018	26/05/2018	10	6	60	0	0	60
27/05/2018	08/06/2018	13	4	52	0	0	52
09/06/2018	16/06/2018	8	6	48	0	0	48
18/06/2018	29/06/2018	12	6	72	0	0	72
02/07/2018	12/07/2018	11	6	66	0	0	66
13/07/2018	19/07/2018	7	6	42	0	0	42
20/07/2018	17/08/2018	29	4	116	0	0	116
18/08/2018	26/08/2018	9	6	54	0	0	54
27/08/2018	29/09/2018	34	4	136	0	0	136
04/10/2018	07/10/2018	4	4	16	8	32	48
09/10/2018	16/10/2018	8	2	16	11	88	104
17/10/2018	24/10/2018	8	2	16	4	32	48
25/10/2018	04/11/2018	11	4	44	3	33	77
05/11/2018	06/11/2018	2	4	8	12	24	32
07/11/2018	08/11/2018	2	3	6	12	24	30
09/11/2018	14/11/2018	6	4	24	12	72	96
15/11/2018	16/11/2018	2	2	4	10	20	24
18/11/2018	21/11/2018	4	4	16	12	48	64
22/11/2018	27/11/2018	6	3	18	12	72	90
11/12/2018	14/12/2018	4	5	20	0	0	20
		267		1288		597	1885

Research Vessel: ROV Holland 1
Start Date: 01/01/2018 End Date: 31/12/2018

No. of Surveys: 5

Survey Code	Survey Name	Start Date	End Date	Survey Days	No. of Scientists	Scientist Days
RH18002	MRE Trials	07/05/2018	12/05/2018	6	8	48
CE18008	Tectonic Ocean Spreading at the Charlie Gibbs Fracture Zone (TOSCA)	14/05/2018	08/06/2018	26	13	338
RH18001	SeaRover 2	02/07/2018	22/07/2018	21	6	126
CE18011	Controls of Cold-Water Coral Habitats in Submarine Canyons II (CoCoHaCa2)	28/07/2018	10/08/2018	14	13	182
CE18012	Exploiting and conserving deep-sea genetic resources: SFI cruise II	11/08/2018	23/08/2018	13	13	169
Totals				80	53	863



# APPENDIX 7

# FOREIGN MARINE SCIENTIFIC RESEARCH ACTIVITIES IN IRISH WATERS IN 2018

# FOREIGN VESSEL OBSERVER SCHEME 2018

29 foreign vessels conducted marine research surveys in Irish waters in 2018. The Northern Irish RV *Corystes* which has blanket approval to operate in Irish waters accounted for 5 of these surveys. Of the remaining 24 surveys, 13 were UK vessels and the rest were French (1), Norwegian

(2), Spanish (2), Dutch (2), German (3) and Belgian (1). The Marine Institute placed a total of 12 Irish observers, mostly recent marine science graduates, on foreign vessel surveys in 2018 with a total of 175 days at sea between them.

Scientist Days Ireland	Scientist Days Foreign
5016	2900

Country	Vessel Name	Survey Name /Code	Discipline	No. of Days in Irish waters	No. of Scientists	Scientist Days
UK	Cefas Endeavour	Groundfish survey using commercially based survey standardised otter trawl.	Fisheries	8	15	120
UK	Scotia *	Bottom Trawl Survey Targeting Juvenile Gadoid Species	Fisheries	6	10	60
Netherlands	Tridens *	International Blue Whiting Survey	Fisheries	8	6	48
UK	Cefas Endeavour *	Groundfish survey using 4m beam trawls - part of internationally coordinated WGBEAM survey	Fisheries	10	15	150
Spain	Miguel Oliver	Blue Whiting Acoustic Survey	Fisheries	7	19	133
UK	Sparkling Sea	Estimate the distribution, abundance and population structure of Cod, Haddock & Whiting in the Irish Sea	Fisheries	3	3	9
Norway	Kings Bay *	Blue Whiting Acoustic Survey	Fisheries	6	7	42
UK	Scotia	Trawl survey to estimate the abundance and distribution for anglerfish	Fisheries	10	10	100
Germany	Maria S Merian	To obtain continuous time series of the variability of the North Atlantic Current	Physical Oceanography	5	23	115
Netherlands	Pelagia *	The unknown role of Submarine Canyons - pathways or sinks for Organic Carbon	Oceanography, Marine Biology	7	14	98
Norway	Fiskebas *	Tagging and biological sampling of mackerel	Fisheries	10	6	60

Country	Vessel Name	Survey Name /Code	Discipline	No. of Days in Irish waters	No. of Scientists	Scientist Days
UK	Prince Madog	Bluefish Survey - assessment & management of scallop stocks and fisheries	Fisheries, Marine Biology	3	8	24
UK	James Cook *	Biogeochemistry and Ecosystems Research at the PAP Sustained Observatory	Oceanography	5	23	115
Belgium	Belgica	GOLLUM - Seismic Tsunami investigations.	Geology/ Geophysics	10	10	100
UK	James Cook *	Habitat Mapping around Haig Fras and Whittard Canyon	Geology/Marine Biology	15	20	300
Germany	Heincke	AZAHAB	Oceanography	12	12	144
UK	Prince Madog	Bluefish Survey - assessment & management of scallop stocks and fisheries	Fisheries	7	8	56
UK	MSR Endeavour *	4m Beam-trawl Groundfish survey	Fisheries	10	7	70
Spain	Vizconde de Eza * *	Abundance Estimations & Distribution Patterns of Demersal-Benthic Species	Fisheries	13	15	195
UK	Scotia	Bottom Trawl Survey Targeting Juvenile Gadoid Species	Fisheries	11	12	132
France	Thalassa *	Evhoe 18 - French Bottom Trawl Surveys	Fisheries	10	25	250
UK	Scotia	Demersal Trawl survey to assess pre-recruit year class strengths of cod, haddock whiting, Norway pout, mackerel and herring.	Fisheries	6	8	48
Germany	Walther Herwig III *	Investigations on fish diseases and biological effects of contaminants	Fisheries, Pollution	6	12	72
UK	Corystes	Various	Various	27	17	459
Totals				215	305	2900

<sup>\*</sup>Irish observers participated in these surveys.

## **GLOSSARY OF ABBREVIATIONS**

AMS Advanced Mapping Services
AORA Atlantic Ocean Research Alliance

ARC Aquaculture Research Committee AND Audit Risk Committee

ARGO floats Temperature/salinity profiling floats

ASP Amnesic shellfish poisoning

BA Bachelor of Arts

BIM Bord lascaigh Mhara (the Irish Sea Fisheries Board)

BSc Bachelor of Science

CEFAS Centre for Environment, Fisheries and Aquaculture (UK)

CEO Chief Executive Officer

CTD Conductivity, Temperature and Death

DAFM Department of Agriculture, Food and the Marine

DCCAE Department of Communications, Climate Action and Environment

DCMAP Data Collection Multiannual Programme

DCU Dublin City University

DHPLG Department of Housing, Planning and Local Government

DIT Dublin Institute of Technology
DSP Diarrhetic Shellfish Poisoning

DTTAS Department of Transport, Tourism and Sport

EEZ European Economic Zone

El Enterprise Ireland

EMFF European Maritime and Fisheries Fund
EPA Environmental Protection Agency

EU European Union

EurOcean European Centre for Information on Marine Science and Technology

FEAS Fisheries Ecosystems and Advisory Services

FIRM Food Industry Research Measure
FP7 Seventh Framework Programme
FSAI Food Safety Authority of Ireland
FSS Fisheries Science Services
GIS Geographic Information System

GDP Gross Domestic Product

GDPR General Data Protection Regulation
GMIT Galway-Mayo Institute of Technology

GSI Geological Survey of Ireland
HABS Harmful Algal Blooms Service
HEI Higher Education Institutions

HR Human Resources

IBM International Business Machines Corporation
ICES International Council for the Exploration of the Sea

ICT Information Communications Technology

IDA Industrial Development Authority

IFREMER Institut français de recherché pour l'exploration de la mer (French Research

Institute for the Exploration of the Sea)

IFSRP Irish Fisheries Research Science Partnership
IHO International Hydrographic Organisation

IMDBON Irish Marine Data Buoy Observation Network

IMDO Irish Maritime Development Office

INFOMAR Integrated Mapping for the Sustainable Development

of Ireland's Marine Resource

INTERREG EU Inter-Regional Cooperation Programme

INTGN Irish National Tide Gauge Network

IOC Intergovernmental Oceanographic Commission

IODE International Oceanographic Data and Information Exchange
MaREI Research Centre for Marine and Renewable Energy Ireland

