Rialtas na hÉireann
Government of Ireland

Harnessing Our Ocean Wealth

An Integrated Marine Plan for Ireland

Review of Progress 2018

All cover photographs sourced from Ireland's Content Pool, Fáilte Ireland and Tourism Ireland

Ballymastocker Bay, Fanad, County Donegal
Image courtesy of Fáilte Ireland

Pod of Common Dolphins breaching the water in West Cork
Photographer Padraig Whooley

A fishing boat surrounded by birds in County Kerry
Photographer Tom Archer

Joint Statement

An Taoiseach, Leo Varadkar TD, and the Minister for Agriculture, Food and the Marine, Michael Creed TD

It is with great pleasure that we launch this latest Progress Report on Ireland's Integrated Marine Plan (IMP), Harnessing Our Ocean Wealth (HOOW). The Progress Report provides an account of the comprehensive work undertaken, in 2018 specifically, to implement the ambitious actions in the Plan.

Ireland is already well on target to achieve and even exceed the ambitious economic targets set out in the Plan with consistently impressive economic trends for the marine sector over the last 8 years.

The latest Ocean Economy Report published for the Summit, the fifth in the series produced by the Socio-Economic Marine Research Unit (SEMRU) at the National University of Ireland Galway, shows that in 2018, Ireland's ocean economy had a turnover of €6.2 billion. The direct economic contribution in terms of Gross Value Added was €2.2 billion or 1.1% of GDP. Ireland's ocean economy provided employment for 34,132 people. The indirect Gross Value Added from ocean related activity in Ireland amounts to €1.96 billion, giving a total GVA (direct and indirect) of €4.19 billion, which represents 2% of GDP.

Reporting in May 2019, the European Commission highlighted significant growth across the blue economy of most EU Member States, noting the most significant expansion observed was in Ireland and Malta, according to Eurostat figures.

Only this week, the Government approved a Marine Planning Policy Statement which sets out the reforms underway to provide a modern, integrated planning system. A Marine Planning and Development Bill is in preparation, and will sit alongside a Maritime Jurisdiction Bill and the National Marine Planning Framework. Together, these will provide a new fit-for-purpose framework for the decades ahead.

This Report coincides with the annual Our Ocean Wealth Summit and the associated SeaFest 2019 National Marine Festival programme. Both are relocating to the great maritime city of Cork after a very successful 3 year period in Galway from 2016-18, where up to 100,000 people attended the various festival events.

This is the sixth annual 'Our Ocean Wealth Summit' taking place in Cork City Hall over June 9th and 10th. The theme of this year's Summit, which has become one of the main marine events in the nation's calendar, is 'Shared Voices from Small Island Nations'. We're delighted that the Summit will welcome delegates from 30 Small Island Developing States and will discuss the considerable ocean and climate-related challenges and the shared mutual experiences of many island nations.

While much has already been achieved in expanding Ireland's marine economy, the specific challenge for Ireland in the years ahead will be the sustainable development of Ireland's immense natural marine resource while ensuring that the resource itself is adequately protected for future generations. The United Nations has already proclaimed a Decade of Ocean Science for Sustainable Development from 2021-2030 which will gather ocean stakeholders worldwide behind a common framework designed to ensure that ocean science can fully support countries in the achievement of UN Sustainable Development Goal 14 on the Ocean.

Contents

Photo courtesy of the Marine Institute

2. Introduction

Photo courtesy of Fáilte Ireland

In 2012, the Inter-Departmental Marine Coordination Group (MCG), on behalf of the Government, published Harnessing Our Ocean Wealth - An Integrated Marine Plan for Ireland (HOOW). HOOW sets out the Government's Vision, High-Level Goals, and Key 'Enabling' Actions to put in place the appropriate policy, governance and business climate to enable Ireland's marine potential to be realised. The Group is chaired by the Minister for Agriculture, Food and the Marine and its members are drawn from Departments with marine related responsibilities.

As part of the implementation of HOOW, the MCG publishes an Annual Progress Report at the annual Our Ocean Wealth Summit. The Progress Report focuses on the main activities undertaken across the range of enabling actions aimed at implementing the Vision and Goals in HOOW. Further information on Harnessing Our Ocean Wealth and previous Annual Progress Reports are available on www.ouroceanwealth.ie.

Figure 1. Composition of the Marine Coordination Group 2018

In Ireland responsibility for marine matters is spread across a number of Government Departments. In recognition of the need for better coordination and the broad scope of the sector, the Inter-Departmental Marine Coordination Group (MCG) was established in 2009. The Group, chaired by the Minister for Agriculture, Food and the Marine and convened by the Department of the Taoiseach, meets on a regular basis to bring together senior officials of Departments with an involvement in marine issues to drive forward the Government's marine strategy and coordinate issues that require cross-departmental action. The Attorney General's Office and the Marine Institute also participate in the Group.

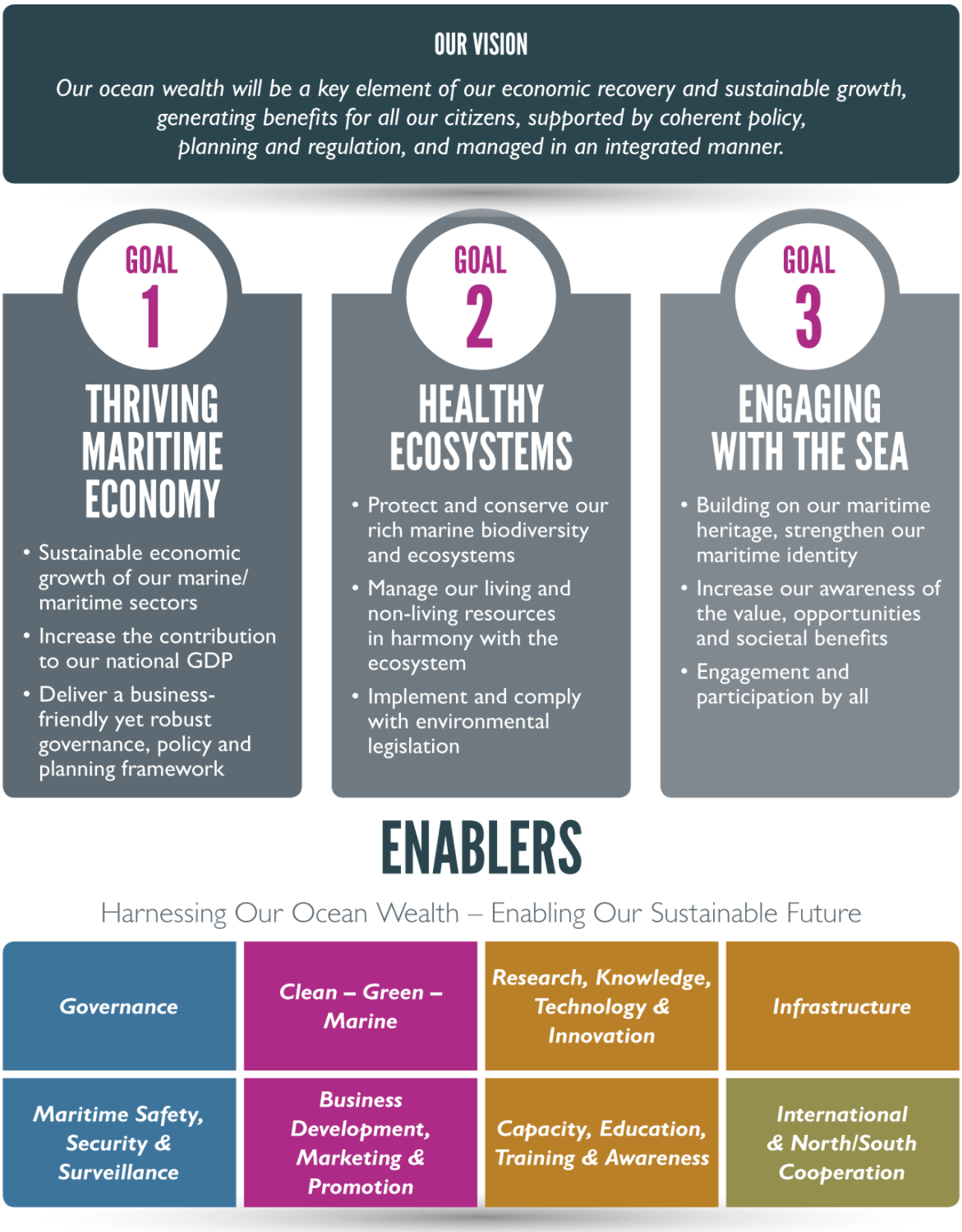


Figure 2. Harnessing Our Ocean Wealth, Vision, Goals and Enablers

2. Summary of Key Achievements and Announcements in 2018

Photo courtesy of Jason Clarke

National Celebration of Our Ocean Wealth

SeaFest is held annually to coincide with the annual Our Ocean Wealth Summit. The festival has grown annually, attracting over 103,400 visitors to Galway Harbour and Docks during the three day event held from 29 June to 1 July 2018. The final day of festivities in 2018 attracted the largest number of visitors to SeaFest since it was established in 2015. As Ireland's national maritime festival, SeaFest aims to strengthen our maritime identity, increasing participation and engagement with the sea in accordance with Goal 3 of Harnessing Our Ocean Wealth (Ireland's Integrated Marine Plan). Working together with a wide range of partner agencies and organisations, the Marine Institute coordinated SeaFest on behalf of the cross-government Marine Coordination Group, which is chaired by Minister Creed. BIM and Bord Bia were also central to the event showcasing a range of activities highlighting Ireland's diverse seafood industry and resource.

Figure 3. Photos from SeaFest 2018

As part of SeaFest, the fifth 'Our Ocean Wealth Summit' was held. The 2018 Summit focused on optimising, commercialising, managing and protecting Ireland's blue economy, worth over €2 billion directly to the economy each year, with the overall theme of 'Investing in Marine Ireland'. Minister Creed addressed delegates at the Summit, welcoming positive growth trends in Ireland's blue economy. The Minister also launched, on behalf of Government, the annual Harnessing Our Ocean Wealth Review of Progress. In addition to Minister Creed's address, Ministers representing the following Government Departments also addressed the Summit – Denis Naughton TD, Department of Communications, Climate Action and Environment; Damien English TD, Minister of State for Housing and Urban Development, Department of Housing, Planning and Local Government and Seán Kyne TD, Minister of State for Rural Affairs and Natural Resource Department of Culture, Heritage and the Gaeltacht. The keynote speaker for the 2018 Summit was Mary Robinson.

Other key events that took place in the city during SeaFest included the Marine Ireland Trade Show organised by Enterprise Ireland, and a commemoration event – Life and the Sea – a civic and military service to remember all those who have lost their lives at sea and recognising the heroism of the men and women of our rescue services.

At a local level in Galway, it is estimated that SeaFest and associated events in 2018 generated €6.5 million in direct income for the city's tourism industry. Local, national and international media coverage of the festival reached record levels. For example, media coverage reached an estimated audience of 16.5 million with SeaFest 2018 featured on shows such as RTÉ Nationwide and RTÉ Countrywide. SeaFest also received a national award for 'Best Cultural Event' at the 2018 Event Industry Awards and was described by judges as "a great celebration of Ireland's maritime heritage that serves an important cultural purpose."

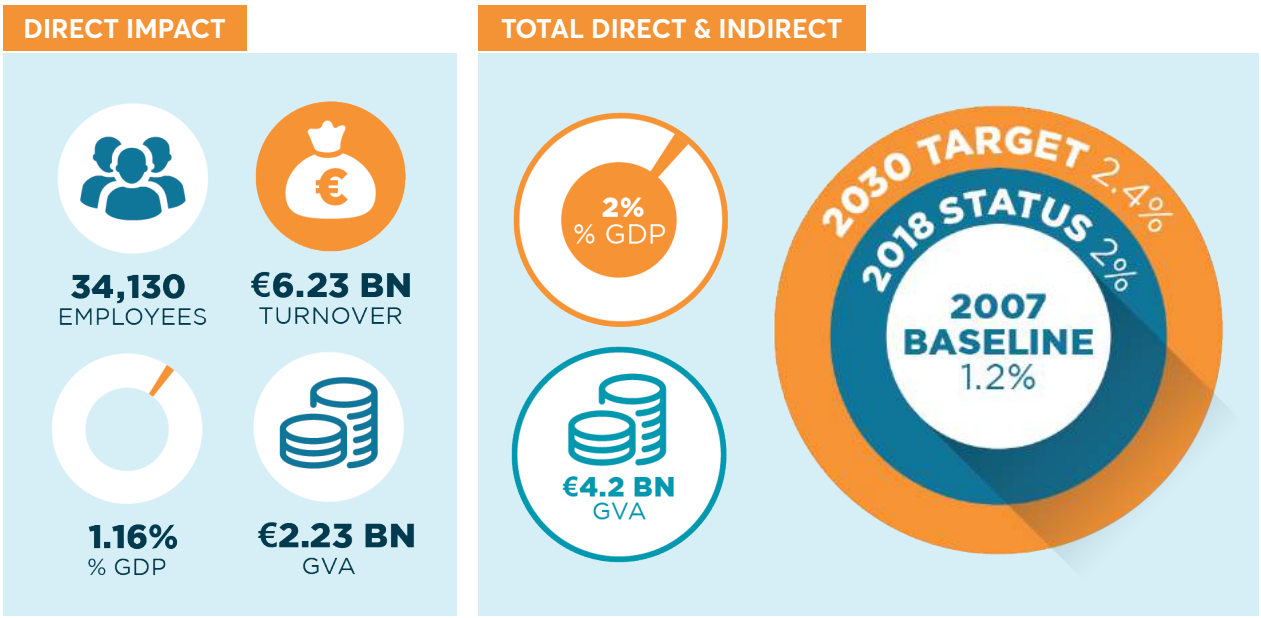
In October 2018, it was announced by the Tánaiste and Minister for Foreign Affairs and Trade, Simon Coveney TD and Minister for Agriculture, Food and the Marine, Michael Creed TD that Cork will host SeaFest from 2019 – 2021. In 2020, Cork will also host European Maritime Day, which will coincide with SeaFest.

Ireland's Ocean Economy on Course to Achieve 2020 Target

The latest report on Ireland's Ocean Economy, published in June 2019 by the Socio-Economic Marine Research Unit (SEMRU) in NUI Galway, provides the most recent trends towards achieving the Government's economic targets set out in Harnessing Our Ocean Wealth.

The SEMRU report shows that in 2018 Ireland's ocean economy had a turnover of €6.2 billion and a direct economic contribution, as measured by gross value added (GVA), of €2.2 billion or 1.1% of GDP. The update shows that Ireland is on course to achieve the 2020 target set by Government and the gap towards the 2030 target is narrowing.