MEFS Marine Environment and Food Safety Services

MSc Master of Science

MSFD Marine Strategy Framework Directive

MSP Marine Spatial Planning
MSY Maximum Sustainable Yield

NASCO North Atlantic Salmon Conservation Organisation

NDP National Development ProgrammeNMCI National Maritime College of Ireland, CorkNMPF National Marine Planning Framework

NOAA National Oceanic and Atmospheric Administration

NPWS National Parks and Wildlife Service

NUI Galway National University of Ireland, Galway

NUI Maynooth National University of Ireland, Maynooth

OAR Open Access Repository

OIE Office International des Epizooties (World Organisation for Animal Health)

OSPAR Oslo and Paris Convention (1992)
OSIS Ocean Science and Information Services

PIRS Policy, Innovation and Research Support Services

PhD Doctor of Philosophy

PSP Paralytic Shellfish Poisoning
QUB Queen's University Belfast
R&D Research and Development
R&I Research and Innovation
ROV Remotely Operated Vehicle

RV Research Vessel

SEAI Sustainable Energy Authority of Ireland SEMRU Socio-Economic Marine Research Unit

SFI Science Foundation Ireland
SFPA Sea Fishers Protection Authority
SMEs Small to Medium Sized Enterprises

UCC University College Cork
UCD University College Dublin

UK United Kingdom

USA United States of America
UU University of Ulster

VIVALDI Preventing and mitigating farmed bivalve diseases

# FINANCIAL STATEMENTS

FOR THE YEAR ENDED 31 DECEMBER 2018



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# ARD REACHTAIRE CUNTAS AGUS CISTE COMPTROLLER AND AUDITOR GENERAL

# Report for presentation to the Houses of the Oireachtas Marine Institute

## Opinion on the financial statements

I have audited the financial statements of the Marine Institute for the year ended 31 December 2018 as required under the provisions of section 12 of the Marine Institute Act 1991. The financial statements comprise

- the statement of income and expendit ure and retained revenue reserves
- the statement of comprehensive income
- the statement of financial position
- the statement of cash flows and
- the related notes, including a summary of significant accounting policies.

In my opinion, the financial statements give a true and fair view of the assets, liabilities and financial position of the Marine Institute at 31 December 2018 and of its income and expenditure for 2018 in accordance with Financial Reporting Standard (FRS) 102- The Financial Reporting Standard applicable in the UK and the Republic of Ireland.

### **Basis of opinion**

I conducted my audit of the financia I statements in accordance with the International Standards on Auditing (ISAs) as promulgated by the Internationa I Organisation of Supreme Audit Institutions. My responsibilities under those standards are described in the appendix to this report. I am independent of the Marine Institute and have fulfilled my other ethical responsibilities in accordance with the standards.

I believe that the audit evidence I have obtained is sufficient and appropriate to provide a basis for my opinion.

## Report on information other than the financial statements, and on other matters

The Marine Institute has presented certain other information together with the financial statements. This comprises the annual report, the governance statement and Board members' report and the statement on internal control. My responsibilities to report in relation to such information, and on certain other matters upon which I report by exception, are described in the appendix to this report.

I have nothing to report in that regard.

**Andrew Harkness** 

For and on behalf of the Comptroller and Auditor General

9 December 2019

## Appendix to the report

## Responsibilities of Board members

As detailed in the governance statement and Board members' report, the Board members are responsible for

- the preparation of financial statements in the form prescribed under section 12 of the Marine Institute Act 1991
- ensuring that the financial statements give a true and fair view in accordance with FRS 102 ensuring the regularity of transactions
- assessing whether the use of the going concern basis of accounting is appropriate, and
- such internal control as they determine is necessary to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error.

## Responsibilities of the Comptroller and Auditor General

I am required under section 12 of the Marine Institute Act 1991 to audit the financial statements of the Marine Institute and to report thereon to the Houses of the Oireachtas.

My objective in carrying out the audit is to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement due to fraud or error. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with the ISAs will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of these financial statements.

As part of an audit in accordance with the ISAs, I exercise professional judgment and maintain professional scepticism throughout the audit. In doing so,

- I identify and assess the risks of material misstatement
  of the financial statements whether due to fraud or error;
  design and perform audit procedures responsive to those
  risks; and obtain audit evidence that is sufficient and
  appropriate to provide a basis for my opinion. The risk
  of not detecting a material misstatement resulting from
  fraud is higher than for one resulting from error, as fraud
  may involve collusion, forgery, intentional omissions,
  misrepresentations, or the override of internal control.
- I obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the internal controls.
- I evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures.

- I conclude on the appropriateness of the use of the going concern basis of accounting and, based on the audit evidence obtained, on whether a material uncertainty exists related to events or conditions that may cast significant doubt on the Marine Institute's ability to continue as a going concern. If I conclude that a material uncertainty exists I am required to draw attention in my report to the related disclosures in the financial statements or, if such disclosures are inadequate, to modify my opinion. My conclusions are based on the audit evidence obtained up to the date of my report. However, future events or conditions may cause the Marine Institute to cease to continue as a going concern.
- I evaluate the overall presentation, structure and content
  of the financial statements, including the disclosures,
  and whether the financial statements represent the
  underlying transactions and events in a manner that
  achieves fair presentation.

I communicate with those charged with governance regarding, among other matters, the planned scope and timing of the audit and significant audit findings, including any significant deficiencies in internal control that lidentify during my audit.

## Information other than the financial statements

My opinion on the financial statements does not cover the other information presented with those statements, and I do not express any form of assurance conclusion thereon.

In connection with my audit of the financial statements, I am required under the ISAs to read the other information presented and, in doing so, consider whether the other information is materially inconsistent with the financial statements or with knowledge obtained during the audit, or if it otherwise appears to be materially misstated. If, based on the work Ihave performed, I conclude that there is a material misstatement of this other information, I am required to report that fact.

## Reporting on other matters

My audit is conducted by reference to the special considerations which attach to State bodies in relation to their management and operation. I report if I identify material matters relating to the manner in which public business has been conducted.

I seek to obtain evidence about the regularity of financial transactions in the course of audit. I report if I identify any material instance where public money has not been applied for the purposes intended or where transactions did not conform to the authorities governing them.

I also report by exception if, in my opinion,

- I have not received all the information and explanations I required for my audit, or
- the accounting records were not sufficient to permit the financial statements to be readily and properly audited, or
- the financial statements are not in agreement with the accounting records.

# GOVERNANCE STATEMENT AND BOARD MEMBERS' REPORT

## Governance

The Board of the Marine Institute was established under the Marine Institute Act, 1991. The functions of the Board are set out in section 3 of this Act. The Board is accountable to the Minister for Agriculture, Food and the Marine and is responsible for ensuring good governance and performs this task by setting strategic objectives and targets and taking strategic decisions on all key business issues. The regular day-to-day management, control and direction of the Marine Institute are the responsibility of the Chief Executive Officer (CEO) and the senior management team. The CEO and the senior management team must follow the broad strategic direction set by the Board, and ensure that all Board members have a clear understanding of the key activities and decisions related to the entity, and of any significant risks likely to arise. The CEO acts as a direct liaison between the Board and management of the Marine Institute. In accordance with the Marine Institute Act, the Board discharges its duties as set out below.

## **Board Responsibilities**

The work and responsibilities of the Board are set out in the Board Standing Orders, The Schedule of Matters for Board Decision and The Roles of the Board, Chairman, Chief Executive and Board Secretary, which also contain the matters specifically reserved for Board decision. Standing items considered by the Board include:

- Declaration of interests
- Reports from committees
- Financial statements and items of expenditure in excess of €50,000
- · Implementation of strategy and
- Reserved matters.

The Board of the Marine Institute provides leadership and strategic direction for the organisation, defining the mission of the Institute and developing the policies required to achieve its goals. The Board sets performance targets and measures progress against these, closely monitoring budgets and financial performance. The Board leads the organisation in behaving ethically and in a manner that accords with the core values of the organisation.

Section 12 of the Marine Institute Act, 1991 requires the Board of the Marine Institute to keep, in such form as may be approved by the Minister for Agriculture, Food and the Marine with consent of the Minister for Public Expenditure and Reform, all proper and usual accounts of money received and expended by it.

In preparing these financial statements, the Board of the Marine Institute is required to:

- select suitable accounting policies and apply them consistently,
- make judgements and estimates that are reasonable and prudent,
- prepare the financial statements on the going concern basis unless it is inappropriate to presume that it will continue in operation, and
- state whether applicable accounting standards have been followed, subject to any material departures disclosed and explained in the financial statements.