Compared to 2016, SEMRU have reported a 13% increase in turnover in 2018, an 11% increase in GVA and a 13% increase in employment. The indirect GVA that is generated from ocean related activity in Ireland amounts to €1.96 billion, with a total GVA (direct and indirect) of €4.19 billion (representing 2% of GDP). Trends and commentary across all established and emerging marine sectors is provided in SEMRU's full report available on www.nuigalway.ie and www.ouroceanwealth.ie.



	2018	Government Targets	% Change 2014-2016 (Actual)	% Change 2016-2018 (Estimate)
GVA	€2.23 bn		33%	11%
Employment (FTEs)	34,132		10%	13%
% GDP (Direct)	1.1% GDP			
% GDP (Direct & Indirect)	2%	2.4% (2030 Target)		
Turnover	€6.23 bn	€6.23 bn	18%	13%

Table 1: Ireland's Ocean Economy 2018. Source SEMRU, NUI Galway (2019)

Developing Ireland's National Marine Planning Framework

In September 2018, the Department of Housing, Planning and Local Government published the National Marine Planning Framework Baseline Report for a three month public consultation period. The Baseline Report sets out the policy, legislative and regulatory context for marine planning in general and, more specifically, for the development of Ireland's first plan. It provides a description of the 'as is' situation in terms of existing sectoral development and activities in Ireland's maritime area, including an identification of the future opportunities and constraints for each. Based on discussions at the Advisory Group an initial elaboration was made of potential high-level objectives for Ireland's first National Marine Planning Framework. A number of consultation questions or issues were provided which were intended to prompt discussion and consideration amongst stakeholders. The consultation closed in December and 173 submissions were received from a wide variety of stakeholders.

Investment under Ireland's European Maritime and Fisheries Fund (EMFF)

Ireland's European Maritime and Fisheries Fund (EMFF) Operational Programme invested a total of €43.8 million in 2018. This compares to investment of €27.6 million in 2017. The increasing level of investment spend is a positive indication of a ramping up of investment levels in what for most schemes was their third year of operation. The performance of the Programme in 2018 was notable in a number of respects, in particular:

- The seven newly established Fisheries Local Action Groups (FLAGs) launched their second calls for projects and the outcome was very positive, with 209 grants awarded, 31% of the overall FLAG funds spent and a project pipeline that will contribute to 2019 spend.
- Strong interest in EMFF funding of innovation and research projects across fisheries, aquaculture and processing.
- A notable increase in capital investment in aquaculture as more sites are licensed.
- Investment of €7.6 million for improvements to two Fishery Harbour Centres under the EMFF Fishery Harbour Scheme, with further investments in 2019.
- An increase in the scale of capital projects.

Specific details on investments across the six Union Priorities is available under Action 1.

€23.4 Million Harbour Development Works at Castletownbere Fishery Harbour Centre

Construction on a major harbour development works project at Castletownbere, Co. Cork commenced in October 2018. Once completed, the investment will provide a major expansion of the existing 'Dinish Wharf'. The €23.4 million works contract, awarded in July 2018, progressed steadily through to year end with site establishment, construction enabling works, capital dredging, and steel sheet piling to extend the pier, underway. Environmental and archaeological monitoring works contracts were in place to supervise the civil works and are ongoing. With expenditure of €7.6 million incurred in 2018, the works programme are scheduled to be completed in December 2019. Further details are available under Action 34f.

Significant Progress Towards Introduction of the Landing Obligation (Discards Ban)

A key element of Common Fisheries Policy (CFP) Reform has been the introduction of a practical and phased discards policy (or landing obligation) by 1 January 2019. The objective of the Landing Obligation (also referred to as the 'discards ban') is to eliminate the wasteful and unsustainable practice of discarding. Since October 2014 the European Commission has adopted several discard plans, within the parameters laid down in Article 15 of the Common Fisheries Policy, in the waters of interest to Irish fishermen in preparation for the full implementation of the landing obligation.

The North West Waters Regional Group of Member States and stakeholders met regularly throughout 2018 to discuss various implementation issues and also to agree to the inclusion of additional measures to support the phasing in of the landing obligation and in particular reducing unwanted bycatch by the target date of 1 January 2019. It is expected that over time, the landing obligation will lead to an improvement in the state of the stocks of importance to Ireland and will result in increased sustainable fishing opportunities for the Irish fishing industry. Further details are available under Action 10.

Inshore Fishing Sector - Increased Protection to Waters inside Ireland's Six Mile Limit

In December 2018, following extensive public consultation and scientific and technical advice, Minister Creed announced the exclusion of trawling by fishing vessels over 18 metres from inshore waters inside the six nautical mile zone and the baselines from 1 January 2020. This increased protection to waters inside Ireland's 6 mile limit will bring benefits for the Irish inshore fishing sector as well as providing wider ecosystem benefits for nursery areas and juvenile fish. Further details are available under Action 10.

BIM Hosted the Global Accelerator Programme for Aquaculture in 2018

In 2018 Bord Iascaigh Mhara (BIM) hosted the first Accelerator programme for aquaculture to be held in Ireland, and only the second such programme in the world.

The Accelerator programme is an intensive fixed-term programme aimed at upscaling start-ups and includes access to investors, workshops and mentoring. BIM recognises that start-ups help to drive new ideas and are crucial to the continued development of Ireland's seafood sector and that this type of programme is often the launchpad for incredible innovation.

Aquaculture start-ups from the UK, US, Canada, Chile and India participated in the three month programme based in Cork city. During the programme the start-ups received the support they need to develop and tap into a network of investors, commercial partners, experts and experienced entrepreneurs.

The Hatch Accelerator Demo Day in December 2018 marked the end of the programme. On the day the start-ups presented to an audience of Irish and international investors and via a livestream, with Aquamonk, an Indian based start-up that uses real-time monitoring and data management for shrimp farming.

The programme supported by BIM under the European Maritime and Fisheries Fund was managed by Hatch, who also ran the first programme focused on the aquaculture industry in Bergen, Norway in early 2018. BIM's support for the programme is aligned with its ambition to position Ireland as a leader in the next phase of aquaculture innovation.

Ireland's River Basin Management Plan (RBMP) 2018-2021

In April 2018, the Minister for Housing, Planning and Local Government, Eoghan Murphy TD, published Ireland's River Basin Management Plan (RBMP) 2018-2021 pursuant to the EU Water Framework Directive. This second-cycle RBMP outlines the approach that Ireland will take to protect our waters over the period to 2021, building on the lessons learned from the first planning cycle.

An enhanced evidence base was developed to guide national policies and the targeting of local measures. Technical assessments of 4,829 water bodies were carried out, examining their atus (quality) and whether they are 'at risk' of not meeting status objectives in the future. Using this information, the RBMP sets out national policies and regional prioritised measures.

Maritime Security and Safety – Ship and CASA Replacement Programmes

As part of the Government's Ship Replacement Programme a fourth Offshore Patrol Vessel, the LÉ *George Bernard Shaw* was delivered in 2018. Also in 2018, a Civil/Military Working Group was formed to research and make proposals in relation to a Multi-Role Vessel for the Naval Service in accordance with the White Paper on Defence 2015.

Stage one of the CASA CN235 Replacement Programme Request for Proposal was completed in mid-2018. Stage two Request for Tender commenced in the last quarter of 2018. The first of the new aircraft deliveries is expected by mid-2021. The airframe, sensory and communication capability of the new aircraft is expected to deliver notable improvements to supporting the Recognised Maritime Picture through aerial surveillance.

Implementing the National Ports Policy

A number of developments across Ireland's ports made significant progress in 2018.

Dublin Port Company began preliminary work on the second major capital project from the Dublin Port Masterplan – called the 'MP2 Project' – to provide additional capacity for future growth. The project will create one terminal for three of the company's five ferry operators – Irish Ferries, P&O and Stena Line. Following extensive public consultation, the Dublin Port Masterplan 2040 – Reviewed 2018 was launched in June 2018. Between now and 2040, major development projects are envisaged on both the north side of the Port and on the Poolbeg Peninsula. All of these major projects will be subject to detailed scrutiny in terms of their environmental impact and, particularly, their potential impact on Natura 2000 sites in Dublin Bay.

Port of Cork Company commenced work on its Ringaskiddy Project in June 2018. This project represents an investment of €90 million in the redevelopment of Ringaskiddy.

In May 2018, Shannon Foynes Port Company announced plans for an expansion at its general cargo terminal at Foynes, adding over two-thirds to the size of its existing area. Shannon Foynes will invest over €20 million in converting 83 acres on the east side of the existing port into a land bank for marine related industry, port centric logistics, and associated infrastructure.

In March 2018, the European Commission (DG MOVE) published its draft Connecting Europe Facility (CEF) midterm review, which confirms the extension of the North Sea Mediterranean Corridor (NSMED) to include Shannon Foynes Port Company.

In November 2018, the Irish Maritime Development Office (IMDO) published a report on the 'Implication of Brexit on the use of the Landbridge'. Further details on this study, as well as other developments in the maritime transport sector are available under Actions 24 and 32.

Wild Atlantic Way

In December 2018, the Department of Transport, Tourism and Sport published a Tourism Action Pan for the period 2019-2021. The Plan includes actions enhancing visitor experiences, development of food-related experiences (of which seafood is a key element) as well as recognising the importance of local communities. 2018 saw a number of developments linked to one of Fáilte Ireland's key regional experience brands the 'Wild Atlantic Way'.

A number of Visitor Experience Development Plans (VEDPs) were progressed in 2018:

- Skellig Coast – a plan has been launched and funding for four new and existing visitor attractions announced. There has been a 7% increase in business across the Skellig Coast and 15 new saleable experiences have been developed.
- Connemara Coast and Aran Islands – A Steering Group has been established to implement the plan and funding for five key new and existing visitor attractions allocated.
- The Burren and Cliffs of Moher, Three Heads (Ballydehob, Co. Cork to Kenmare, Co. Kerry) and Dingle Peninsula plans are works in progress which are due to be launched in early 2019.
- Fáilte Ireland launched the New Horizons on the Wild Atlantic Way 2018 Small Grants Scheme to provide funding of over €1 million to nine new and operating visitor attractions along the route within the defined geographies of the Connemara Coast/Aran Islands, and the Skellig Coast.

A number of Large Capital Investment Projects were also announced in 2018:

- In partnership with the Office of Public Works (OPW), Fáilte Ireland announced investment of €4.3 million in four key heritage sites along the Wild Atlantic Way: the Blasket Islands Visitor Centre, Co. Kerry (development of new signature viewing point and a number of interpretive galleries at the visitor centre); Céide Fields in Co. Mayo (addition of new exhibition and interpretation space at the visitor centre); Inis Mór in the Aran Islands, Co. Galway (major upgrade of the existing visitor interpretation centre); and Carrowmore in Co. Sligo (improvement/updating of the visitor exhibition).
- Alongside funding from the Special EU Programmes Body, Irish Lights, Donegal County Council Údarás na Gaeltachta and Fáilte Ireland invested €470,000 in the development of a new visitor centre and car park for Fanad Lighthouse, Co. Donegal, which was officially opened in 2018.

A Wild Atlantic Way Tourism Co-ordination Steering Group and Working Group were established to ensure that all stakeholders are working together for the benefit of the Wild Atlantic Way. Chaired by Fáilte Ireland, members of the Steering Group include CEOs of relevant Local Authorities and public agencies active in tourism, along with representation from industry.

INFOMAR

The State's seabed mapping programme (INFOMAR), jointly managed by the Geological Survey Ireland and the Marine Institute, reported unprecedented seabed mapping coverage in 2018 with a total of 11,724 km² of seafloor mapped. The favourable weather conditions also allowed for the mapping of 52 shipwreck locations. Further details are available under Action 23.

Observing and Managing Our Oceans - Increased Investment in and Commitment to Marine Research and Innovation

An important announcement in 2018 was the Government's approval to build a replacement vessel for the RV *Celtic Voyager* and the award of the design contract in December 2018. 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. It will greatly enhance the Marine Institute and the State's capabilities in managing Ireland's vast maritime territory. 2018 also saw a significant infrastructure grant from Science Foundation Ireland to the Marine Institute aimed at upgrading and replacing a number of marine observation infrastructures, as well as acquiring new observation equipment. This is in addition to additional funding from the Department of Agriculture, Food and the Marine to the Marine Institute to run the National Weather Buoy Infrastructure. Enhancing the State's capabilities in the area of forecasting ocean and climate change places Ireland in a unique position to better understand and contribute to national climate adaptation as well as international climate policy.

In 2018, the Marine Institute awarded €2 million over a five year period to Maynooth University for a Principal Investigator-led programme of research on oceans and climate change. This is in addition to funding provided by the EPA in support a range of marine and coastal research projects linked to Ireland's changing climate, climate adaptation and resilience. 2019 will see additional calls for research, jointly funded by the EPA, Marine Institute, OPW and Met Éireann. Further details are available under Actions 13 and 21. Increasing Ireland's scientific research capacity in key areas such as sea level change, ocean circulation, and carbon sequestration, is essential in a global context. The continued investment will further contribute to building Ireland's national capacity and delivering relevant knowledge aimed at better understanding the complex interactions between the ocean and climate change.

The Irish marine research community also continued to successfully win a number of national and international research grants. As of the end of 2018, Irish-based researchers have been awarded a total of €48 million for participation in marine research projects across all parts of the EU Horizon 2020 programme. Further details are available under Action 21.

'Safe Seas – Connected Coasts'

During 2018, Irish Lights launched their new Strategy 2018-2023: Safe Seas – Connected Coasts. The strategy sets out a range of value added activities including the objective of maximising the utilisation of its infrastructure to the national benefit.

In addition to the continuous provision of Aid to Navigation (AtoN) services to international standards in 2018, Irish Lights also experienced growth and further development of their Great Lighthouses of Ireland (GLI) programme. The GLI brand partnership continued to experience growth with visitor numbers up by 12%. 2018 also saw the completion of the Fáilte Ireland funded reception centre and car park at Fanad Lighthouse. Further details are available under Action 34d.

Leveraging Funds to Support the Development of Ireland's Offshore Renewable Energy Sector

Sustainable Energy Authority of Ireland (SEAI) were awarded three EU projects in October 2018, which will leverage EU funds to support activities relevant to the development of the offshore renewable sector and test infrastructure:

- AFLOWT is a five year project with the objective of testing a floating turbine in Atlantic Marine Test Site (AMETS) in 2022/23, subject to consent. The project value is €31 million and SEAI have been grant aided €4.5 million to carry out infrastructure upgrades on AMETS. Over 2019 and 2020 the project will focus on planning, permitting and detail design of the technology prior to any significant expenditure. Funding for this project has been awarded by Interreg North-West Europe (NEW).

- OPIN (Ocean Power Innovation Network) started in pilot phase for 12 months in 2017 and is a joint initiative between Ireland, Scotland and Northern Ireland. This project enables the further development of the network to include other international marine clusters and the development of services to support business and product development. The network will encourage interaction with relevant sectors (e.g. oil and gas, automotive, airline) that can assist the growth of the ocean renewable sector. SEAI will lead the project, which has a budget of €2.5 million. Funding for this project has been awarded by Interreg NWE.

- OceanSET was developed to support the implementation of the European Strategic Energy Technology Plan (SET-Plan) for ocean energy. An implementation plan has since been developed which will now be rolled out and supported by the OceanSET consortia. OceanSET will be led by SEAI. Funding for this project was awarded under the EU Horizon 2020 programme.

Maritime Affairs Attaché

Maritime Affairs Attaché is based at the Permanent Representation of Ireland to the European Union in Brussels. The purpose of the post is to ensure that there is a full-time resource in Brussels to represent Ireland in relation to EU developments in respect of the marine and integrated maritime policy. Specifically in 2018 this included:

- Participating in the Atlantic Strategy Steering Group and contributing to the mid-term evaluation of the Atlantic Action Plan, which included hosting a workshop in October 2018 in Dublin. the event brought together key stakeholders in the two areas of aquaculture and maritime connectivity in the EU Atlantic area. The outcomes of the workshops will form the foundation for a revised Atlantic Strategy Action Plan to be published bu the European Commission in 2019.

- Playing an active role in a number of conferences and seminars throughout 2018, among them the 5th Annual Atlantic Strategy Conference that took place in Vigo, Spain in October.

- Participating in European Maritime Day which took place on 31st May and 1st June in Burgas, Bulgaria.

- Representation at the international Our Ocean Conference in Bali, Indonesia by the Minister for Agriculture, Food and the Marine, Michael Creed TD. This annual conference aims to identify solutions and commit to actions in order to address some of the most important challenges facing the oceans: marine protection, marine pollution, climate change impact and sustainable fisheries, the blue economy and maritime security. Ireland was one of seven EU Member States to make commitments at this conference and overall, committed €320 million to direct actions across each of the specific areas.

- Contributing to the development of a new EU Maritime Security Strategy Action Plan which was agreed by the European Council at the end of June 2018.

- Continuing to work closely with the EU Commission and other institutions in the areas of the blue economy, ocean energy and research and innovation and recognises the centrality of the EU's maritime policies to the successful implementation of Harnessing Our Ocean Wealth.

Marine Ireland

A multi-agency focus on promoting the 'Marine Ireland' brand at home and internationally continued in 2018. This included a number of targeted business development activities in the ocean energy/offshore renewables sector as well as a number of cross-sectoral events and activities. This included promoting marine capabilities in Irish small and medium-sized enterprises (SMEs) as well as attracting new marine businesses into Ireland. 2018 also saw continued multi-agency support and involvement in the Enterprise Ireland (EI) managed Irish Marine Industry Network (IMIN). The IMIN membership stands at 430 members, with new members joining up on a weekly basis. The aim for IMIN in 2019 is to expand and develop a calendar of events aimed at building business relationships and showcasing Irish capability in the sector to overseas stakeholders. Work will also commence on building an online and social media presence for the Network. The Network held three events in 2018:

- A visit to the Ringaskiddy campus in February 2018, where the members visited the Naval Base, toured a Naval Service vessel, had a networking dinner on the Base and the following morning visited the Lir Ocean Test Facility, MaREI and the National Maritime College of Ireland.

- Marine Ireland Tradeshow: a networking event held as part of the Our Ocean Wealth Summit in Galway in June 2018. More than 45 businesses exhibited over the two days across a diverse range of marine products and services (marine construction and engineering, Information and Communications Technology [ICT], offshore renewables, maritime surveillance and security, environmental management and data services, as well as marine robotics and other technologies).

- Dun Laoghaire in September 2018, where members toured the Irish Lights building, the Geological Survey Research Vessel *Keary* and finished with a networking dinner in association with the EI Middle Eastern Ports/Harbours Inward Buyer Delegation. The Dinner was addressed by Minister of State for Higher Education, Mary Mitchell O' Connor, TD, who encouraged the Network to continue its development.

Enterprise Ireland, Sustainable Energy Authority Ireland (SEAI) and the Irish Maritime Development Office (IMDO) of the Marine Institute also continued to work with a number of agencies aimed at supporting 'Marine Ireland'. A number of EI client companies in the marine engineering, construction, Internet of Things (IoT) and advanced technologies and offshore renewables sectors were directly supported in 2018. In addition, EI and the IMDO, hosted a 'Marine Ireland' branded stand at Oceanology International, the hi-tech marine trade show in London in March 2018. The stand showcased a number of Irish SMEs in the sector. IDA executives from London and Dublin also attended the event where IDA identified and met with approximately 20 target companies. Ireland's test sites for ocean energy (Lir – Cork, SmartBay/Marine Institute – Galway Bay, AMETS – Co. Mayo) continue to be developed and promoted at a cross-agency level under the 'Ocean Energy Ireland' brand led by SEAI, as part of the Offshore Renewable Energy Development Plan (OREDP).

IDA Ireland's 2018 activities continued to encourage investment in the 'Marine Ireland' brand. Activites included:

- Supporting a two day event, in conjunction with Ireland Ocean Racing, with multinationals regarding potential sponsorship
- Completing a marketing trip to Oslo to meet with companies in the shipping and marine renewable energy space
- Presenting to the Shetland Alliance – companies specialised in oil and gas, renewables, energy storage, marine engineering (for energy, infrastructure, and aquaculture), ports/harbours, and infrastructure
- Contributing to the mission and direction of the Our Ocean Wealth Summit, supporting an international panel discussion on the topic of 'Integrated Digital Ocean'
- Presenting to a delegation of Norwegian marine and renewable companies and the Norwegian Ambassador to Ireland
- Meeting with a marine renewable company headquartered on the East Coast of the US, to discuss the international operation in Dublin focused on product development. The company has already received SEAI funding and are now at a scale to be onboarded as an IDA client in 2019
- Hosting a three day company itinerary to Dublin, Galway and Cork from an innovative, Southern California aquaculture company seeking to set up a manufacturing and R&D facility in Ireland
- Attending the IMDO Maritime Commerce Forum to meet counterparts within the marine sector

Other significant initiatives included investment by Bord Iascaigh Mhara (BIM) under the European Maritime and Fisheries Fund (EMFF) Operational Programme in schemes such as the Knowledge Gateway Scheme and the Seafood Innovation Scheme. Investments in 2018 included a number of Research and innovation projects supporting both the aquaculture and seafood industry.

The Marine Institute has partnered with BIM and Údarás na Gaeltachta to develop an Aquaculture Research Cluster. The Cluster includes the proposed Páirc na Mara site in Cill Chiaráin as well as the Marine Institute's research facilities site in Beirtreach Buí (Carna). Co. Galway and Newport, Co. Mayo.

The National Marine Research & Innovation Strategy 2017-2021 continues to be implemented as a whole of government strategy. In collaboration with the members of the Marine Research Funders' Forum, a Forum set up as an implementing mechanism for the strategy, a preliminary analysis of funding data provided by the members was undertaken in 2018. Further details on this, and on the Marine Institute Industry-Led Call launched in May, are available under Action 21.

Other significant announcements in 2018 included the award of a number of marine projects under the Government's Disruptive Technologies Innovation Fund. This includes a €2 million collaborative project (Hydro-fish) involving NUI Galway, Bio-Marine Ingredients Ireland Ltd, Teagasc and the Marine Institute. While Teagasc and the Marine Institute are collaborating on this project, as public bodies they will not receive co-funding from the Fund, which is testament to this consortium's commitment to developing an innovative and disruptive solution to address short-comings in the aquaculture industry.

3. Progress on Actions in 2018

Section 3 provides an overview of progress on Actions across the eight Enablers identified in Harnessing Our Ocean Wealth.

Governance	Clean Green Marine	Research, Knowledge, Technology & Innovation	Infrastructure
Maritime Safety, Security & Surveillance	Business Development, Marketing & Promotion	Capacity, Education, Training & Awareness	International & North/South Cooperation

Photo courtesy of Richard Mcall

Governance

Good governance and coordinated cross-government action is essential to achieving our Vision and Goals

- Harnessing Our Ocean Wealth

Photo courtesy of Failte Ireland

Governance

Action 1

Develop and implement clear and forward-looking policies and strategies that support an increased contribution from our ocean economy to national GDP.

(1a) Implement existing (e.g. Food Harvest 2020) and planned (e.g. Ports Policy, Offshore Renewable Energy Development Plan) sectoral strategies/plans through effective coordination of actions across a range of government departments and agencies.

(1b) Develop an integrated enterprise strategy to generate momentum in specific emerging market opportunities prepared across development agencies (e.g. offshore renewables, offshore services, ICT and sensors, biotechnology).

(1c) Continue to develop new policies/strategies that address gap areas through an integrated approach.

The Offshore Renewable Energy Development Plan (OREDP)

In May 2018, the Minister for Communications, Climate Action and Environment, Denis Naughten TD, published the Interim Review of the Offshore Renewable Energy Development Plan (OREDP).

The OREDP identifies the opportunity for the sustainable development of Ireland's abundant offshore renewable energy resources. To increase indigenous production of renewable electricity, contribute to reductions in our greenhouse gas emissions, improve the security of our energy supply and create jobs in the green economy, the OREDP sets out key principles, policy actions and enables the delivery of Ireland's significant potential in this area. In this way, the OREDP provides a framework for the sustainable development of Ireland's offshore renewable energy resources.

The Review addressed a number of actions related to supporting ocean energy research, development and demonstration, including the development of enabling infrastructures such as the Atlantic Marine Energy Test Site (AMETS) and the Galway and Cork test facilities. Further details of these are provided in Actions 25 and 31.

2018 also saw Sustainable Energy Authority of Ireland (SEAI) leverage significant EU funding. This includes AFLOWT, a five year project with the objective of testing a floating turbine in AMETS; a joint initiative between Ireland, Scotland and Northern Ireland enabling the further development of the Ocean Power Innovation Network to include other international marine clusters; and OceanSET to support the implementation of the European Strategic Energy Technology Plan (SET-Plan) for ocean energy.

Offshore Oil and Gas

The 2015 Energy White Paper forecasts that, in a low-carbon energy future, between a quarter and half of Ireland's energy needs will continue to be met by fossil fuels. As Ireland transitions to a low carbon energy system, secure supplies of gas and oil will continue to be a key need for our society. In the short to medium-term, the mix of non-renewables will shift away from more carbon-intensive fuels, like peat and coal, to lower-carbon fuels like natural gas. In the longer-term, the intention is to largely replace fossil fuels with renewable energy sources. In that transition period the development of Ireland's offshore oil and gas resources have the potential to deliver significant and sustained benefits to the people of Ireland in terms of security of supply, import substitution, national and local economic development, technology learning and fiscal return.

Gas Production

The Corrib gas field commenced production at the end of 2015 and is expected to supply, on average, up to 57% of the State's natural gas demand out to 2020. The Kinsale and Seven Heads gas fields are expected to meet 3-5% of Ireland's natural gas demand until they cease production in 2020/2021, at which point the facilities will be decommissioned.

Indigenous gas production from the Corrib, Kinsale Head and Seven Heads gas fields accounted for 62% of the State's total natural gas demand in 2018.

In 2018, gas production from Corrib met over 55% of Ireland's gas demand. The introduction of Corrib was a key contributor to Ireland's energy import dependence falling from 87% in 2015 to 70% in 2016. Corrib met 56% of the Republic of Ireland's gas demand in 2018, with the Inch (Kinsale) and Moffat entry points providing the remaining 6% and 38% respectively. By 2025/2026 Corrib gas supplies will have declined to less than 40% of initial peak production levels. The anticipated reduction in Corrib and Inch gas supplies will re-establish the Moffat Entry Point as the dominant supply point in the near future. 2018 also saw the divestment by Shell of their interest in the gas field to Nephin Energy.

Exploration

The Department of Communications, Climate Action and Environment continues to facilitate exploration and development opportunities offshore Ireland.

Twelve Frontier Exploration Licences were granted offshore Ireland during 2018. As at the end of 2018, there were three petroleum leases and 50 petroleum exploration authorisations.

There were no seismic surveys acquired or wells drilled in the Irish offshore in 2018.

European Maritime and Fisheries Fund (EMFF) Implementation 2018

In 2018, 19 schemes were funded under the European Maritime and Fisheries Fund Operational Programme for Ireland, with a total investment of €43.8 million in 2018 in Ireland's seafood sector. See Key Achievements Section above for a summary of the key achievements for the year.

Union Priority 1

Sustainable Development of Fisheries

In 2018, €17.15 million was invested in 244 projects across nine schemes supporting activities in a wide range of areas, including:

- Developing more selective fishing gear and methods
- Marine science and data
- On board investment in health and safety, hygiene, quality, selective gear, energy efficiency and value adding
- Adaptation to the Landing Obligation
- Advisory services to the fishing fleet
- Fostering adaptation to the Common Fisheries Policy (CFP)
- Networking and dissemination of knowledge
- Recovery of marine litter and management of waste
- Stock conservation
- New entrants

Many projects approved in 2018 for EMFF funding are of a multi-annual nature and will continue in 2019.

Sustainable Fisheries Scheme

In 2018, 123 projects were supported with €4.44 million under the Sustainable Fisheries Scheme with projects approved under three distinct parts.

Part A - Public Projects

In 2018, 12 Part A projects were approved and implemented by Bord Iascaigh Mhara (BIM) and were supported with public aid of €1.25 million. These were implemented by BIM for the benefit of the seafood sector and for the public good. The projects focused on:

- Development and testing of selective fishing gears and methods
- Provision of Partnerships & Advisory Services to the seafood sector to improve the overall performance and competitiveness of operators, and to promote sustainable fisheries
- Addressing the problem of parasitic worms in fish through the development of sea and shore-based mitigation and detection methods
- Recovering marine litter from the sea and the management of fisheries generated waste at sea and ashore
- Support for the certification and promotion of sustainable fishery products, at sea and ashore

Part B - On Board Investments

In 2018, 105 Part B projects were supported with public aid of €2.92 million

Projects supported in 2018 included:

- Selective gears such as square mesh panels and selective cod ends
- Equipment to improve hygiene, health and working conditions on board such as sanitary facilities and galley facilities for crew
- Equipment to reduce manual lifting
- Equipment to improve fuel efficiency including fuel monitoring equipment
- Gear monitoring equipment and fuel efficient fishing gears
- Investments that improve fish quality and add value to fishery products on board

Demand under this Scheme was exceptionally strong in 2018. While 105 projects were completed and paid, some 185 projects were actually approved for grants worth €5.75 million. This strong project pipeline will contribute to spend in 2019.