The Board is responsible for keeping adequate accounting records which disclose, with reasonable accuracy at any time, its financial position and enables it to ensure that the financial statements comply with Section 12 of the Marine Institute Act, 1991. The maintenance and integrity of the corporate and financial information on the Marine Institute's website is the responsibility of the Board.

The Board is responsible for approving the annual plan and budget. The Board is also responsible for safeguarding its assets and hence for taking reasonable steps for the prevention and detection of fraud and other irregularities.

The Board considers that the financial statements of the Marine Institute give a true and fair view of the financial performance and the financial position of the Marine Institute for the year ended 31 December 2018 and as at 31 December 2018, respectively.

## **Board Structure**

The Board consists of a Chairperson and eight ordinary members, all of whom are appointed by the Minister for Agriculture, Food and the Marine. The members of the Board were appointed for a period of five years and met twelve times in 2018. The table below details the appointment period for current members:

<b>Board Member</b>	Role	Date Appointed
John Killeen	Chairperson	8th January 2014
Lorcán O'Cinneide	Ordinary Member	2nd December 2015
Dermot Clohessy	Ordinary Member	2nd December 2015
Alan Dobson	Ordinary Member	2nd December 2015
Owen Lewis	Ordinary Member	2nd December 2015
David Owens	Ordinary Member	6th February 2018
Berna Grist	Ordinary Member	6th February 2018
Patricia Barker	Ordinary Member	19th February 2018
Donal Kelly	Ordinary Member	15th April 2018

John Killeen's first term ended on the 8th January 2019 and he was reappointed for an additional five-year term on 8th January 2019 by the Minister. During 2018, David Owens, Berna Grist, Patricia Barker and Donal Kelly were reappointed to the Board on the dates set out above.

The Board has established two committees, as follows:

**Audit and Risk Committee:** comprises four Board members, all of whom are non-executive. The role of the Audit and Risk Committee (ARC) is to support the Board in relation to its responsibilities for issues of risk, control and governance and associated assurance. The ARC is independent from the financial management of the organisation. In particular, the Committee ensures that the internal control systems including audit activities are monitored actively and independently. The ARC reports to the Board after each meeting, and formally in writing annually.

The members of the Audit and Risk Committee are: Patricia Barker (Chairperson), David Owens, Dermot Clohessy and Donal Kelly. There were 8 meetings of the ARC in 2018.

In 2018 the Board and Audit and Risk Committee both conducted a self-evaluation of their respective performances.

**Board Strategy Sub-Group:** comprises three Board members, all of whom are non-executive. The role of the Board Strategy Sub-Group (BSSG) is to guide the development of the Marine Institute Strategy 2018-2022. The members of this committee are: Lorcán O'Cinneide (Chairperson), Dermot Clohessy and Alan Dobson. There were 2 meetings of the Board Strategy Sub-Group in 2018.

## Schedule of Attendance, Fees and Expenses

A schedule of attendance at the Board and Committee meetings for 2018 is set out below including the fees and expenses received by each member:

Name	Board	Audit and Risk Committee	Board Strategy Sub-Group	Fees 2018 €	Expenses 2018 €
Number of Meetings	12	8	2		
John Killeen	12			11,970	
Patricia Barker	11	8		7,695	2,143
David Owens*	10	6		6,957	911
Berna Grist*	10			6,957	2,313
Lorcán O'Cinneide	11		2	5,911	5,035
Donal Kelly	8	4		7,695	3,824
Dermot Clohessy	12	8	2	7,695	4,318
Alan Dobson**	6		2	7,695	3,304
Owen Lewis	12			7,695	3,552
Total				70,270	25,400

<sup>\*</sup>David Owens and Berna Grist were re-appointed in February 2018 and could attend a maximum of 11 Board meetings in 2018.

# Disclosures Required by Code of Practice for the Governance of State Bodies (2016)

The Board is responsible for ensuring that the Marine Institute has complied with the requirements of the Code of Practice for the Governance of State Bodies ("the Code"), as published by the Department of Public Expenditure and Reform in August 2016. The following disclosures are required by the Code:

## **Consultancy Costs**

Consultancy costs include the cost of external advice to management and exclude outsourced 'business-as-usual' functions.

	2018 €	2017 €
Legal	64,938	44,226
Financial and Governance	179,487	119,345
PR/Marketing	25,656	74,426
HR and Pension	14,329	8,377
Business Planning	15,785	115,050
Evaluators	64,187	75,364
Business Development	69,495	213,097
IT	28,597	41,357
Shipping Development	277,561	161,355
Biodiscovery	0	19,987
Other	55,965	39,207
Total	796,000	911,791

<sup>\*\*</sup> The fee of Alan Dobson, was paid directly to University College Cork (UCC). Alan Dobson is in full time employment with UCC and the fee was not paid directly to him under the One Person One Salary (OPOS) principle.

## **Legal Costs and Settlements**

The Marine Institute had no legal costs or settlements in connection with dealings with third parties. This does not include expenditure incurred in relation to general legal advice received by the Marine Institute which is disclosed in Consultancy costs above

## **Travel and Subsistence Expenditure**

Travel and subsistence expenditure is categorised as follows:

		2018 €	2017 €
Domestic	Board	25,400	30,996
Domestic	Employees	680,861	756,934
International	Board	0	0
international	Employees	551,817	577,789
Total		1,258,078	1,365,719

## **Hospitality Expenditure**

The Statement of Income and Expenditure includes the following hospitality expenditure:

	2018 €	2017 €
Staff Hospitality	6,148	6,747
Client Hospitality	755	1,362
Total	6,903	8,109

## **Statement of Compliance**

The Board has adopted the Code of Practice for the Governance of State Bodies (2016) and has put procedures in place to ensure compliance with the Code. The Marine Institute was in full compliance with the Code of Practice for the Governance of State Bodies at 31 December 2018.

On behalf of the Board

**Dr John Killeen** Chairperson

3<sup>rd</sup> December 2019

# MARINE INSTITUTE STATEMENT ON INTERNAL CONTROL

## Scope of Responsibility

On behalf of the Marine Institute I acknowledge the Board's responsibility for ensuring that an effective system of internal control is maintained and operated. This responsibility takes account of the requirements of the Code of Practice for the Governance of State Bodies 2016.

## Purpose of the System of Internal Control

The system of internal control is designed to manage risk to a tolerable level rather than to eliminate it. The system can therefore only provide reasonable and not absolute assurance that assets are safeguarded, transactions authorised and properly recorded and that material errors or irregularities are either prevented or detected in a timely way.

The system of internal control, which accords with guidance issued by the Department of Public Expenditure and Reform has been in place in the Marine Institute for the year ended 31 December 2018 and up to the date of approval of the financial statements

## **Key Control Procedures**

The Board of the Marine Institute has established a strong and robust control environment in the Marine Institute through:

- Holding regular Board meetings where the agenda includes strategic issues such as corporate governance, financial management and corporate strategy
- The implementation of the Marine Institute Strategy
- Clearly defined management responsibilities, authority and accountability, delegation of appropriate functions and reviewing and approving all Marine Institute policies
- Approval of annual budgets, cash flow forecasting and capital programme expenditure with formal review of these at each Board meeting
- The work of the Audit and Risk Committee, which met eight times in 2018
- Four internal audits were conducted in 2018, with regular meetings between the Audit and Risk Committee and the Internal Auditors to discuss their work programme, the outcomes of their audits, their recommendations and a private meeting without members of the executive
- The operation of a risk management system with annual review of the risk policy and quarterly review of the risk register and report from the joint risk officers
- Robust systems of health and safety, with monthly reports to the Board
- Monitoring of compliance with legislation including Freedom of Information and Access to Environmental Information
- The systems of internal control as detailed in the Marine Institute Operating Control Framework which sets out
  each of the key controls in place within the Institute, together with the owner of each control. To further improve the
  quality of the report, each of the control owners has submitted an Assurance Statement for each set of controls in
  respect of 2018.

#### Statement on Internal Control

The Statement on Internal Control was reviewed by the Audit and Risk Committee on the 26th February 2019.

## Financial and Budgetary Management Systems

There is a comprehensive annual budgeting system with annual income, budget allocation process, cash flow forecasting and capital programme budgeting reviewed and approved by the Board at the start of each year, with formal review at each subsequent Board meeting. Policies and procedures are in place in relation to budgetary and financial matters, with all contracts with a value in excess of €50,000 coming to the Board for consideration and approval. There are regular reviews by the Executive of financial management reports and a Corporate Procurement Plan is in place.

## Procedures for monitoring the effectiveness of the Internal Control System

The 2018 Internal Audit Plan was implemented in full with the following audits completed:

- Review of 2018 Internal Financial Controls
- Compliance with the Code of Practice for the Governance of State Bodies
- General IT Controls
- HR and Payroll

Implementation plans to address internal audit recommendations are approved by the Audit & Risk Committee. Progress on the implementation of the actions in each of the Internal Audit Implementation Plans is reviewed annually and reported to the Audit & Risk Committee and the Board.