Part C - Promoting Quality and Added Value Onshore

In 2018, six projects received public aid of €267,958

Five of these projects were infrastructure improvement projects which aim to assist fishermen and onshore businesses to meet the challenges of the landing obligation. The main elements of the projects were the provision of cold storage facilities and associated handling equipment for the storage of unwanted catches. The sixth project was related to certification.

Marine Biodiversity Scheme

In 2018, some €307,649 was invested under the Marine Biodiversity Scheme supporting four projects under Union Priority 1. Projects supported included the following:

- Restoration of crayfish stocks
- Skate and ray restoration project
- Oyster restoration project
- A dedicated website was developed to function as an information sharing and dissemination platform for the scheme

The Scheme is also supported under Union Priority 6. See details below.

New Fishermen Scheme

In 2018, there were four projects completed under the New Fishermen Scheme with public aid of €226,700.

There was an improved interest in the Scheme during 2018 with eight projects approved for public aid of €375,200. Five projects with grant aid of €148,500 will be carried over into 2019.

Inshore Fisheries Conservation Scheme

In 2018, 80 projects were supported with public aid of €833,262.

Grants of €439,634 were approved so that BIM could undertake five projects for the benefit of the sector. These projects supported:

- Networking in the inshore fisheries sector
- The completion of a strategy for the inshore fisheries sector
- Governance of native oyster fisheries
- The dissemination of information to the sector
- The installation of landing derricks at minor ports

Two industry projects were funded to a value of €32,858 for the installation of onshore cold store facilities for a Small Scale Coastal Fisheries (SSCF) operator and the development of a business plan for an SSCF organisation.

73 projects concerning v-notching of lobsters received support of €360,769.

Control and Enforcement Scheme

In 2018, one project was supported with public aid of €737,232.

The Information Management Technology (IMT) division of the Department of Agriculture, Food and the Marine (DAFM) develops and maintains the fisheries IT systems to support the fisheries divisions of the Department. In 2018, work begun on the development of a new Quota Balancing IT system which allows for the management of the allocation of fishing opportunities in the main pelagic fisheries to:

- Manage the number of stocks within authorised catch limits resulting in a fairer distribution of quota across the fleet
- Put in place a process to adjust future catch limits to address where a vessel has exceeded its allocated catch limit

Further development work under these activities will be advanced in 2019.

Seafood Innovation and Business Planning Scheme

In 2018, 17 innovation and business planning projects were supported with total public aid of €1.55 million.

Nine projects from processing enterprises were supported with public aid of €55,598. These projects included a broad range of new product development and product enhancement projects related to fish and seaweed and seafood derivative products, consumer and market testing, market feasibility studies, and business planning.

Bord Iascaigh Mhara undertook eight innovation projects for the benefit of the sector at a cost of €1.5 million. Projects included:

- Operation and support of a new innovation process in the Seafood Innovation Hub, Clonakilty
- Green Seafood Processing – initiatives in the seafood processing sector to generate cost reductions in the areas of water energy, waste and transport
- Providing business planning and client engagement services
- International leadership and management development programmes

Seafood Capacity Building Scheme

In 2018, the Seafood Capacity Building Scheme provided support for seven public body projects. Six of these were BIM led projects, while the seventh was an external project. These projects drew down a total aid of €889,804 and €486,187 respectively. In addition there were nine projects from seafood enterprises approved in 2018. Three of these drew down a total grant aid of €3,981 in 2018, with the remaining approved projects expected to draw down in 2019. This was the first year of operation of this Scheme, it was introduced primarily to provide aid to stakeholder representative bodies. Feedback suggests that although aid of 60% was available, these bodies have difficulty funding the remaining 40% of costs, resulting in a lack of applications.

Seafood Skills and Training Scheme

This Scheme was launched in 2018. It provides grant aid to people involved in the Irish seafood industry to attend and complete defined training courses. In 2018, 59 applications were approved with three of these drawing down grant aid, amounting to €6,457. The remaining approved projects are expected to complete and draw down in 2019. This Scheme is expected to grow significantly in the future.

Fishery Harbour Scheme

In 2018, two projects were implemented with €7.67 million in public investment. These projects involved the improvement of harbour facilities at the Fishery Harbour Centres in Castletownbere and Killybegs. The objectives of the two projects were as follows:

- Improve safety conditions for staff and users of or visitors to the harbour
- Improve working conditions for staff and users of the harbour
- Increase the quality of products landed in the harbour
- Increase the control of products landed
- Increase the energy efficiency of the harbour
- Contribute to environmental protection

Union Priority 2

Sustainable Development of Aquaculture

In 2018, the EMFF Programme invested €5.13 million in support of 66 aquaculture projects through two support schemes under Union Priority 2. This investment was evenly split between supports for capital investment and for innovation/research/advice. There was good interest in capital investment, particularly for oyster farming, and increasingly from the salmon sector. Changes to the support structure for innovation projects proved positive and attracted strong interest from the research sector, which again involved multi-annual projects that contributed to spend in 2018. Across the two Schemes there has been a doubling in spend and number of projects compared to 2017.

Knowledge Gateway Scheme

In 2018, 28 projects were supported with public aid of €2.54 million. The Managing Authority (DAFM) directly approved 22 projects to be undertaken by BIM for the benefit of the sector and for the public good. Nine of these projects concerned innovation/research while 13 projects were of an advisory services nature.

The innovation projects included the following:

- Technical development of seaweed cultivation and integrated multi-trophic aquaculture (IMTA)
- Developing hatchery techniques for scallop and native oyster
- Improving the depuration process for shellfish
- Quantification and risk assessment of shellfish in respect to viruses
- Investigating alternatives to veterinary medicines in salmonids
- Emerging treatments for Amoebic Gill Disease (AGD)

The advisory service projects included the following:

- Fish Welfare and Guidance Workshops
- CQA Standard Programme including Organic Certification
- Benchmarking CQA standard to Global Seafood Sustainability Initiative standard
- Online standards portal
- Production efficiency in shellfish

Six projects from higher level institutions and industry were supported with public aid of €448,051 in 2018. These are multi-annual projects and so will contribute to spend in 2019 and 2020.

These projects concern:

- Integrated multi-trophic aquaculture
- Development of products from seaweed
- Environmental management in connection with the Water Framework Directive (WFD)
- Animal husbandry
- Developing techniques for production of native oysters

Sustainable Aquaculture Scheme

In 2018, 38 aquaculture capital development projects were supported with public aid of €2.59 million. The Investment included capital investment in oyster, mussel, and salmon production. Projects related to trout and also multi species projects onshore were also funded. Specifically, this included

- Development of oyster farms
- Capacity development on seaweed farms
- Upgrade of salmon technology
- Upgrades of fish ponds
- Development of oyster handling facilities
- Introduction of continuous rope mussel systems

Oyster revenue continues to enjoy a particularly high price point at present and that is reflected in the number of oyster projects being undertaken. It is also likely that 2018 saw an increase in demand for investment in oysters as licences are being renewed.

Union Priority 3

Implementing the CFP (Enforcement and Data Collection)

In 2018, €11.98 million was invested in 10 projects across two Schemes supporting activities in Control and Enforcement and Data Collection.

Control and Enforcement Scheme

The Sea Fisheries Protection Authority (SFPA) invested €1.14 million of EMFF funds in 2018 in support of eight projects under the Control and Enforcement Scheme. In addition to the existing multi-annual projects the Managing Authority (DAFM) directly approved five new SFPA projects in 2018. The projects, currently underway, include:

- ERS (electronic recording and reporting system) Enhancements: Providing replacement equipment for fishing vessel electronic logbooks and inspection devices for SFPA Sea Fisheries Protection Officers.
- Compliance Promotion: Raising awareness of the Common Fisheries Policy (CFP) amongst stakeholders within the Irish fishing community and to improve compliance and enforcement of the CFP rules through promotional activities and events. To date, projects implemented include awareness campaigns and events, and the redevelopment of the SFPA website.
- Technical Assistance: The project office continues to provide support to deliver the portfolio of EMFF projects identified by the Control Authorities.
- Audit Assessment: Improving the effectiveness and efficiency of the Control and Inspection service through independent and objective assessments of the management control and framework.
- Training and Exchange: Development of training and exchange programmes between Member States, in the monitoring, control and surveillance of fisheries activities; training in relation to risk analysis and assessment to promote more effective sea inspection and air surveillance regime; and aligned shore based regime and regulator training to provide an understanding of the legal system, legislation and its integration within the Irish system.
- Engine Power Measurement: Establishment of a national capacity to test the engine power of Irish registered sea fishing boats. This includes the development of a robust process for engine power verification on board fishing vessels, providing the ability to identify non-compliant vessels where they exist, and to recognise and exclude compliant vessels.

- Sales Notes External Portal: Supporting the requirement to redevelop the Sales Notes Portal, which records the first sale of fish. This ensures compliance with the landing obligation by providing support for impacted operators to upgrade existing systems.
- Vessel Monitoring Systems: Replacing the existing Vessel Monitoring System (VMS) on all Irish fishing vessels greater than 12 metres in overall length to ensure continued monitoring of activity on Irish vessels subject to EU and other regulations.

The Information Management Technology (IMT) division of the Department of Agriculture, Food and the Marine (DAFM) develops and maintains the fisheries IT systems to support the fisheries control authority, the SFPA. DAFM invested a total of €3.04 million for Phase 2 of the Integrated Fisheries Information System (IFIS) and electronic reporting systems. This project covered the following developments:

- Data exchange application (FERS) developed for the introduction of the UN/CEFACT (United Nations Centre for Trade Facilitation and Electronic Business) standard for exchange of Fishing Activity and Sales via FLUX (Fisheries Language for Universal Exchange) for other Member States
- Sales Notes – development of an internal and external portal including web services for the transmission of first sale of fish, ensuring compliance with the landing obligation
- Enhancements to vessel tracker application – overlays, catch display data, charts etc.
- ieCatch – ongoing work on redevelopment of vessel software to incorporate changes for the landing obligation and UN/CEFACT standardisation for the exchange of information
- Fleet over Flux – provide a snapshot and daily updates of fleet register in UN/CEFACT format over FLUX as required under Article 9 of Implementation regulation EU 218/2017

Data Collection Scheme

In 2018, €7.8 million was invested by the Marine Institute in the Data Collection Scheme under Union Priority 3. The national data collection programme includes catch sampling at sea and in ports, six internationally coordinated research survey programmes, inshore and diadromous sampling and surveys, collection of transversal data and the socioeconomic evaluation of the fishing, fish processing and aquaculture sectors.

- Biological data was collected at sea on board commercial and research vessels and in fishing ports around the coast as part of ports based sampling. Some 110 at sea trips were completed, and 65 inshore shellfish observer trips were completed in 2018. A total of 288 port sampling trips were completed for demersal stocks. The at sea and port based sampling programme amounted to €357,700 in 2018 (excluding staff costs).
- In 2018, a biological sampling programme for the diadromous species salmon and eel was carried out at a cost of €48,600. This included surveys in the freshwater, trap returns, and the national coded wire tag programme.
- Six internationally coordinated offshore research programmes at sea were completed in 2018, comprising 206 sea days and 2,054 scientific sea days. Total expenditure for these activities was €4.11 million.
- Thirteen inshore shellfish surveys had a cost of €75,186 and provided data for oyster, cockle, scallop, surf clam and razor fish.
- The economic situation of the aquaculture and processing industry sectors was evaluated by BIM through the collection of census data, economic sample surveys and audited accounts from the Companies Registration Office (CRO).

International coordination of fisheries data collection and analysis was achieved through the participation at and contribution to 64 ICES (International Council for the Exploration of the Sea) and EU scientific expert groups directly related to the Data Collection Scheme with a cost of €137,800.

Union Priority 4

Sustainable Development of Fisheries and Aquaculture Areas

Fisheries Local Development Scheme

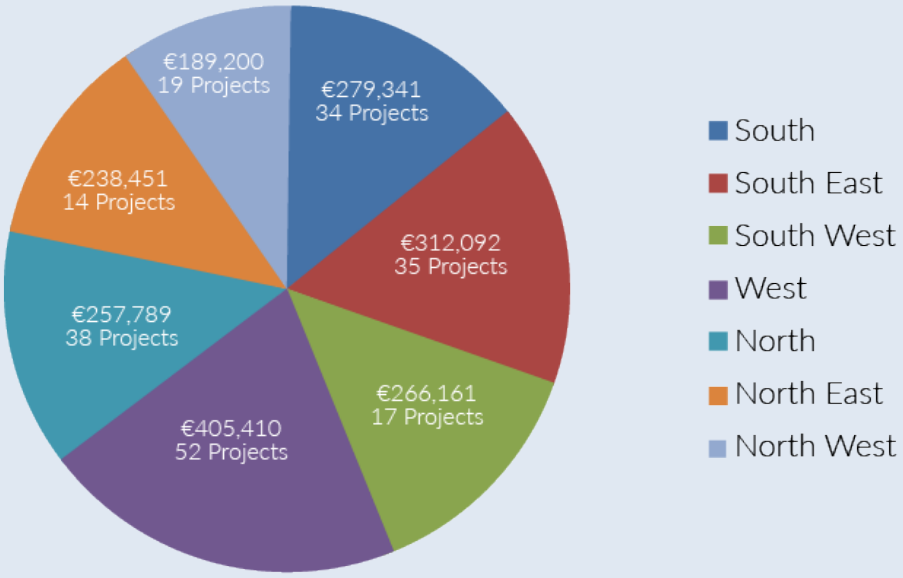
In 2018, the seven FLAGs paid out public aid of €1.95 million to 209 projects.

The seven FLAGs initiated their second year of project calls in early 2018. Approximately 350 project applications were received over the course of 2018, with 247 finally selected for grant approval. Payments were made to 209 projects, including some deferred from 2017. Other approved 2018 projects will be completed in 2019.

FLAG projects implemented in 2018 included the following:

- Capital investments in micro seafood enterprises
- Marine tourism and leisure projects
- Heritage projects
- Small harbour facilities and environmental projects
- Environmental and training projects

Further details are available under Action 19.