The Internal Audit Plan for 2018 reflected the risks identified in the Marine Institute's Risk Register, the management letter of the Office of the Comptroller and Auditor General, and general developments and issues in relation to Corporate Governance. The Internal Audit Plan for 2019-2021 was approved by the Audit & Risk Committee in December 2018 and by the Marine Institute Board in February 2019.

## Capacity to Handle Risk

The Marine Institute has an Audit and Risk Committee (ARC) comprising four Board members with a broad range of experience including financial and audit expertise, one of whom is the Chair.

The Marine Institute has also established an internal audit function which is adequately resourced and conducts a programme of work agreed with the ARC and approved by the Board. The internal audit function is outsourced to a commercial firm. To ensure appropriate business continuity two joint Risk Officers have been appointed.

The ARC oversees the risk management policy which sets out the Marine Institute's risk appetite, the risk management processes in place and details the roles and responsibilities of staff in relation to risk. The policy has been issued to all staff who are expected to work within the Marine Institute's risk management policies, to alert management to emerging risks and control weaknesses and to assume responsibility for risks and controls within their own area of work.

The financial implications of business risks have been considered through the formal business risk assessment process and in the preparation of the Marine Institute's Internal Audit Plans. A comprehensive set of Financial Procedures have been put in place to control the significant financial elements of the Marine Institute's business including authorisation limits for purchasing/expenditure.

### **Risk and Control Framework**

The Marine Institute has implemented a risk management system which identifies and reports key risks and the management actions being taken to address and, to the extent possible, to mitigate those risks.

The Marine Institute's Risk Management Policy and Business Continuity Policy are in compliance with the Code of Practice for the Governance of State Bodies 2016. The Marine Institute has appointed two Risk Officers. A risk register is in place which identifies the key risks facing the Marine Institute and these have been identified, evaluated and ranked according to their significance. The register is reviewed and updated by the ARC on a quarterly basis. The outcome of these assessments is used to plan and allocate resources to ensure risks are managed to an acceptable level.

The risk register details the controls and actions needed to mitigate risks and responsibility for operation of controls assigned to specific staff. I confirm that a control environment containing the following elements is in place:

- Procedures for all key business processes have been documented
- · Financial responsibilities have been assigned at management level with corresponding accountability
- There is an appropriate budgeting system with an annual budget which is kept under review by senior management
- There are systems aimed at ensuring the security of the information and communication technology systems
- There are systems in place to safeguard the assets, and
- Control procedures over grant funding to outside agencies ensure adequate control over approval of grants and monitoring and review of grantees to ensure grant funding has been applied only for the purpose intended.

## **Ongoing Monitoring and Review**

Formal procedures have been established for monitoring control processes and control deficiencies are communicated to those responsible for taking corrective action and to management and the Board, where relevant, in a timely way. I confirm that the following ongoing monitoring systems are in place:

- Key risks and related controls have been identified and processes have been put in place to monitor the operation of those key controls and report any identified deficiencies
- Reporting arrangements have been established at all levels where responsibility for financial management has been assigned, and
- There are regular reviews by senior management of periodic and annual performance and financial reports which indicate performance against budgets/forecasts

### **Procurement**

I confirm that the Marine Institute has procedures in place to ensure compliance with current procurement rules and guidelines. Except for the issues noted in the Internal Control paragraph below, the Institute was in compliance with these procedures.

### **Review of Effectiveness**

I confirm that the Marine Institute has procedures in place to monitor the effectiveness of its risk management and control procedures. A review of the performance of the Board and the Audit and Risk Committee was undertaken through a self-appraisal exercise in 2018. The Marine Institute's monitoring and review of the effectiveness of the system of internal financial control is informed by the work of the internal and external auditors, the Audit and Risk Committee which oversees their work, and the senior management within the Marine Institute responsible for the development and maintenance of the internal control framework.

#### Annual Review of the Effectiveness on Internal Control

I confirm that the Board conducted an annual review of the effectiveness of internal controls for 2018 and was approved by the Board on 25 March 2019. In undertaking this review, the Board considered the following:

- Risk management policies, systems and procedures
- Four internal audits which were conducted in 2018. All audits provided substantial assurance and all recommendations are being implemented
- External audit by the Comptroller and Auditor General
- The work of the Audit and Risk Committee

#### Internal Control Issues

There were no material losses, frauds or breaches in control in 2018.

The audit of the 2017 financial statements drew attention to weaknesses in control over fixed assets. In 2018 the Institute completed a reconciliation of the fixed asset register with the financial statements and the downward adjustments from the reconciliation are included in the 2018 financial statements. This had an impact of €55k on the net book value of fixed assets in 2018. The Institute will conduct a full stocktake during 2019 and the fixed asset register and financial statements will be updated after the stocktake has been completed. The Institute does not expect the stocktake will have any material effect on the net book value in the financial statements.

The Marine Institute pays grants to various third parties (i.e. third level institutions, companies involved in marine research) under the Marine Research programme. In accordance with the provisions of Department of Public Expenditure and Reform (DPER) Circular 13/2014 (Management of and Accountability for Grants from Exchequer Funds) the Institute applied in February 2018 and February 2019, via the Department of Agriculture, Food and the Marine, for sanction from DPER to continue pre-funding these grants. At the date of approving the financial statements, the Institute had not received formal sanction from DPER.

The 2018 audit identified two instances of non-compliant procurement. Almost  $\leq 100,000$  was paid to one supplier for the supply of various consumables. A tender was not published in respect of this combined supply. Each individual order placed was under  $\leq 5,000$  and the procurement procedures followed were based on that limit. Separately, an amount of  $\leq 59,000$  was paid to a supplier in the two months after contract expiry. This arose where an award under a mini competition extended beyond the contract end date. The Institute is reviewing its procedures to ensure such exceptions do not arise in the future. All staff in the Institute will be reminded of ensuring full compliance with public procurement guidelines

No other weaknesses in internal control were identified in 2018 that require disclosure in the financial statements.

On behalf of the Board

Shall.

Dr John Killeen

Chairperson

3 December 2019

# MARINE INSTITUTE STATEMENT OF INCOME AND EXPENDITURE AND RETAINED REVENUE RESERVES

#### YEAR ENDED 31 DECEMBER 2018

	Note	2018 €'000	2017 €'000
Income			
Oireachtas Grants	2	32,430	31,363
Other State Grants	3	7,703	6,557
EU and Other Income	4	9,781	5,564
Net Deferred Funding For Retirement Benefits	18	4,296	3,836
		54,210	47,320
Expenditure			
Remuneration and Pension Costs	5	13,671	12,682
Retirement Benefit Costs	18	4,159	3,702
Vessel Operating Costs	6	8,136	7,709
Travelling Expenses	7	1,258	1,365
Grants and External Service Providers	8	15,503	9,130
Facilities Costs	9	1,872	1,958
IT, Telephone & Communications		1,717	1,412
Laboratory & Field Costs		1,296	1,153
Other Administration and Equipment Hire Costs	10	3,679	3,617
Depreciation	14	4,857	5,244
Total Expenditure		56,148	47,972
Transfer (to)/from Capital Account	13	1,942	602
Surplus \ (Deficit) for the year		4	(50)
Balance brought forward at 1 January		1,993	2,043
Balance carried forward at 31 December		1,997	1,993

The Statement of Cash flows and Notes 1 – 23 form part of these financial statements.

On Behalf of the Board

Dr John Killeen

Chairperson

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On Behalf of the Board

**Prof Patricia Barker** 

**Board Member** 

3. XII 2019

## MARINE INSTITUTE STATEMENT COMPREHENSIVE INCOME

#### YEAR ENDED 31 DECEMBER 2018

	Note	2018 €'000	2017 €'000
Surplus/(Deficit) for the year after Appropriations		4	(50)
Revaluation of Assets	15	5,460	-
Experience (Losses) Gains on Retirement Benefits Scheme Obligation	18	(1)	(3,754)
Changes in assumptions underlying the present value of the Retirement Benefit Obligation	18	767	(139)
Adjustment to Deferred Benefits Scheme Funding		(766)	3,893
Total Comprehensive Income for the year		5,464	(50)

The Statement of Cash flows and Notes 1 – 23 form part of these financial statements.