Union Priority 5

Marketing and Processing

In 2018, the EMFF Programme supported 32 projects with grant aid of €4.02 million through four Schemes. These investments supported a broad range of activities, including:

- Promotion of seafood
- Capital investment in seafood enterprises to support value-adding investments
- Advisory services to seafood processing small and medium-sized enterprises (SMEs) on innovation, new product and packaging development, business planning, energy efficiency and seafood processing technologies
- Development of route to market structures
- Market development
- Consumer and market research
- Innovation and development of new seafood and seaweed products and packaging
- Development of processing technologies and techniques

Seafood Promotion

In 2018, Bord Bia invested some €2.07 million in public expenditure under its approved 2018 work programme. This work programme contributed to the following initiatives:

- International trade exhibition programme for seafood - which comprised a Bord Bia Ireland Pavilion at eight international trade shows including the following:
    - SEG, Brussels
    - Biofach, Nuremburg
    - Tokyo Seafood Show
    - Seafood Asia, Hong Kong

  A total of 65 seafood processors from the pelagic, shellfish, salmon and added value seafood sectors participated across these eight international seafood shows.
- Domestic market seafood campaigns - two campaigns to promote shellfish amongst Irish consumers were carried out in 2018. A seafood Trails television series was launched which aimed to educate Irish consumers about the range and diversity of Irish seafood available from the catching sector and how versatile and easy it is to cook seafood.
- 'Feet on the Street' resources - These additional ground resources in China and Japan have resulted in 25 inward buyers visits to Ireland and it has also resulted in nine food journalists from China, Korea and Japan visiting Irish seafood farms and processing facilities and generating fantastic media coverage on the Irish sector in these target markets in 2018.
- International consumer research - Six deep dive seafood studies undertaken across key markets in Asia and a further 10 seafood studies undertaken in European seafood markets.
- Emerging Market Seafood promotions - Five promotions carried out in leading retail and foodservice outlets in China and Japan in 2018.

Further details are available under Action 17.

Producer Organisation Scheme

In 2018, four projects were supported with public aid of €312,415 based on eligible expenditure of €480,638. Four claims were received from the Producer Organisations in relation to expenditure incurred in 2017.

The grant aid rates involved a mixture of fixed maximum assistance or a 65% grant aid rate. Expenditure related to direct staff costs, with other typical costs allocated to the engagement of consultants to assist in the preparation of the marketing plans and activity reports. Capital items mainly involved upgrading of computer software and equipment.

Seafood Scaling and New Market Development Scheme

In 2018, six projects were supported with public aid of €476,152.

- Two projects involved collectives, with each collective containing three unrelated processing enterprises. These collectives invested in marketing costs to develop markets in Asia, including retention of the services of a native In-Market consultant. These two projects accounted for EMFF grants of €122,548, which, at a grant rate of 50%, leveraged a total investment into the projects of €245,096 by the two collectives.
- BIM undertook four scaling and new market development projects for the benefit of the sector at a cost of €353,604. This includes:
    - Project Atlantic – Ireland has a quota of approximately 20% of the 1.2 million tonnes of seafood caught annually off the Irish Atlantic coast, highlighting the opportunity to increase landings from foreign vessels into Ireland. Food Wise 2025 sets the goal to significantly increase additional landings into Ireland, generating value and employment in processing and ancillary port services. Project Atlantic is BIM led with a joint industry and state steering group with the objective to determine and enable the Irish seafood sector to add value to the increased landings into Irish fishery ports.
    - China Seafood Council and Domestic Seafood Council discussions on in-market issues and ways to collaborate.
    - Carrying out supply chain projects to identify where value is created and where it can be improved. Use of technology to create value and reduce costs was also examined.

Seafood Processing Capital Investment Scheme

In 2018, 21 capital investment projects were implemented by 16 seafood companies and were supported with public aid of €1.16 million

- There were nine fresh whitefish/salmon value added projects, three smoked salmon/trout projects, two shellfish projects, four pelagic, two food ingredients and one seaweed project.
- Under the Scheme a grant rate of 30% is allowed for value adding secondary processing equipment, while 15% is allowed for other eligible investments.
- In general, the projects related to fresh whitefish/salmon processing and typically involved expenditure on state of the art seafood processing equipment including fish filleting portioning and packing lines.
- Shellfish projects typically included cookers, graders and freezing equipment.
- The food ingredients projects related to equipment for processing blue whiting into protein to be supplied into the global food ingredients industry.
- Salmon and trout smoking operations invested in a mix of seafood smoking equipment.
- The four pelagic projects related to value adding equipment and buildings. Buildings and ancillary equipment formed the expenditure for the one seaweed project.

Union Priority 6

Fostering the Implementation of the Integrated Maritime Policy (IMP)

In 2018, €2.66 million was invested by the Marinie Institute in support of 20 projects across two Schemes.

Blue Growth and Marine Spatial Planning (MSP) Scheme

In 2018, nine MSP projects were supported with public aid to the total spend of €906,074.

The Blue Growth and Marine Spatial Planning Scheme supports actions with the specific objective to provide technical and scientific support for the development of a Marine Spatial Plan for Ireland.

The implementation of UP6 will allow Ireland to improve the level of protection of marine resources and to create conditions for the sustainable exploitation of natural resources.

- Funded under this Scheme are five Spatial Data and Evidence projects, which provide a technical and scientific foundation for implementation of MSP in Ireland. In 2018, a detailed data discovery and gap analysis was undertaken and over 1,900 MSP related datasets were identified nationally.
- Also funded are two projects in the area of Data Management and Information Services for MSP. 2018 saw the implementation of an MSP Data Catalogue, Data Storage and Data Management Quality Framework (DMQF). These systems will provide assurance on the reliability, availability and versioning of MSP data. An achievement for the Marine Institute in 2018 was the International Oceanographic Data and Information Exchange (IODE) accreditation for the DMQF.
- There are two marine invasive species research projects focused on species surveillance and mapping approved for funding as part of the Scheme. One of these projects commenced in late 2018 (see Action 14 for details). The second project will commence in 2019.

Marine Biodiversity Scheme (see also UP 1)

In 2018, €1.76 million supported 11 projects under the Marine Biodiversity Scheme in Union Priority 6. These projects cover the areas of Natura fisheries interactions, Natura aquaculture interactions and support for the Marine Strategy Framework Directive. One additional project was initiated in 2018. The 11 projects can be broken down into the following actions:

- Four projects related to mapping of fishing pressure and fishery Natura interaction.
    - To improve the data collection of vessels <12m and map fishing patterns, iVMS systems have been deployed on over 140 inshore vessels of three métiers (potters, netters, dredgers) in support of Natura assessments and MSP
    - A second offshore reef survey was carried out in 2018 to map sensitive reef areas along Ireland's offshore banks and the northern continental slope
    - Enhanced bycatch project which focused on setnet and pelagic trawl fisheries
    - A project on testing the feasibility of aerial surveys for biodiversity monitoring was initiated in 2018 and a scan of aerial surveys was completed across three areas on the east coast of Ireland to monitor the distribution of seabirds and wading birds
- Three projects focused on the assessment and mitigation of aquaculture impacts on Natura sites at a cost of €208,000 in 2018.
    - Appropriate Assessment Reports of aquaculture activities from six bays were completed
    - Three draft assessments were prepared and revisions were made to four sites
    - Monitoring of mitigation measures continued in two sites and was initiated in a third site in 2018

- Three projects were completed to support the Marine Strategy Framework Directive (MSFD) and biodiversity.
    - Under the project 'Ecosystem data collection on Irish fisheries surveys in support of MSFD', 136 sediment samples were collected on five fisheries surveys. Monitoring for marine mammal distribution and abundance was carried out on nine weeks of the fisheries acoustic survey programme in 2018 covering the Irish shelf and offshore banks. The collected data will feed into Ireland's reporting requirements under the Habitats Directive. Research continued to derive Maximum Sustainable Yield (MSY) reference points on fish species vulnerable to fishing pressure and of ecological significance to improve data availability for MSFD, Good Environmental Status assessment and Common Fisheries Policy MSY targets.
- The 'Informatics project' aims to set up the infrastructure and competence to efficiently integrate and utilise fisheries related data (including fishery/ecosystem interaction data) to support CFP, Natura and MSFD implementation. During 2018, the development of four publically available applications was completed. This included the digital stock book, a fish species dashboard, an Irish groundfish survey data explorer and a tagging app. The expenditure for the Informatics project in 2018 was €330,000.

Brexit
Possible impacts on the Irish Seafood Sector

Throughout 2018 the Marine Institute carried out various analyses and provided scientific support to the Department of Agriculture, Food and the Marine 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 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?

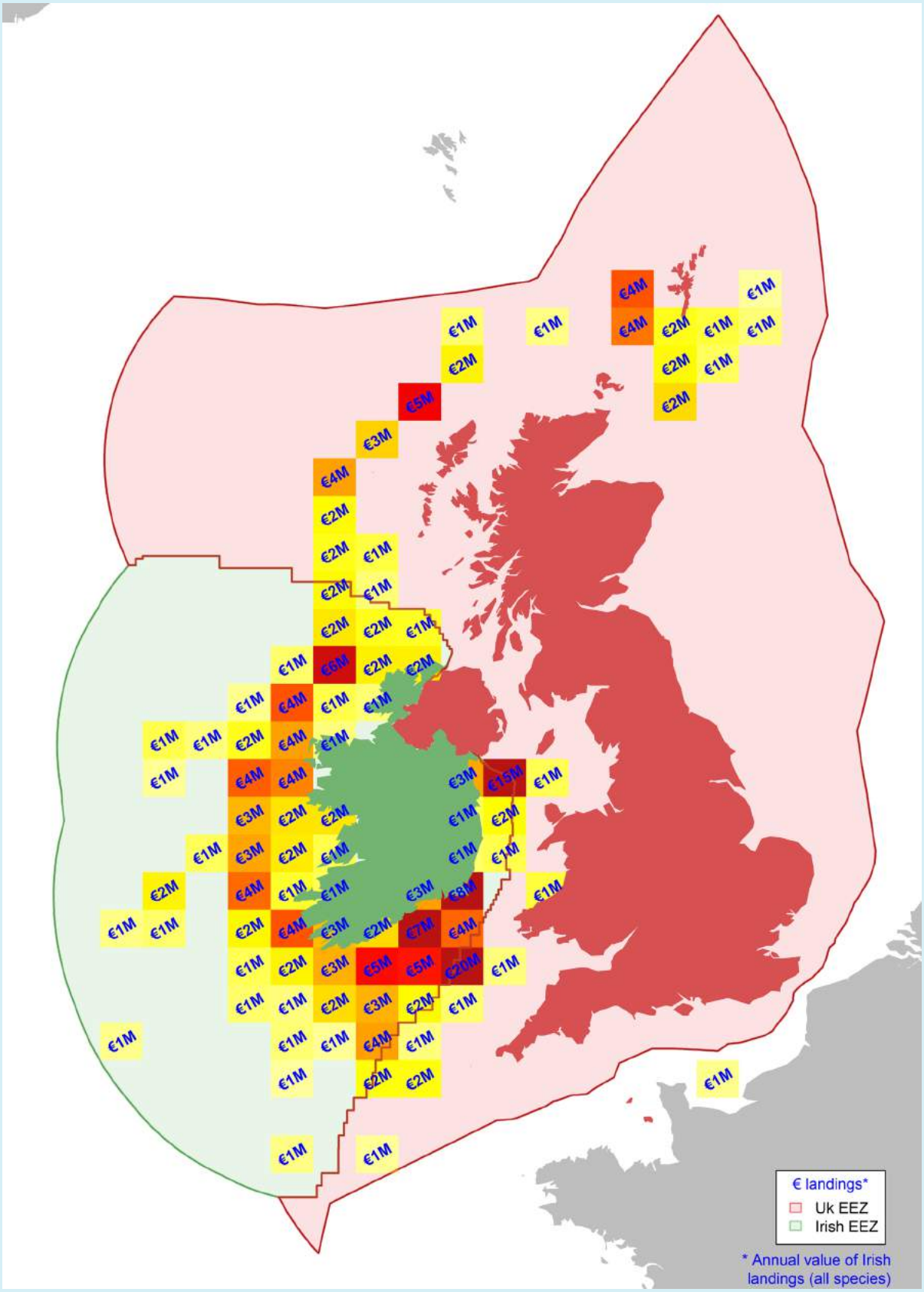


Figure 4. The map shows the distribution of Irish landings (expressed as value € millions) for each of the 'statistical rectangles' in the waters around Ireland. The green area represents EU waters around Ireland. The red areas represent sea areas that will become UK waters after Brexit. Note the value 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.

National Adaptation Framework – Preparing for a Climate Resilient Ireland

Following a public consultation, Ireland's first statutory National Adaptation Framework (NAF), prepared under Section 5 of the Climate Action and Low Carbon Development Act 2015, was published in January 2018. The Framework sets out the context to ensure local authorities, regions and key sectors can assess the key risks and vulnerabilities of climate change, implement climate resilience actions and ensure climate adaptation considerations are mainstreamed into all local, regional and national policy making.

Seven Government Ministers with responsibility for twelve priority sectors are required to prepare sectoral adaptation plans under the Framework while local authorities are required to prepare local adaptation strategies. Amongst the sectors preparing adaptation plans are seafood and biodiversity. Cross sectoral cooperation is an integral part of the preparation of these plans to ensure coherence and key cross sectoral issues are addressed.

The National Adaptation Framework identifies the critical role to be played by local authorities in addressing climate change adaptation. In January 2018, the Minister for Communications, Climate Action and Environment, Denis Naughten TD, announced that the Department would provide €10 million to the local authority sector to establish four Climate Action Regional Offices (CAROs). This commitment recognises the significant obligation that has been placed on local government to develop and implement its own climate action measures, as well as the need to build capacity within the sector to engage effectively with climate change – both in terms of mitigation and adaptation. The CAROs will support local government in addressing shared climate change risks, including marine and coastal issues such as coastal flooding and sea level rise.

The National Marine Planning Framework Baseline Report published by the Department of Housing, Planning and Local Government in September 2018 is a key part of the process of developing Ireland's first Marine Spatial Plan. As set out in the Report, the Marine Plan will consider climate change from two perspectives – how actions under the plan may help mitigate climate change and how actions under the plan need to be adapted to take account of the effects of climate change.

As part of the implementation of the National Adaptation Framework, sectoral adaptation plans for a number of relevant sectors (including Flood Risk Management, Communications Network, Electricity and Gas Networks, Transport Infrastructure, Built and Archaeological Heritage, Biodiversity and Seafood) are to be submitted to Government for approval by 30 September 2019. Local authorities will also be preparing local adaptation strategies by that date.

Seafood Sector Climate Change Adaptation Planning

The Department of Agriculture, Food and the Marine (DAFM) is the lead Department for the preparation of sectoral adaptation plans in relation to agriculture, forestry and seafood.

A working group with representatives from across the marine divisions within DAFM and the marine agencies (Bord Iascaigh Mhara, Marine Institute and Sea Fisheries Protection Authority) was set up to advance work on the seafood element of the draft plan. Work to date has focused on developing the draft, addressing weaknesses, progressing illustrative case studies and engaging in efforts to promote awareness of climate change adaptation planning in the sector. The DAFM website has been updated to include information on the preparation of the Adaptation Plan and an information leaflet is also available.

Some headline changes observed to date:

- Increase in sea surface temperature of 0.6°C per decade since 1994 is unprecedented in the past 150 years
- Satellite observations indicate that the sea level around Ireland has risen by approximately 4-6 cm since the early 1990s
- Ocean acidity has increased significantly in sub-surface and deep offshore waters around Ireland in recent decades
- Phytoplankton – Increased numbers of diatoms and dinoflagellates around the Irish coast since 1998 (these can lead to more frequent instances of harmful algal blooms)
- Increased numbers of warm water marine fish species in Irish waters with increased sightings of exotic fish species

In terms of future climate changes for Irish waters, indications suggest there will be continued warming of Irish waters consistent with global ocean projections along with increased precipitation in winter and decreased precipitation in summer. Coastal areas and sea fishing activities face the threats of an increase in the frequency of storm surge events, increased extreme wave heights in most regions and the continued rise in sea levels in line with global projections.

The impacts of climate change on the seafood sector are likely to include increased damage to fishing vessels, fishing gear and seafood infrastructure from the increased severity of storms and frequency of storm events. There is expected to be a change in traditional fisheries as the distribution of certain stocks move northwards due to increasing sea temperatures. Increased ocean acidification is expected to lead to reduced shell growth in commercially important seafood species such as oysters and mussels. Sealevel rise has the potential to affect the future operability of harbours and the suitability of some coastal regions for intertidal aquaculture.

Adaptation actions are being developed as part of an ongoing stakeholder engagement. The actions will focus on addressing knowledge gaps in relation to climate impacts on the seafood sector, examining the economic potential of changing species distributions, improving Irish ocean observing infrastructure to inform adaptation, and research programmes to support impact and adaptation studies focusing on areas such as migration routes, spawning and productivity.

Increasing stakeholder engagement will be an important aspect of the work schedule in 2019 and of the plan itself. Information leaflets will be made available at Sea Fisheries Protection Authority Breakfast events, the Skipper Expo, SeaFest and other such industry events to enhance awareness of the adaptation planning process. DAFM intends to publish a draft combined Agriculture, Forestry and Seafood Adaptation Plan for a period of public consultation in mid-2019 with a final draft version due to be submitted for Government approval in September 2019.

The BLUEFISH Project
Coastal Communities Views on Climate Change

During the summer of 2018, a scientist and an artist from the Marine Institute travelled around some of the coastal communities in Ireland and Wales that border the Irish and Celtic Seas. The purpose was to engage with those living and working in these coastal communities and gather their opinions about the importance of the ocean to their livelihoods and record their thoughts on the potential impacts of climate change. Along with interviewing these coastal communities, the medium of art was used to record their daily activities.

The coastal communities visited engaged in a broad spectrum of marine activities, included fishing, aquaculture, leisure, transport, tourism, boat repairs and marine renewable energy. In August 2018, the ports of Dingle in Co. Kerry, Baltimore in Co. Cork, Kilmore Quay in Co. Wexford and Howth in Co. Dublin were visited. The Welsh coastal communities were visited in October 2018 focusing on the Isle of Anglesey, Bangor, Pwllheli, New Quay, Milford Haven and Pembrokeshire. Those who benefit from the ecosystem goods and services of the Irish and Celtic Seas were asked "How do you benefit from the ocean and how do you think climate change is going to affect your life/business?"

The general consensus within the coastal communities visited was that climate change is happening. There was an acknowledgment and a realisation amongst the people interviewed that there was a real looming threat to their livelihoods.

This work of linking science and art as a mechanism to convey the importance of the ocean to coastal communities and the potential impacts of climate change on these communities will continue throughout 2019. The project will visit several maritime festivals in Ireland and Wales during the summer to show the results of the work and continue the dialogue with these coastal communities on what the future holds.

The BlueFish Project is an 'Ireland Wales Territorial Co-operation Operation' for the Irish and Celtic Sea led by Bangor University bringing together Aberystwyth and Swansea Universities in Wales, the Marine Institute, Bord Iascaigh Mhara and University College Cork in Ireland. The project was awarded €5.5 million through the Interreg Ireland-Wales 2014-2020 Programme.

Figure 5. 'Without the ocean, we wouldn't have a living: it's our only source of income in this rural part of Ireland. Climate change is definitely happening: growth periods are longer than they ever were. But higher water temperatures and higher rainfall could be catastrophic for our business.' Oyster and mussel fishermen, Cromane, Co. Kerry

Enabling Sustainable Growth for the 2018-2020 Period – New Strategy for Ireland's €1.15 Billion Seafood Sector

Bord Iascaigh Mhara's (BIM) new Statement of Strategy, Enabling Sustainable Growth for the 2018-2020 period was launched by the Minister for Agriculture, Food and the Marine, Michael Creed TD in May 2018. The strategy aims to boost competitiveness amidst market uncertainties and the actions outlined will help BIM to work effectively with Government to achieve the ambitions set out for seafood in Food Wise 2025 and with the seafood industry to drive growth for fishermen, seafood producers and processors around the coast. The new strategy identifies five key strategic priorities that will underpin the delivery of BIM services, they comprise: Sustainability, Skills, Innovation, Competitiveness and Leadership, which will all operate within the framework objective of the Common Fisheries Policy and Food Wise 2025.

Building Ocean Knowledge - Delivering Ocean Services

The Marine Institute's Strategic Plan 2018-2022, Building Ocean Knowledge - Delivering Ocean Services, which was launched in 2018, ensures the provision of fit-for-purpose research, advice and services for the Department of Agriculture, Food and the Marine; other government departments and agencies; as well as a broad range of national and international stakeholders. It provides an outline of the Marine Institute's collective effort to deliver on the ambitious targets of Harnessing Our Ocean Wealth, Ireland's Integrated Marine Plan.

Updates on other key national policies and strategies are available later in this report. This includes the development of the National Marine Research & Innovation Strategy 2017-2021.

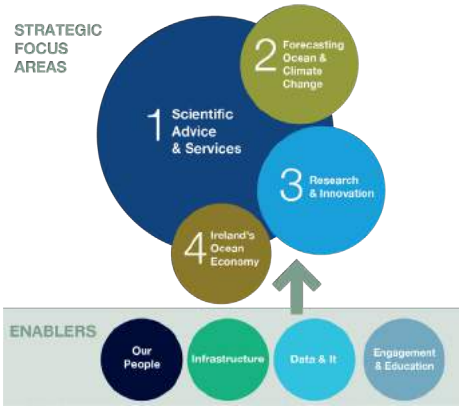


Figure 6. Marine Institute Strategy Framework

Action 2

Develop an integrated approach to marine and coastal planning and licensing in order to maximise the potential for Ireland's ocean economy; assist with managing our resources effectively and sustainably; manage potential conflicts; and ensure harmonisation with coastal/terrestrial planning.

(2a) Address the deficiencies in the current planning and licensing system by continuing to make business process improvements.

(2b) Update/improve legislation to streamline planning and consent processes.

(2c) Develop an appropriate Maritime Spatial Planning Framework for Ireland.

Sustainable Aquaculture

To ensure compliance with environmental requirements and to avoid fines with particular reference to a European Court of Justice judgement, aquaculture licensing in most bays, must be carried out in line with very specific requirements under the Birds and Habitats Directives. A large element of the judgment concerned a failure by the State to put in place adequate assessment of aquaculture licence applications in 'Natura 2000' areas. In the negotiations to address this judgment, a process was agreed with DG Environment (in 2009) and this is being implemented.

The process includes data collection, the setting of Conservation Objectives, carrying out of Appropriate Assessments and appropriate licensing, taking account of, among other things, Natura requirements. This process is ongoing.

Conservation Objectives are being set by the National Parks and Wildlife Service (NPWS) on an ongoing basis. The position at the 31 December 2018 was that Appropriate Assessments had been received by the Department of Agriculture, Food and the Marine in respect of 29 bays – Ballymacoda Bay, Ballyness Bay, Bannow Bay, Ballycotton Bay, Blacksod/Broadhaven, Castlemaine Harbour, Clew Bay, Donegal Bay, Drumcliff Bay/Cummeen Harbour, Dundalk Bay, Dungarvan Harbour, Galway Bay, Gweedore Bay, Kenmare Bay, Kilkieran Bay, Lough Swilly, Loughros Beg Bay/Slieve Tooey/Tormor Is., Mannin Bay/Slyne Head, Mulroy Bay, River Barrow and River Nore, Roaringwater Bay, Rutland Island and Sound, Shannon Estuary, Sheephaven Bay, Tralee Bay Complex, Trawbreaga Bay, Valentia Harbour/Portmagee Channel, West of Ardara/Maas Road and Wexford Harbour.

The Department of Culture, Heritage and the Gaeltacht continued to comment, as a statutory consultee, on Appropriate Assessments/risk assessments for aquaculture and fisheries undertaken by the Department of Agriculture, Food and the Marine.

In 2018 the Minister for Agriculture, Food and the Marine made 305 licence determinations.

Aquaculture Licensing Review Group

The Minister for Agriculture, Food and the Marine (DAFM) commissioned the Independent Review of Aquaculture Licensing in December 2016. The report of the Review Group was submitted to the Minister in 2017. The Review Group carried out a detailed examination of the existing aquaculture licensing process, undertook comprehensive stakeholder consultation and looked at comparative national and international consent systems to determine best practice for managing a complex licensing process in a transparent, environmentally appropriate and legally robust manner. The Group's Report is published and available to view on the Department of Agriculture, Food and the Marine's website.
www.agriculture.gov.ie.

Implementation/Prioritisation Strategy

Since receiving the Report of the Review Group DAFM has engaged in detailed consideration of the recommendations set out in the Report with a view to their implementation, having regard to the legislative, environmental, technical and public interest issues that arise. The Department has also engaged closely with industry representatives and relevant State Agencies.

The core recommendation of the Licensing Review Group is to eliminate the aquaculture licensing backlog. In response, the Department has undertaken a two year project to eliminate the shellfish licensing backlog. Minister Creed made 305 licence determinations in 2018 and the Department is committed to a further 300 determinations in 2019. This will effectively eliminate the shellfish licensing backlog as an issue affecting the aquaculture industry.

Aquaculture Advisory and Technical Services

The Marine Institute provides advisory services to the Department of Agriculture, Food and the Marine 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, with advice provided on 275 aquaculture licence applications, covering 357 individual sites, all within the six week timeframe set out in legislation. Additionally, environmental impact assessment screening for non-salmonid licence renewal applications was conducted on land-based facilities in Cork, Galway and Donegal.

Shellfish and Fish Health Monitoring

The monitoring of fish and shellfish health on Irish aquaculture farms is required under the Fish Health Directive, and is a licensing condition governing all aquaculture farms in the State. In 2018, the Fish Health Unit of the Marine Institute, the National Reference Laboratory, 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). 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.

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 cardio myopathy syndrome (CMS) were diagnosed in April 2018 on Atlantic Salmon farms in a single bay but overall detections of the causative agent, piscine myocarditis virus, were less frequent than in 2017.

Foreshore Licensing Systems and Business Process Improvements

The foreshore geographic information system (GIS) is a prototype which currently resides on a shared platform accessible by Department Housing, Planning and Local Government (DHPLG) staff only. The Foreshore Unit and GIS team in the Department are currently seeking to progress this beyond the prototype stage.

There is a pressing requirement to bring the GIS up to date by digitizing applications received in the last three years. There is also a need to explore options for enhanced usability and integration with other systems (i.e. Foreshore Case Management System) as well as the potential for increasing the range of users.

Maritime Area and Foreshore (Amendment) Bill

Considerable work has been undertaken to advance the drafting of the Maritime Area and Foreshore (Amendment) Bill, including through engagement with the Marine Coordination Group and a number of workshops and bilateral meetings with relevant policy Departments and the Office of the Attorney General throughout 2017 and 2018.

In addition, a high level Marine Legislation Steering Group was established in 2018 to facilitate the development of marine legislation with cross-departmental impacts. Legal advice on the draft text was finalised in November 2018.

Marine Spatial Planning (MSP)

A stakeholder Advisory Group was established to lead and oversee the development of the MSP in parallel to the Departmental Group that was set up in 2017. The Advisory Group comprises more than 30 stakeholder representatives from across the social, economic and environmental pillars to ensure the participation of relevant non-governmental organisations, professional bodies and technical experts in the process. The Group is chaired by the Minister of State for Housing and Urban Renewal, Damien English TD, Department of Housing Planning and Local Government. The Advisory Group met three times in 2018.

The MSP Team has been involved in extensive public and stakeholder engagement to raise awareness of marine planning and maximise public participation, ensuring interested parties can engage with the plan-making process. A variety of methods have been used including: public events in almost all coastal counties, targeted sessions with marine sector stakeholders, speaking slots at conferences and seminars, social media/Twitter, press and broadcast media, website, and direct contacts with 600+ stakeholders on an email contact list. During 2018, the MSP Team held in excess of 100 engagement meetings with the public and stakeholders.

An informal 'Six Administrations' grouping was established to bring together senior policy and planning officials from the six administrations of Ireland, Northern Ireland, England, Scotland, Wales and the Isle of Man to discuss planning-related issues of mutual concern or interest on an ongoing basis. Ireland hosted the first meeting, which was attended by delegates from Northern Ireland, England, Scotland and Wales in June 2018 in Cork. This informal grouping is to facilitate close collaboration and the sharing of ideas and experience as a parallel to the formal mechanism of transboundary consultation between Member States as provided for by the MSP Directive (EU Directive 2014/89/EU).

The MSP Directive was originally transposed into national legislation by way of regulations made in 2016 (SI 352 of 2016). Since the regulations were made under the European Communities Act 1972, they were strictly limited to measures required to transpose the Directive. In October 2018, the regulations were repealed and replaced by Part 5 of the Planning and Development (Amendment) Act 2018. Part 5 re-transposes the Directive in primary legislation and contains a number of measures that are additional to those required by the Directive, including:

- Adoption of the plan by both Houses of the Oireachtas;
- Review and replacement of the plan every six years;
- Obligation for marine regulatory bodies to secure the objectives of the plan when making policies, plans, or granting consents; and
- Enforcement powers for the Minister if the foregoing obligations are not being fulfilled.

The Marine Institute is providing scientific and technical support to the MSP process and continued its ongoing work on the identification and analysis of data and information required to provide a robust evidence base to underpin the planning process.