On Behalf of the Board

Dr John Killeen

Chairperson

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On Behalf of the Board

**Prof Patricia Barker** 

Board Member

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## MARINE INSTITUTE STATEMENT OF FINANCIAL POSITION

#### AS AT 31 DECEMBER 2018

	Note	2018 €'000	2018 €'000	2017 €'000	2017 €'000
Property, Plant and Equipment	14		21,801		18,228
Current Assets					
Receivables	16	7,406		6,981	
Cash and cash equivalents		3,300		137	
		10,706		7,118	
Current Liabilities (amounts falling due within one year)					
Payables	17	8,709		5,125	
Net Current Assets			1,997		1,993
Total Assets Less Current Liabilities before Retirement Obligations			23,798		20,221
Deferred Retirement Benefit Obligations	18	(63,129)		(59,599)	
Deferred Retirement Benefit Funding	18	63,129		59,599	
Total Net Assets			23,798		20,221
Representing					
Capital Account	13	16,341		18,228	
Revaluation Reserve	15	5,460		0	
Retained Revenue Reserves		1,997		1,993	
			23,798		20,221

The Statement of Cash flows and Notes 1 – 23 form part of these financial statements.

On Behalf of the Board

Dr John Killeen

Chairperson

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On Behalf of the Board

**Prof Patricia Barker** 

**Board Member** 

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## MARINE INSTITUTE STATEMENT OF CASH FLOWS

#### YEAR ENDED 31 DECEMBER 2018

	2018 €'000	2017 €'000
Net Cash flows from operating activities		
Surplus\(Deficit) for the financial year	4	(50)
Adjustments for:		
Depreciation of tangible Property, Plant and Equipment	4,857	5,244
Transfer to Capital Account	(1,942)	(602)
(Increase) Decrease in Receivables	(425)	(1,852)
Increase (Decrease)/ in Payables	3,584	1,147
Net cash flows from operating activities	6,078	3,887
Cash flows from investing activities		
Payments for tangible Property, Plant and Equipment	(2,915)	(4,642)
Net cash flows from investing activities	(2,915)	(4,642)
Net increase(decrease)/ in cash and cash equivalents	3,163	(755)
Cash and cash equivalents at beginning of financial year	137	892
Cash and cash equivalents at end of financial year	3,300	137

## NOTES TO FINANCIAL STATEMENTS

#### YEAR ENDED 31 DECEMBER 2018

## 1. Accounting Policies

The basis of accounting and significant accounting policies adopted by the Marine Institute are set out below. They have all been applied consistently throughout the year with one exception. There was a change in accounting policy relating to the valuation of Land and Buildings (see note f) which has changed from cost to revaluation. The Institute has analysed its expenditure based on the nature of the expense as opposed to a programme basis.

#### (a) General Information

The Marine Institute was established on 30 October 1992 under the provisions of the Marine Institute Act 1991. The Institute headquarters is located in Rinville, Oranmore, County Galway, H91 R673.

The Marine Institute's primary objectives as set out in section 4 of the Act are

"to undertake, to co-ordinate, to promote and to assist in marine research and development and to provide such services related to marine research and development, that in the opinion of the Institute will promote economic development and create employment and protect the marine environment".

The Marine Institute is a Public Benefit Entity (PBE).

#### (b) Statement of Compliance

The financial statements of The Marine Institute for the year ended 31 December 2018 have been prepared in accordance with FRS 102, the financial reporting standard applicable in the UK and Ireland issued by the Financial Reporting Council (FRC), as promulgated by Chartered Accountants Ireland.

#### (c) Currency

The financial statements have been presented in Euro ( $\leq$ ) which is also the functional currency of the Institute. In instances where amounts have been rounded to the nearest thousand Euro, this is indicated by the symbol  $\leq$ '000.

#### (d) Basis of Preparation

The financial statements are prepared under the accruals method of accounting and under the historical cost convention in the form approved by the Minister for Food, Agriculture and the Marine with the concurrence of the Minister for Public Expenditure and Reform, in accordance with Section 12(1) of the Marine Institute Act 1991.

The following accounting policies have been applied consistently in dealing with items which are considered material in relation to The Marine Institute's financial statements.

#### (e) Income

Income arising from Oireachtas Grants is recognised on a cash receipts basis, except for the Oireachtas income in relation to the European Maritime and Fisheries Fund (EMFF) expenditure. This is recognised on an accruals basis as the Oireachtas income for the direct related expenditure is funded in the year after occurrence of the expenditure.

Income received in relation to EU and other contract research projects is recognised on an accruals basis whereby the income is recognised in the accounting period in which the related expenditure is charged. Income received in advance is treated as deferred income and included within Payables in the Statement of Financial Position. Expenditure incurred where the related income has not been received is treated as accrued income and shown as a Receivable in the Statement of Financial Position.

## (f) Property, Plant and Equipment and Depreciation

Plant and Equipment are stated at cost less accumulated depreciation. The basis of valuation of land and property has been changed during the year under review from cost to revaluation. The change of land and property to valuation was undertaken so as to obtain an up to date value of these assets for the Statement of financial position and were completed by professionally qualified valuers.

The impact of the revaluation is set out in note 14. Land and Buildings will be revalued every five years by a professionally qualified valuer.

Depreciation is provided on a straight line basis at rates estimated to reduce the assets to their realisable value by the end of their expected lives. The rates in use are as follows:

Buildings	2%
Fixtures and Fittings	25%
Computers	33%
Research Vessel	4%
Research Vessel Equipment	20 - 25%
Motor Vehicles	20%

The carrying values of the tangible assets are reviewed for impairment when events or changes in circumstances indicate that the carrying value may not be recoverable. If there is objective evidence of impairment of the value of the asset, an impairment loss is recognised in the Statement of Income and Expenditure and Retained Revenue Reserves in the year.

#### (g) Intangible Assets

Intangible assets include fishing rights held by the Marine Institute to Lough Feeagh, Lough Furnace and Estuaries in Newport, County Mayo. These intangible assets are carried in the Statement of Financial Position at their cost of €nil as their fair value cannot be reliably determined by reference to an active market.

#### (h) Leased Assets

Rental expenditure under operating leases is recognised in the Statement of Income and Expenditure and Retained Revenue Reserves over the life of the lease. Expenditure is recognised on a straight-line basis over the lease period, except where there are rental increases linked to the expected rate of inflation, in which case these increases are recognised when incurred. Any lease incentives received are recognised over the life of the lease.

#### (i) Capital Account

The Institute recognises funding received for capital purposes under the Accruals Model specified in FRS102. The amount received is recognised in income on a systematic basis over the expected useful life of the asset.

#### (j) Foreign Currencies

Transactions denominated in a foreign currency are translated into the functional currency using the spot exchange rates at the date of the transactions. At the end of each financial year, foreign currency monetary items are

translated to Euro using the closing rate. Non-monetary items measured at historical cost are translated using the exchange rate at the date of the transaction and non-monetary items measured at fair value are measured using the exchange rate when fair value was determined.

#### (k) Marine Research Programme

The Marine Institute enters into commitments in respect of contracts awarded for Marine Research Programme projects. Expenditure is charged in the financial statements on the basis of initial payments made on the signing of the project contract, an interim payment may be made subject to satisfactory performance and further payments are charged on receipt and verification of claims in respect of work completed. Costs incurred by the Institute in the administration of Marine Research Programme projects are funded by the capital vote of the Marine Institute and charged to the financial statements as they are incurred.

#### (I) Employee Benefits

Short term benefits such as holiday pay are recognised as an expense in the year, and benefits that are accrued at year-end are included in the payables figures in the Statement of Financial Position.

#### (m) Retirement Benefits

The Marine Institute previously established its own defined benefit pension scheme, funded annually on a pay-as-you-go basis from monies provided by the Department of Agriculture, Food and the Marine and from contributions deducted from staff and members' salaries. The Marine Institute also operates the Single Public Service Pension Scheme ("Single Scheme"), which is a defined benefit scheme for pensionable public servants appointed on or after 1 January 2013. Single Scheme members' contributions are paid over to the Department of Public Expenditure and Reform (DPER).

Pension costs reflect pension benefits earned by employees, and are shown net of staff pension contributions which are remitted to the Department of Agriculture, Food and the Marine. An amount corresponding to the pension charge is recognised as income to the extent that it is recoverable, and offset by grants received in the year to discharge pension payments.

Actuarial gains or losses arising on scheme liabilities are reflected in the Statement of Comprehensive Income, and a corresponding adjustment is recognised in the amount recoverable from the Department of Agriculture, Food and the Marine.

The financial statements reflect, at fair value, the assets and liabilities arising from The Marine Institute's pension obligations and any related funding, and recognises the costs of providing pension benefits in the accounting periods in which they are earned by employees. Retirement benefit scheme liabilities are measured on an actuarial basis using the projected unit credit method.