Supporting Marine Spatial Planning Through a Range of Integrated Technical and Scientific Services

The Marine Institute is leading a national marine data discovery project to identify and collate relevant data from a wide range of internal and external organisations. The project is funded under Ireland's European Maritime and Fisheries Fund (EMFF) Operational Programme's Blue Growth and Marine Spatial Planning Scheme, which aims to foster the implementation of integrated maritime policy. This evidence base is the foundation of the national marine spatial planning (MSP) process led by the Department of Housing, Planning and Local Government.

The first technical support task implemented by the Marine Institute in 2018 focused on the identification and collation of existing marine spatial data, and a review of these data sources for their quality and compatibility with MSP needs. The 2018 data review drew upon a number of key online data sources, such as Ireland's Marine Atlas, the Environmental Protection Agency (EPA) Portal, National Parks and Wildlife Service (NPWS) maps and data, and INFOMAR seabed map archives. Available data relevant to MSP were identified that encompass administrative and physical boundaries, physical environment, biological environment, environmental quality and the human environment.

Quality assurance (QA) is important both to ensure accuracy of information used within MSP and to promote stakeholder confidence in the data being used. All data identified were subject to a QA assessment based on the following criteria:

- How relevant are the data to marine spatial planning?
- Is there a clear explanation of the methodology used, and was it robust enough?
- Timeliness/Temporal extent
- Was the data collected or modelled? If modelled, is there a statistical accuracy assessment?
- Is there sufficient information provided on QA checks of the dataset?

Based on the results, a total of 1,923 datasets were identified as being useful for marine planning purposes. The number of data sets that met the QA threshold was 1,776. A substantial number of these datasets are undergoing re-processing in 2019 to generate suitable MSP data products.

Maritime Safety, Security & Surveillance

The creation of the conditions needed for economic growth, investment and job creation depend on the State ensuring a safe, secure and protected environment consistent with best international standards of governance and the protection of the maritime environment.... Ireland must have in place effective and efficient security and surveillance arrangements and quality maritime regulatory regimes that meet best practice within which our ocean wealth can prosper.

- Harnessing Our Ocean Wealth

Photo courtesy of the Marine Institute

Maritime Safety, Security & Surveillance

Action 3

Develop and implement systems to provide real-time operating, surveillance and monitoring information on activity within Ireland's maritime domain.

Developing a Shared Integrated Maritime Picture

The Naval Service, as the maritime component of the Defence Forces, is the principal seagoing agency of the State. Ireland's economic outlook, as an island nation, would be adversely affected by any physical disruption to the security of international trade, trafficking, piracy or threats to our sea lines of communication. To this end, maritime domain awareness and a presence at sea are delivered continuously.

The Naval Service has developed a Recognised Maritime Picture (RMP) to improve maritime domain awareness, provide near-real time situational awareness in Ireland's maritime domain, and provide a command and control information system for naval operations. As a command and control information system, the RMP enables a network-enabled approach to naval operations, delivering the right information to the right place and at the right time. The RMP is deployed on board all Naval Service ships as well as being available and operated at the Naval Base. Information sources for the RMP include Naval Ships' sensor data (AIS and radar), fisheries vessel monitoring system (VMS) data and coastal automatic identification system (AIS) data from the Irish Coastguard. The RMP also has an automatic filtering capability for auto-detection of vessels of interest or unusual vessel behaviour.

The Air Corps maritime patrol aircraft is utilised to support the RMP where the aircraft sensor information can be overlaid on the RMP common operating picture. Future developments will take advantage of the latest technological advancements to provide real time updates to the RMP from aerial assets. RMP will be maintained and enhanced in 2019 and data sharing protocols will continue to be maintained with external stakeholders.

The Irish Air Corps in cooperation with the Naval Service and other state agencies forms part of the Joint Taskforce on Drug Interdiction.

The Air Corps continues to develop and expand the input providers to the Recognised Air Picture (RAP), an aspect on its application will be maritime, with features in security and surveillance.

In 2018, the Irish Naval Service continued its involvement in the European Defence Agency (EDA) Maritime Surveillance (MARSUR) project which enables information sharing amongst 18 EU participating Member States.

Ireland is also engaged in PESCO (Permanent Structured Cooperation) projects in relation to Maritime Surveillance. The PESCO project 'Upgrade of Maritime Surveillance' aims to enhance maritime situational awareness by providing added value to existing European naval maritime information sharing networks such as the EDA supported MARSUR project. This will be achieved through sharing resources and collaboration with industry through programmes such as EDIDP (European Defence Industrial Development Programme) to harness technological capabilities in order to improve maritime situational awareness in European waters. Ireland is a participant on this project.

The PESCO project 'Maritime Autonomous Systems/Mine Counter Measures', which Ireland is an Observer in, aims to develop a next generation mine countermeasures (MCM) toolbox utilising a system of systems. This system would incorporate unmanned air, surface, and underwater assets deployed as an organic capability from an asset outside the mine danger area. The project has engaged a consortium of research and industry small and medium-sized enterprises (SMEs) who will shortly commence a scoping study.

Real Time Surveillance and Monitoring of Ireland's Maritime Domain

The Irish Coast Guard (IRCG), through its Marine Rescue Centres, maintains geographical information systems (GIS) for monitoring the maritime domain off our coast. These systems use Automatic Identification Systems (AIS) and are used to monitor the search and rescue region and Exclusive Economic Zone to assist with search and rescue and maritime casualties. AIS is shared with the Irish Naval Service and the European Maritime Safety Agency (EMSA).

There were a total of 2,647 incidents recorded in 2018 under the IRCG search and rescue operations (2017: 2,502). There was a slight decrease in the number of incidents responded to aboard merchant vessels and a slight decrease in incidents responded to in the recreational craft sector.

In 2018, in response to the 2,647 incidents, Coast Guard helicopters were tasked 669 times with RNLI being tasked to 843 incidents and Coast Guard units being tasked 1,192 times.

	2013	2014	2015	2016	2017	2018
Incidents	2627	2631	2664	2582	2502	2647
Persons saved/assisted	5685	4256	3899	4080	3974	4990
Incidents involving Pleasure Craft	498	676	600	482	521	411
Incidents involving Merchant Craft	61	69	52	62	69	67
Incidents involving Fishing Craft	215	189	185	212	169	162
Pollution/Salvage Report	46	44	32	44	40	77
IRCG Coastal Units tasked	1156	1272	1289	1065	1072	1192
IRCG Helicopter tasked	808	915	1013	898	755	669
RNLI tasked	877	819	836	854	842	843
Community Rescue Boats Ireland tasked	145	211	219	131	88	112
False Alarms	91	94	135	245	434	411

Table 2: Irish Coast Guard Statistics – Six-year trend

Ship Replacement Programme

A ship replacement strategy for the Naval Service has been in progress since 2007 to provide for the replacement of existing ships. The next project is the delivery of a Multi-Role Vessel. A Civil/Military Working Group has been formed to research and make proposals in relation to a Multi-Role Vessel for the Naval Service in accordance with the White Paper on Defence 2015.

Mid Life Extension of P50 Class Vessels

Work is to commence on the mid-life extension project of two P50 Class vessels, which will extend the life of the vessels and address obsolescence.

CASA Replacement Programme

The current fleet of two Airbus Military CASA CN235 maritime patrol aircraft which have been in service since 1994 will be replaced with a larger more capable aircraft type. This will enhance maritime surveillance and provide a greater degree of utility for logistical cargo and transport flight operations. Stage one of the CASA CN235 Replacement Programme – Request for Proposal was completed in mid-2018. Stage two Request for Tender commenced in the fourth quarter of 2018. Tender responses are expected by end of the first quarter of 2019. The first of the new aircraft deliveries is expected by mid-2021. The airframe availability, sensory capability and communication ability of the new aircraft is expected to deliver notable improvement to supporting the Recognised Maritime Picture (RMP) through aerial surveillance.

Sea Fisheries Protection

The current Common Fisheries Policy (CFP), introduced in 2014, represented a fundamental departure from previous fisheries regimes. The revised CFP provides a robust framework to deliver stocks to maximum sustainable yield levels by 2020 at the latest and included significant reforms, such as the regionalisation of certain aspects of fisheries management and the phased introduction of the landing obligation to eliminate discards. With the support of the Naval Service and the Air Corps, the Sea Fisheries Protection Authority (SFPA) continue to operate the statutory regulatory system fairly and proportionately, prioritising compliance with the landing obligation regulations.

The Irish Naval Service operated a risk and intelligence based approach to delivering an effective and credible sea fisheries protection service. Activities included a range of at sea inspection programmes including inshore patrols and joint deployment plans. The Naval Service completed over 760 inspections at sea during 2018 as part of its commitment to sea fisheries protection. The Air Corps completed a total of 184 maritime fishery patrols in 2018.

All vessels over 12 metres fishing within the Irish Exclusive Economic Zone are monitored electronically to assess compliance risks and to identify vessels that require further inspection. In 2018, SFPA's Sea Fisheries Officers undertook official controls, an important component of which were 1,922 landing inspections, while a further 760 boarding operations were undertaken (at sea) by the Naval Service.

A total of ten vessels were detained during 2018 with 61 cases referred to the Director of Public Prosecutions (DPP). The infringements detected mainly related to the under-recording of catches and exceeding quota. However, the low level of non-compliance that was found bears testimony to the

considerable efforts being made by most fishermen to work within the regulations. It also illustrates the comprehensive and robust inspection system that is in place to detect and, where necessary, to enforce compliance.

In 2018, SFPA continued to develop a risk based approach to Inspections so that a risk assessment is undertaken at a 'fishery level' for all vessels engaged in a specific fishery. This informs and directs the tasking of inspection at individual vessel level for vessels from within that fleet segment, based wholly on risk. SFPA organised a workshop for the Navy and Air Corps in relation to Risk Assessment of Fisheries and Vessels with the participation of EFCA (European Fisheries Control Agency).

During the year, the SFPA continued to participate and input expertise into the European regulatory framework, at EU and at regional level as part of combined efforts towards promoting and achieving best practice and securing a 'level playing field' in EU fisheries control.

Further details of the SFPA's collaborative work is available under International and North/South Cooperation.

Figure 7. Pictured at the inaugural Fisheries Control Conference which was hosted by the SFPA at the National Maritime College of Ireland, Cork, in conjunction with the Irish Naval Service, in October are, from left to right: Adrienne Patterson, Director of Port Operations, SFPA; Captain Brian Fitzgerald, Naval Service; Cristina Morgado, European Fisheries Control Agency; Dr Susan Steele, Chair, SFPA; and Lt Cdr Anthony Geraghty, Naval Service. The title of the Fisheries Control Conference was 'Risk Based Approach to Inspections' - the following key control agencies were in attendance: the Naval Service; the Air Corps; European Control Fisheries Agency (EFCA) as well as the SFPA. Presentations were provided by the following: Susan Steele, Chair of the SFPA; Captain Brian Fitzgerald, Irish Naval Service; Adrienne Patterson, Director of Port Operations, SFPA; Paul Duane, Director of Food Safety & Fisheries Support, SFPA; Lieutenant Commander Anthony Geraghty, Irish Naval Service, FMC and Cristina Morgado, Desk Manager for Risk Management, EFCA

Action 4

Update national legislation code for an effective Irish Maritime Administration in accordance with national and international requirements.

Action 5

Implement effective flag and port state inspection regimes and improved enforcement of existing regulation, including new regulation standards emanating from the EU and IMO.

Action 6

Maintain and improve Ireland's status on the international shipping benchmarks and use Ireland's positive status to promote shipping related enterprises.

Action 7

Develop the Irish Maritime Administration to provide effective and efficient services to people, ships and ports

- Enhance the maritime regulatory and marine emergency response services.

Irish Maritime Administration

Within the Department of Transport, Tourism and Sport, the Irish Maritime Administration (IMA) integrates the planning and delivery of all the maritime services of the Department under a single national office. The overall goal is to facilitate safe and sustainable maritime transport and the delivery of emergency management services.

In 2018, the IMA continued its role in the development of national, EU and international policies and legislation relating to maritime safety, environment and security matters, as well as aids to vessel navigation. The IMA also delivered emergency response and pollution prevention measures, providing a regulatory and enforcement role, and a framework for port services which are efficient, effective and adequate for the needs of our trading economy, fostering economic development and employment in the sector.

Further information relating to contributions of the IMA at an international level are available under International and North/South Cooperation.

Effective Implementation of EU and International Regulation

The Marine Survey Office (MSO) of the Department of Transport, Tourism and Sport continued in 2018 to fulfil its role as the maritime transport safety regulator, carrying out a comprehensive regime of inspections covering issues such as safety, security, living and working conditions, and accessibility. This work encompasses recreational craft, fishing vessels, passenger vessels and cargo ships on the

Irish flag (whether operating internationally or domestically); certification of Irish seafarers including fishers and recreational craft users; and security in Irish ports. It also includes risk-based inspections on foreign-flagged ships calling to Irish ports using the internationally agreed methodology of the Paris Memorandum of Understanding on Port State Control (Paris MoU). The MSO carries out an average of 1,300 inspections every year.

During 2018, the MSO continued to provide effective implementation of EU and international regulation. Inspection continued for flag state vessels, with new international merchant ships, domestic ships and fishing vessels entering the flag. The MSO also continued to implement the Port State Control regime for foreign vessels.

Also in 2018, Ireland maintained its position on the latest Paris MoU 'White List' and remained on the International Maritime Organisation Standards of Training, Certification and Watchkeeping (STCW) 'White List' for seafarer training, as well as positive outcomes on the International Chamber of Shipping flag state performance table.

Action 8

Collaborate with industry and R&D institutes to deliver leading-edge technology that supports more effective and efficient maritime surveillance capacity.

Improved Knowledge and Understanding of Protected Offshore Species and Habitats

The ObSERVE Programme has provided a robust multiannual test base for the use and operability of offshore surveillance technologies and platforms, both above and beneath the ocean surface. Through such government research, industry and institutional action, initiatives like the ObSERVE Programme can provide a strong base for technological advancement, field testing, integrated data acquisition and, ultimately, improved maritime surveillance in Irish waters. Further details on the outputs of the ObSERVE Programme are available under Actions 14 and 21.

The Department of Culture, Heritage and the Gaeltacht (DCHG) commenced a scientific and technical partnership with the Marine Institute in a new European Maritime and Fisheries Fund (EMFF) funded initiative concerning enhanced catch sampling at sea and targeted necropsies to investigate causes of death in marine mammals and birds. The first phase of this project was successfully completed in 2018 and a new contract has been issued to continue the investigations into 2019.

DCHG cofunded and coordinated the second SeaRover scientific cruise – a collaborative project with the Marine Institute, INFOMAR, and Geological Survey Ireland - partly funded by Ireland's EMFF Operational Programme. It is the most extensive survey of deep sea biodiversity ever undertaken in European waters. The aim of the project was to survey Ireland's deep-water reef habitat along the shelf margin. Data collected by this project is critical in informing future protection of Ireland's vulnerable marine ecosystems. The third phase of SeaRover will commence in August 2019 to explore the canyon systems of the southern continental shelf.