#### (n) Receivables

Receivables are recognised at fair value, less a provision for doubtful debts. The provision for doubtful debts is a specific provision, and is established when there is objective evidence that the Marine Institute will not be able to collect all amounts owed to it. All movements in the provision for doubtful debts are recognised in the Statement of Income and Expenditure and Retained Revenue Reserves.

#### (o) Contingencies

Contingent liabilities, arising as a result of past events, are not recognised when (i) it is not probable that there will be an outflow of resources or that the amount cannot be reliably measured at the reporting date or (ii) when the existence will be confirmed by the occurrence or non-occurrence of uncertain future events not wholly within the Institute's control. Contingent liabilities are disclosed in the financial statements unless the probability of an outflow of resources is remote.

Contingent assets are not recognised. Contingent assets are disclosed in the financial statements when an inflow of economic benefits is probable.

#### (p) Related Parties

Related party transactions have been disclosed in the notes to the financial statements in accordance with FRS 102. See note 21 for disclosure of the related party transactions during 2018.

## (q) Critical Accounting Estimates and Judgements

The preparation of the financial statements requires management to make judgements, estimates and assumptions that affect the amounts reported for assets and liabilities as at the reporting date and the amounts reported for revenues and expenses during the year. However, the nature of estimation means that actual outcomes could differ from those estimates. The following judgements have had the most significant effect on amounts recognised in the financial statements.

## (r) Impairment of Property, Plant and Equipment

Assets that are subject to amortisation are reviewed for impairment whenever events or changes in circumstances indicate that the carrying amount may not be recoverable. An impairment loss is recognised for the amount by which the asset's carrying amount exceeds its recoverable amount. The recoverable amount is the higher of an asset's fair value less cost to sell and value in use. For the purpose of assessing impairment, assets are grouped at the lowest levels for which there are separately identifiable cash flows (cash generating units). Non-financial assets that suffered impairment are reviewed for possible reversal of the impairment at each reporting date.

#### (s) Depreciation and Residual Values

The Board has reviewed the asset lives and associated residual values of all fixed asset classes and in particular, the useful economic life and residual values of fixtures and fittings and have concluded that asset lives and residual values are appropriate.

#### (t) Retirement Benefit Obligation

The assumptions underlying the actuarial valuations for which the amounts recognised in the financial statements are determined (including discount rates, rates of increase in future compensation levels, mortality rates and healthcare cost trend rates) are updated annually based on current economic conditions and for any relevant changes to the terms and conditions of the pension and post-retirement plans.

The assumptions can be affected by:

- The discount rate, changes in the rate of return on high-quality corporate bonds
- Future compensation levels, future labour market conditions
- Health care cost trend rates, the rate of medical cost inflation in the relevant regions.

## 2. Oireachtas Grants from the Department of Agriculture, Food and the Marine

	2018 €'000	2018 €'000	2017 €'000	2017 €'000
Current Purposes				
Marine Institute - Vote 30, Subhead A.7	18,057		17,047	
EMFF Income (Note 17)	4,894		4,808	
Less Superannuation contributions repayable	(521)		(492)	
		22,430		21,363
Capital purposes				
Marine Research Programme Vote 30, Subhead A.7 (Note 12)	10,000		10,000	
		10,000		10,000
		32,430		31,363

Since 2014, the EMFF Income has been accounted for on an accruals basis as the direct related expenditure is funded in the year after occurrence. The EMFF is the EU's maritime and fisheries policies fund which is co-funded by the EU and the Department of Agriculture, Food and the Marine and supports Ireland's operational programme.

By agreement with the Department of Agriculture, Food and the Marine, employee pension contributions are refunded directly to the Department and are shown as a reduction in grant levels. Single scheme pension contributions are remitted to the Department of Public Expenditure and Reform.

## 3. Other State Grants

	2018 €'000	2018 €'000	2017 €'000	2017 €'000
National Seabed Survey — Department of Communications, Energy and Natural Resources Vote 29, Subhead D.7	2,000		2,000	
Databuoy — Department of Transport, Tourism and Sport Vote 31, Subhead C.3	0		413	
BIM – EMFF Funded	486		0	
Water Framework Directive funded by EPA	1,168		1,224	
FIRM projects funded by Department of Agriculture, Food and the Marine Vote	181		342	
Wave Energy Test Sites Funded by SEAI	988		1,010	
EMFF projects funded by Department of Agriculture, Food and the Marine Vote	2,880		1,568	
TOTAL		7,703		6,557

### 4. EU and Other Income

	2018 €'000	2018 €'000	2017 €'000	2017 €'000
EU Contract Research		6,663		2,545
Other Income				
Research Vessel Charterage	1,719		1,652	
Sundry and Other Contract Income	1,399		1,367	
		3,118		3,019
TOTAL		9,781		5,564

#### 5. Remuneration and Pension Costs

Aggregate Employee Benefits	2018 €'000	2017 €'000
Staff Short term benefits	11,930	11,118
Termination Payments	0	0
*Pension Contribution	492	387
Board Fees	70	61
Holiday Accrual Cost	26	58
Employers Contribution to Social Welfare	1,153	1,058
	13,671	12,682

Total salary costs include an accumulated accrual of €0.350m (2017: €0.324m) in respect of accumulated staff annual leave entitlements.

Pension related deductions of €0.400m (2017 €0.390m) were made from salaries and were remitted to the Department of Agriculture, Food and the Marine. Single pension related deductions of €0.121m (2017 €0.090m) were made from salaries and were remitted to the Department of Public Expenditure and Reform.

\*Pension contribution (20% of Gross Pay) is to cover the deferred cost to the Exchequer of future pension entitlements for employees on contract research and other externally funded posts. This amount was refunded to the Department of Agriculture, Food and the Marine.

Chief Executive Officer Salary and Expenses	<b>2018</b> €'000	<b>2017</b> €'000
Basic Pay	144	138
	144	138

The total expenses for business purposes for the CEO for 2018 was €33,178 (2017: €27,677) which includes foreign travel expenses of €13,006. The amounts paid to the CEO for expenses in 2018 was €19,568 (2017 €17,449).

Staff Short term Benefits	2018 €'000	2017 €'000
Basic Pay	11,380	10,559
Overtime	0	0
Allowances	550	559
	11,930	11,118

The average number of employees by location at year end is as follows:

Employees	2018 No.	2017 No.
Rinville Galway	193	177
Newport	17	16
Wilton Terrace, Dublin	8	11
Ports	16	10
EU Based	3	2
	237	216
The whole time equivalents at each year end	227.10	207.5

Key Management and Personnel	2018 €'000	2017 €'000
Salary	792	750
	792	750

Key Management personnel in the Marine Institute include the members of the Board, the Chief Executive Officer and the Executive directors of the Marine Institute. The total value of employee benefits for key personnel is set out above. No payments in respect of termination payments, allowances and health insurance were made. This does not include the value of retirement benefits earned in the period. The Executive directors and CEO are members of the Marine Institute Staff Superannuation Scheme 1998 or the Single Public Service Pension scheme and their entitlements in that regard do not extend beyond the terms of the model public service pension scheme. The total expenses paid to key executive management in 2018 was €72,871 (2017: €67,192).

## **Employee Short-Term Benefits Breakdown**

Employees' short-term benefits in excess of €60,000 are categorised into the following bands:

Wages and Salaries breakdown of Employees	2018 No's	2017 No's
€60,000 - €69,999	36	42
€70,000 - €79,999	25	26
€80,000 - €89,999	12	5
€90,000 - €99,999	4	4
€100,000 - €109,999	2	1
€110,000 - €119,999	1	0
€120,000 - €129,999	0	0
€130,000 - €139,999	0	1
€140,000- €149,999	1	0

**Note:** For the purposes of this disclosure, short-term employee benefits in relation to services rendered during the reporting period include salary, overtime allowances and other payments made on behalf of the employee, but exclude employer's PRSI

## 6. Vessel Operating Costs

	2018 €'000	2017 €'000
Payroll and Associated Costs	4,261	4,321
Fuel	1,111	976
Insurance	237	230
Victualling	187	167
Management Fee	265	216
Port Fees and Safety	80	92
Leases	140	133
Engineering and Maintenance Costs	1,071	835
Operating and Administration Costs	784	739
	8,136	7,709

The vessel operating costs exclude the cost of vessel equipment and refits which are capitalised per note 14. The vessels are owned by the Marine Institute and the operations of the vessels are subcontracted to a vessel management company.

## 7. Travelling Expenses

Travel & Subsistence	2018 €'000	2017 €'000
Domestic	706	788
Foreign	552	577
	1,258	1,365

### 8. Grants and External Service Providers

	<b>2018</b> €'000	<b>2017</b> €'000
Marine Research Programme Grants and support costs (Note 12)	4,417	3,216
Seafarer Training & Education	170	185
Contractors, External Service Providers, Professional Fees and Other Research Funding*	10,474	5,233
Sample Analysis	442	496
	15,503	9,130

<sup>\*</sup>This includes project payments to partners where the Marine Institute is the lead partner in EU funded projects

### 9. Facilities Costs

	<b>2018</b> €'000	<b>2017</b> €'000
Maintenance	1,075	1,074
Light & Heat	401	437
Replacements	171	162
Other	225	285
	1,872	1,958

## 10. Other Administration and Equipment Hire Costs

	2018 €'000	2017 €'000
Rent, Rates & Other Property Costs	237	237
Journal Subscriptions, Memberships and Library Costs	203	218
Training	190	183
Stationery & Consumables	124	115
Publications, Promotional Materials and Design	401	503
Insurance	134	134
Audit fee	20	18
Hire of Equipment & Vessels	1,085	1,299
Sundry Equipment	134	26
Other Admin Costs	1,151	884
	3,679	3,617

The provisions of the European Communities (Late Payment in Commercial Transactions) Regulations 2012 (S.I. No. 580 of 2012) apply to the Marine Institute. Interest and compensation paid during 2018 was €139 (2017: €11,809).

#### 11. Taxation

The Marine Institute is specifically exempted under the provisions of Section 32 and Schedule 2 of the Finance Act 1994. Accordingly, no taxation charge has been included in the financial statements.

## 12. Beaufort and Marine Research Programme 2014 - 2020 (NDP 2007-2013)

	2018 €'000	2017 €'000
Oireachtas Income (Note 2)	10,000	10,000
Other income	563	322
Total Income on Marine Research	10,563	10,322
Expenditure on Marine Research Programme projects	2 / 4	2 ( 25
Shiptime Award Payments	2,641	2,685
Marine Research Programme Grants (Note 8)	4,417	3,216
Marine Research Policy Support Payments	1,947	1,645
Marine Institute Capital, IT and Oceanographic Equipment	1,362	1,676
Marine Institute Vessel Equipment and Refit	196	1,100
Total Expenditure on Marine Research	10,563	10,322

## Marine Research Programme 2014-2020

In 2014, the Marine Institute launched the Cullen Fellowship Programme, an annual programme call to provide post-graduate research training opportunities for students in marine science and related disciplines. Investment in this programme has continued annually since then, with 27 Cullen Fellowships awarded to date. There are currently 25 Fellows in post, as two Masters completed in 2018.

The National Marine Research & Innovation Strategy 2017-2021 was published in June 2017, which identified 15 research themes under the three goals of Harnessing Our Ocean Wealth, and this strategy will set the research priorities for the next number of years. Two research calls were launched by the Marine Institute in 2018 with a total of €4.4m in new investment made for 12 industry-led awards to marine enterprises plus a research project on Oceans in a Changing Climate, which will focus on ocean climate in the Atlantic area and the likely consequences for Ireland and will support eight new researcher posts over five years. In addition, a further €1.75m was invested in five co-funded projects with national and international funding agencies (SFI, GSI, EPA, Met Éireann, SEAI and the EU) that will carry out research on marine technologies, ocean observation and seabed mapping and climate change.

Research Projects awarded are subject to contract which specifies that an initial payment will be made on signing of the contract; an interim payment(s) may be made subject to satisfactory performance with final payment made on receipt of and verification of claims. Expenditure is charged in the financial statements in accordance with the Marine Research Programme accounting policy. At 31 December 2018 payments in the amount of €199,975 (2017: €446,767) were outstanding on amounts charged to the financial statements and are included within payables.

A total of 239 projects have been supported under the Marine Research Programme 2014-2020 with 99 of these projects still ongoing at the end of 2018.

Contractual commitments at 31 December 2018, which have not yet been charged to the financial statements, were €16.4m, analysed as follows:

	Total €'000
Commitments as at 1 January 2018	13,149
Committed in 2018	10,651
Paid in 2018	(7,392)
Commitments as at 31 December 2018	16,408

## 13. Capital Account

	2018 €'000	2018 €'000	2017 €'000	2017 €'000
Balance at 1 January		18,228		18,830
Transfer (to) /from Statement of Income and Expenditure				
Income allocated for Capital funding	2,915		4,642	
Depreciation charge for the year	(4,857)		(5,244)	
Net Transfer (to)/from Statement of Income & Expenditure Account		(1,942)		(602)
Historical correction of depreciation		55		
Balance at 31 December		16,341		18,228

The balance of the Capital Account (€16.341m) and the Revaluation Reserve (€5.46m) agrees to the Net Book Value of Property, Plant and Equipment (€21.801m)

## 14. Property, Plant and Equipment

	Land & Buildings €'000	Research Vessels €'000	Vessel Equipment €'000	Fixtures & Fittings €'000	Computers €'000	Motor Vehicles €'000	TOTAL €'000
Cost or Valuation							
Balance at 1 January 2018	3,743	34,781	7,384	29,516	10,928	439	86,791
Additions	-	196	68	1,670	969	12	2,915
Revaluation	5,440			20			5,460
Adjustment	75	1	(850)	(5,876)	(4,051)	(3)	(10,704)
Disposals	-	-	-	(34)	-	0	(34)
Balance at 31 December 2018	9,258	34,978	6,602	25,296	7,846	448	84,428
Depreciation							
Balance at 1 January 2018	1,301	23,465	6,730	26,781	10,040	246	68,563
Charge for the financial year	75	1,652	482	1,681	903	64	4,857
Adjustment	76	(1)	(1,063)	(5,691)	(4,083)	3	(10,759)
Disposal	-	-	-	(34)	-		(34)
Balance at 31 December 2018	1,452	25,116	6,149	22,737	6,860	313	62,627
Net Book Value							
At 31 December 2018	7,806	9,862	453	2,559	986	135	21,801
At 31 December 2017	2,442	11,316	654	2,735	889	193	18,228

The Marine Institute's headquarters are at Rinville, Oranmore, County Galway. This building, which is owned by the OPW, is provided rent free. The Institute owns land and buildings in Newport, Co Mayo and in Parkmore, Galway. All the land, and buildings owned by the Marine Institute were revalued upwards by €5.46m after a valuation by professional qualified valuers during 2018. The cost of fixed assets in the financial statements at 31st Dec 2018 also includes a downward adjustment of €10.70m after a fixed asset reconciliation exercise was completed during the year. The concomitant accumulated depreciation was also adjusted downward by €10.75m. The impact on the Net book value at 31 Dec 2018 was an adjustment of €0.05m. The other various premises used by the Institute in Dublin and at the port locations around Ireland are held under either operating leases or rental agreements as set out in Note 20.

## 15. Revaluation Reserve

	<b>2018</b> €'000	<b>2017</b> €'000
Revaluation of Land and Property 2018 (Note 14)	5,460	0
	5,460	0

The basis of the valuation of land, property was changed in 2018 from cost to revaluation and the amount of  $\leq$ 5.460m is the increase in value which has been included in the revaluation reserve.

## 16. Receivables

	2018 €'000	2017 €'000
Trade Receivables	191	305
Contract Income	1,621	1,081
EMFF Accrued Income (Note 2)	4,894	4,808
Prepayments	700	787
	7,406	6,981

All receivables are due within one year. Trade receivables are shown net of impairment in respect of doubtful debts.

## 17. Payables

	2018 €'000	2017 €'000
Amounts falling due within one year		
Trade Payables	3,596	2,679
Deferred Income	4,033	1,176
Marine Research Programme Accrual (Note 12)	199	447
Accruals	138	167
Payroll and Revenue Accruals	393	332
Holiday Pay Accrual (Note 5)	350	324
	8,709	5,125

Included in trade payables above are the following amounts due to the Revenue Commissioners:

	2018 €'000	2017 €'000
Professional Service Withholding Tax	229	161
PAYE/PRSI/USC	393	332
VAT	185	135
Relevant Contract Tax	5	1
	812	629

## 18. Superannuation Scheme and Spouse & Children's Contributory Retirement Benefits Scheme

#### (a) General Description of the Scheme

The Marine Institute is a statutory State agency, established under section 3(1) of the Marine Institute Act, 1991 (No. 2 of 1991). Section 9(1) of the Act provides that the Institute shall make schemes for the granting of superannuation benefits to and in respect of staff members, subject to Ministerial approval. Two such approved schemes – the Marine Institute Staff Superannuation Scheme 1998 and the Marine Institute Spouses' and Children's Contributory Pension Scheme 1998 are being operated by the Institute. The former scheme provides retirement benefits (lump sum and pension) to staff members and death gratuity benefits in respect of death in service. The latter scheme provides pension benefits for the surviving spouses and dependent children of deceased members. Normal retirement age is a member's 65th birthday. Both schemes are defined benefit superannuation schemes. Staff Superannuation contributions are paid to the Department of Agriculture, Food and the Marine.

The Single Public Service Pension Scheme (Single Scheme) is the defined benefit pension scheme for pensionable public servants appointed for the first time on or after 1 January 2013 in accordance with the Public Service Pension (Single Scheme and Other Provisions) Act 2012. The scheme provides for a pension and retirement lump sum based on career-average pensionable remuneration, and spouses and childrens pensions. The minimum pension age is 66 years (rising in line with State pension age changes). It includes an actuarially-reduced early retirement facility from age 55. Pensions in payment increase in line with the consumer price index.

For the purposes of reporting in accordance with FRS102, the Institute has been advised by a qualified actuary who has prepared a full valuation in order to assess the liabilities of the superannuation schemes at 31 December 2018.

The principal actuarial assumptions, per annum, are as follows:

	2018	2017	2016
Inflation rate increase	1.95%	1.95%	1.90%
Salary rate increase	2.95%	2.95%	2.90%
Pension rate increase	2.45%	2.45%	2.40%
Scheme liabilities discount rate	1.90%	2.00%	1.96%

As pension increases under the Marine Institute schemes are based on salary increases rather than on price increases, a price inflation assumption is not necessary for the purposes of this valuation. However, since FRS 102 requires reference to an assumed rate of inflation, the above rate would be appropriate for this purpose.

The average remaining future life expectancy according to the mortality tables used to determine pension liabilities, is as follows:

	2018	2017
Male aged 65	21.4	21.2
Female aged 65	23.9	23.7

On the basis of these and other assumptions and applying the projected unit method prescribed in FRS 102, the deferred funding asset and retirement benefits liability are as follows:

	2018	2017
Total accrued retirement benefits liability	€63.1m	€59.6m

#### (b) Analysis of the Total Pension Costs charged to Expenditure

	2018 €'000	
Current Service Cost	3,493	3,181
Interest on pension scheme liabilities	1,188	1,013
Employee Contributions	(522)	(492)
	4,159	3,702

#### (c) Analysis of the amount recognised in the Statement of Comprehensive Income

	2018 €'000	
Experience gains/(Losses)	(1)	(3,754)
Changes in assumptions underlying the present value of scheme	767	(139)
Actuarial gain and (loss) recognised in the Statement of Comprehensive Income	766	(3,893)

#### (d) Net Deferred Funding for Pensions Recognised in the year

	<b>2018</b> €'000	<b>2017</b> €'000
Current Service and Interest Cost	4,681	4,194
Less benefits paid in the year	(385)	(358)
	4,296	3,836

The Marine Institute recognises amounts owing from the State as an asset corresponding to the unfunded deferred liability for pensions on the basis of the set of assumptions described above and a number of past events. These events include the statutory basis for the establishment of the superannuation scheme and the policy and practice in relation to funding public service pensions, including contributions from employees and the annual estimates process. In common with the generality of public service superannuation schemes, no separate fund is maintained, or assets held, to finance the payment of pensions and gratuities.

In line with the custom and practice as adopted by the Department of Agriculture, Food and the Marine to date, the Marine Institute has no evidence that this funding policy will not continue to meet such sums in accordance with current practice. The deferred funding asset for pensions as at 31 December 2018 amounted to €63.1million (2017: €59.6million). The quantification of the liability is based on the financial assumptions set out in this note. The assumptions used, which are based on professional actuarial advice, are advised to the Department of Agriculture, Food and the Marine but are not formally agreed with the Department.

#### (e) Analysis of movement in net pension liability during the year

	2018 €'000	2017 €'000	2016 €'000	2015 €'000	2014 €'000	2013 €'000
Liability at the beginning of the year	59,599	51,870	40,050	30,200	28,200	27,501
Current Service Cost	3,493	3,181	2,299	1,772	1,800	1,900
Interest on Scheme Liabilities	1,188	1,013	1,017	1,652	1,500	1,500
Actuarial (Gain)Loss recognised in the Statement of Comprehensive Income	(766)	3,893	8,850	6,772	(816)	(2,339)
Benefits paid in the year	(385)	(358)	(346)	(346)	(484)	(362)
Liability at the end of the year	63,129	59,599	51,870	40,050	30,200	28,200

#### (f) History of Defined Benefit Obligations

	2018 €'000	2017 €'000	2016 €'000	2015 €'000	2014 €'000
Deficit benefit obligations	63,129	59,599	51,870	40,050	30,200
Experience Gains/(Losses) on Scheme Liabilities	(1)	(3,754)	1,251	1,694	816
Percentage of Scheme Liabilities	0%	6.3%	2.4%	4.2%	2.7%
Assumption Gains/(Losses) on Scheme Liabilities	767	(139)	(10,101)	(8,466)	-
Percentage of Scheme Liabilities	1.21%	0.2%	19.4%	21.1%	0%

The cumulative actuarial loss recognised in the Statement of Comprehensive Income amounts to €11,496,000.

## 19. Operating Lease commitments

The Marine Institute occupies leased and rented premises at the following locations:

- Lease 1: Wilton Park House, Dublin 2, commenced in 2015 for a period of 4 years and 3 months and is due to terminate on 31st October 2019. A new lease for office accommodation in 3 Park Place, Dublin 2 will commence in 2019.
- Lease 2: Parkmore Office Park, Galway, commenced in 1999 for a period of 25 years with five yearly rent reviews.
- Lease 3: Red Sail Warehouse, Galway Harbour, commenced in 2013 for a period of 11 years with a rent review in 2018.
- Lease 4: Industrial Land, Galway Harbour, commenced in 2014 for a period of 5 years with the option to extend to August 2024.
- Lease 5: Industrial Land, Galway Technology Park, commenced in 1988 for a period of 999 years, with five yearly rent reviews.
- Lease 6: Foreshore lease in Spiddal, granted for 35 years with effect from 15th Dec 2017.
- **Rental Agreements:** The Institute has a number of rental agreements relating to piers, labs and sheds, all of which are renewable on an annual basis.

The total future minimum lease payments under non-cancellable operating leases, all of which relate to Land & Buildings, are as follows:

Relating to leases:	2018 €'000	2017 €'000
Payable within 1 year	270	308
Payable between 2 and 5 years	612	849
Payable thereafter	117	227
	999	1,384

Operating lease payments recognised as an expense in 2018 amounted to €308,750 (2017: €308,737).

## 20. Related Party Transactions

Smartbay (Ireland) Ltd, was established to implement the Programme for Research in Third-Level Institutions (PRTLI) Smartbay project to develop a Marine Research, Test and Demonstration Platform consisting of a communications and sensing infrastructure deployed in Galway Bay. The company was established as a company limited by guarantee by PRTLI project partners Dublin City University (DCU) and National University of Galway in Feb 2012.

The Institute's CEO was a Board member until May 2016 and the Head of Corporate Services of the Institute was the Secretary at the 31 Dec 2018. During 2018, the Institute advanced funding of €322,467 to Smartbay Ltd (2017: €365,550). This expenditure is included within research expenditure in Note 8 to these financial statements. The payment is in respect of a contract to provide operational support in respect of the development of the Ocean Energy Test Site in Galway and the Atlantic Test Site at Belmullet and the balance outstanding to Smartbay Ltd at 31st Dec 2018 was €0 (2017: €0).

## 21. Register of interests

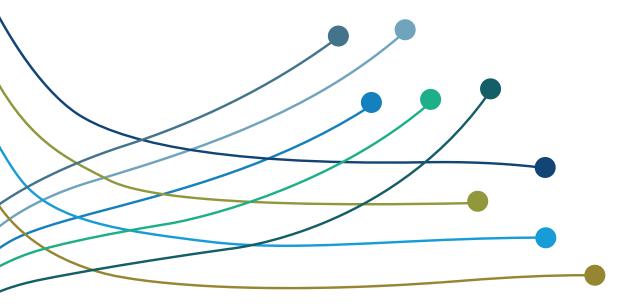
The Institute has adopted procedures in accordance with the guidelines issued by the Department of Public Expenditure and Reform in relation to the disclosure of interests by the Board and the Institute has adhered to these procedures. There were no transactions in the year in relation to the Institute's activities in which members of the Board had a beneficial interest.

## 22. Events after the end of the financial year

The Board is not aware of any events occurring after 31 December 2018 which affect these financial statements.

## 23. Board Approval

The financial statements were approved by the Board on 3 Dec 2019.





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