Delivering Leading-Edge Maritime Surveillance Technologies

Through the Defence Enterprise Committee (DEC), the Defence Organisation supports Irish enterprise and research institutes engaged in the development and exploitation of technologies which contribute to Defence Forces capabilities for crisis management operations, within the roles assigned by Government.

The Naval Service continues to be involved and engage with the Halpin Centre for Research and Innovation at the National Maritime College of Ireland (NMCI). Further details on the NMCI and it's acitivites are avilable under Action 27.

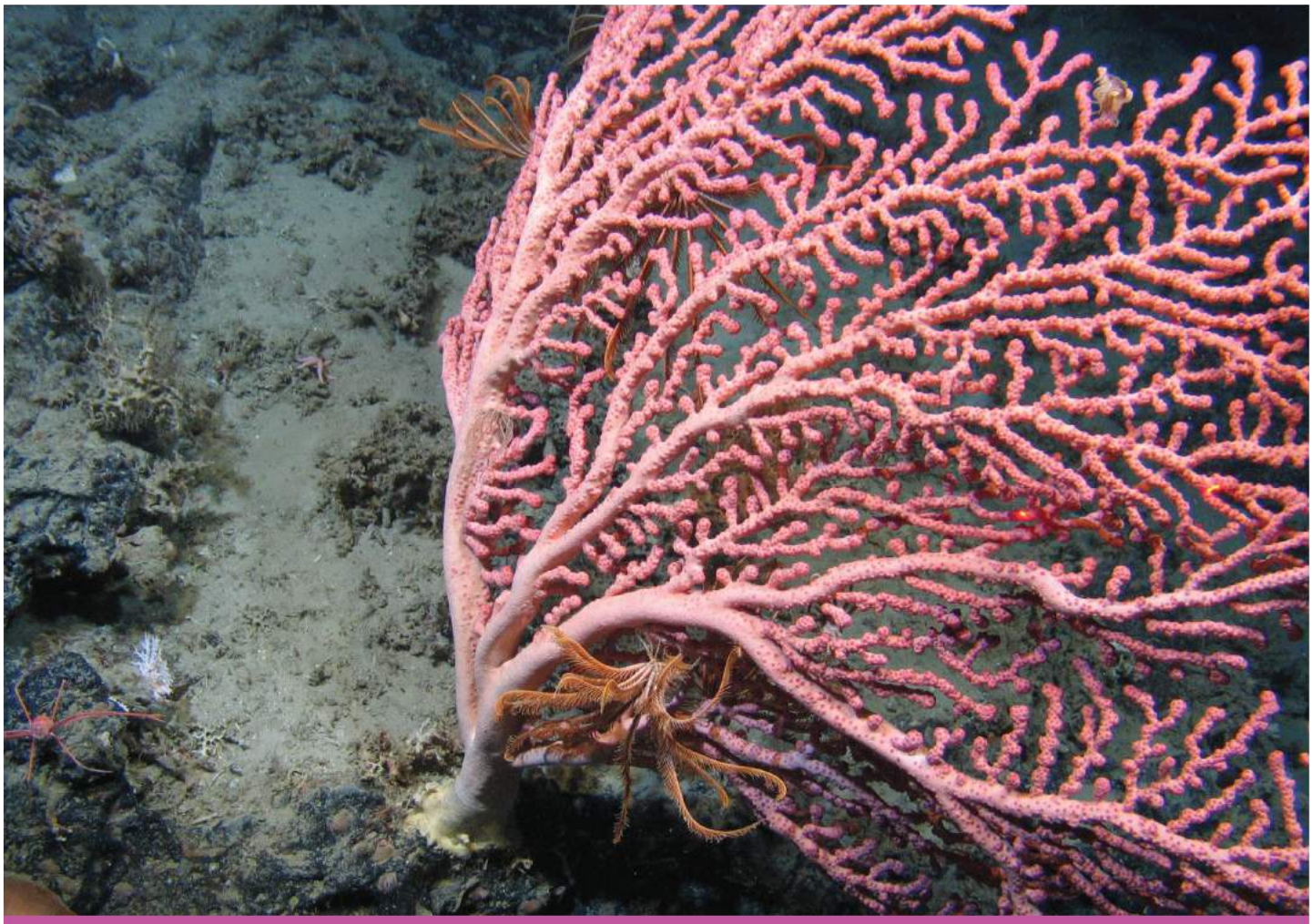
Naval Service personnel are participating as end-users, as part of the Defence contribution to the Horizon 2020 CAMELOT Project. CAMELOT is an EU project aimed at increasing knowledge and observation/maritime surveillance technologies and coordinating the command and control of multiple autonomous systems such as unmanned aerial vehicles (UAVs) and autonomous underwater vehicles (AUVs). The project commenced in May 2017 and is expected to run for three years.

U-Flyte Marine Demonstrator – Researching Innovative Solutions for Drone Operations

U-Flyte is a strategic research partnership, coordinated by Maynooth University and funded by Science Foundation Ireland (SFI), together with Industry collaborators Airbus, Irelandia Aviation and INTEL. The global multi-billion euro drone industry is expanding and these aerial robots are employed for an increasing array of automated airborne tasks including; mapping, surveying, news gathering, specialist services, search and rescue, air-taxi and logistics.

Waterford Airport was chosen as the ideal main testing location for U-Flyte. The airport location also provides easy access to the coastline and offshore areas, allowing researchers to test higher performance drones for marine applications, such as ocean data collection and search and rescue.

As part of the project, a second Marine Watch Demonstrator project is underway. Marine Watch Phase 2 is part of a series of U-Flyte demonstrators taking place between 2018 and 2022. Building on progress made in Phase 1 of the project, Maynooth University and the U-Flyte team are working alongside Airbus and the Irish Coast Guard in supporting their existing marine-based activities, for example search and rescue, with the use of drone platforms and data captured using drones. Marine Watch Phase 2 involves a number of drone applications that have never been tested in Ireland before. These tests required careful planning and coordination, permissions, the development of protocols, and the need to establish lessons learned for the roll-out of more efficient marine-based drone services in the future. Further details on the research project are available on www.u-flyte.com



Clean-Green-Marine

Ireland's marine ecosystems are home to a rich and diverse range of species and habitats. We must protect and conserve these ecosystems, ensuring development strategies and management practices do not impair the capacity of ecosystems to deliver market and non-market goods and services.

- Harnessing Our Ocean Wealth

Photo courtesy of the Marine Institute

Clean-Green-Marine

Action 9

Implement the EU Marine Strategy Framework Directive.

Action 11

Continue to implement the EU Water Framework Directive through the River Basin Management Plans.

Marine Strategy Framework Directive (MSFD)

An interdepartmental and interagency monitoring group has been established to examine Ireland's Marine Strategy Framework Directive (MSFD) monitoring programme in light of the EU Commission decision (EU) 2017/848 of 17 May 2017 'laying down criteria and methodological standards on good environmental status of marine waters and specifications and standardized methods for monitoring and assessment, and repealing Decision 2010/477/EU'. The focus of the monitoring group is to identify where gaps in our current monitoring programme arise in relation to the revised Commission standards and to put new monitoring programmes in place to address those gaps. The work of this group is continuing into 2019.

It is intended to convene an expert working group in 2019 to advise the Minister for Housing, Planning and Local Government on the establishment of spatial protection measures (SPMs) including marine protected areas (MPAs) as required by Article 13 of MSFD and in accordance with the Aichi target 15 relating to marine protected areas established under the Convention on Biological Diversity. This group will advise the Minister on the type of spatial protection measures (SPMs) and marine protected areas (MPAs) required by Article 13 of MSFD, the form they should take and where they should be located. Existing special areas of conservation under the Birds and Habitats Directives will be incorporated as will other protected areas established under existing instruments and policy.

The General Scheme for the proposed legislation to prohibit the manufacture and sale of 'rinse down the drain' products containing plastic microbeads, was published in 2018.

A number of EU supported marine environmental Interreg programmes were initiated in 2019 involving partners from Ireland, Portugal, Spain, France and the UK. These include:

- The Oceanwise project to address the issue of marine litter caused by polystyrene foam products (Irish partners – the Department of Housing, Planning and Local Government; REPAK; the MaREI centre and Bord Iascaigh Mhara)
- The CleanAtlantic project to identify marine litter hotspots in the North Atlantic using new modelling and monitoring techniques (Irish partner – the Marine Institute)
- The iFADO project to develop new technologies for monitoring marine ecosystems and species (Irish partner – the Marine Institute)

The Department of Housing, Planning and Local Government provides national matching funding for these projects.

Richard Cronin, Senior Advisor (Marine) in the Department of Housing, Planning and Local Government was elected on behalf of Ireland to the post of chair of the OSPAR Commission in 2018.

In 2019, it is intended to continue to:

- Deliver further marine litter and marine noise measures
- Further develop marine environmental awareness among key stakeholders and the general public
- Advance science based research in relation to marine litter and marine environmental monitoring
- Advance work on non-indigenous species measures
- Develop synergies with partner national State, stakeholder and environmental non-governmental organisations

Marine Strategy Framework Directive (MSFD) Descriptor 3 Assessment

In 2018, Ireland was preparing its Article 8 submission under MSFD Descriptor D3 (Commercial Fisheries). With support from the Marine Institute's fisheries scientists, Ireland has collated ICES (International Council for the Exploration of the Sea) assessments giving results for MSFD Criterion D3C1 (fishing mortality in relation to F_{MSY} - Fishing mortality consistent with achieving Maximum Sustainable Yield) and Criterion D3C2 (stock size in relation to MSY $B_{trigger}$) along with recently developed Maximum Sustainable Yield (MSY) proxies for some data limited stocks (those without full analytic assessments). MSY $B_{trigger}$ is the parameter in the ICES MSY framework which triggers advice on a reduced fishing mortality relative to F_{MSY}.

Good Environmental Status (GES) assessment for the MSFD D3 should be based on criteria D3C1 (Fishing Mortality) and D3C2 (Spawning Stock Biomass). The assessment is based only on those stocks that have primary indicators (MSY reference points). The assessment is augmented with additional commercial fish stocks for which Ireland has sole responsibility, being located within Ireland's 12 mile territorial limits, or for which ICES does not give advice.

Water Framework Directive (WFD)

With the publication, in April 2018, pursuant to the EU Water Framework Directive of Ireland's River Basin Management Plan (RBMP) 2018-2021, national policies and regional prioritised measures set out the actions that Ireland will take to improve water quality and achieve 'good' ecological status in relevant water bodies (rivers, lakes, estuaries, coastal waters and groundwater).

Among the main actions that will be taken through the RBMP are:

- Improved wastewater treatment: €1.7 billion in investment by Irish Water in more than 250 wastewater treatment projects between 2017 and 2021. This will help improve water quality and prevent deterioration of quality in targeted water bodies, including 'protected areas'.
- Conservation and leakage reduction: Irish Water will implement important measures to make water use more sustainable and efficient, reducing leakage in our water network from 45% of all water produced down to 37% by 2021, based on 2017 figures.
- Scientific assessments of water bodies and implementation of local measures by 43 new, specialist, local authority investigative assessment personnel: Tasked with carrying out scientific assessments of water bodies and lead on local implementation measures.
- A new collaborative Agricultural Sustainability Support and Advisory Programme: This partnership between the State and the dairy industry, consisting of 30 Sustainability Advisers, will promote best farming practice in 190 areas chosen for action, for up to 5,000 farmers.

- Dairy Sustainability Initiative to help improve water quality: 18,000 dairy farmers to receive advice on sustainable farming practices in the 190 areas for action.
- The development of water and planning guidance for local authorities: This will help local authorities to consider the risks to water quality during planning and development decision-making.
- Extension of the Domestic Waste Water Treatment Systems grant scheme: The scheme will assist with the costs of septic tank remediation in high status water areas.
- A Blue Dot Catchments Programme: The new programme will create a network of excellent river and lake areas. Agencies will work together to protect or restore excellent water quality in these water bodies.
- A new Community Water Development Fund: This will enable and support community water initiatives.

Environmental Monitoring of Irish Waters

The Marine Institute continues to monitor transitional coastal and marine waters for priority and other hazardous substances, nutrients and other physico-chemical parameters, phytoplankton and benthic infauna in accordance with requirements of the Water Framework Directive (WFD) (2000/60/EC) and OSPAR Coordinated Environmental Monitoring Programme. Data are reported to national and international organisations including ICES (International Council for the Exploration of the Sea) Data Centre. This work is carried out in close collaboration with the Environmental Protection Agency (EPA).

A seafood sampling and analysis programme is also undertaken by the Institute's scientists, in coordination with the Sea Fisheries Protection Authority and the Food Safety Authority of Ireland. Samples are tested for the presence of environmental contaminants to, supporting status and risk evaluations relational to both the WFD and the Marine Strategy Framework Directive (MSFD).

Providing Scientific and Technical Monitoring Services

On behalf of the EPA and the Department of Housing, Planning and Local Government (DHPLG), the Marine Institute conducts environmental monitoring as part of the 2016-2021 cycle of the EU WFD and OSPAR coordinated monitoring programme. In 2018, selected 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*. 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 Marine Institute 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.

Action 10

Deliver all measures relevant to Ireland as directed under the Common Fisheries Policy (CFP) and national measures including the conservation, management and rebuilding of fish stocks and long-term sustainable exploitation of marine biological resources.

The EU Common Fisheries Policy (CFP) that is currently in place came into force on the 1 January 2014. This policy is reviewed every 10 years with the next review scheduled for completion by the end of 2022. The overarching goal of this policy is to ensure that fishing and aquaculture are environmentally, economically and socially sustainable thus resulting in a competitive and viable seafood sector.

Fishing Opportunities for 2019

The Common Fisheries Policy (CFP) stipulates that fishing will be progressively managed at maximum sustainable yield (MSY) levels where possible by 2015 and by 2020 at the latest. In practice this means taking the highest possible amounts of catches from the sea while keeping fish stocks healthy. In the North-East Atlantic and adjacent waters (North Sea, Baltic Sea, Skagerrak, Kattegat, West of Scotland Sea, Irish Sea and Celtic Sea) EU fisheries Ministers set overall catch limits based on scientific advice. These total allowable catches (TACs) are then divided into national quotas, which set limits on the amount of fish that can be caught.

Fishing opportunities negotiated at the December 2018 Agriculture and Fisheries Council have been negotiated and fixed in line with the objectives of the CFP, in particular the objective of bringing the impact of fishing fleets on the stocks (fishing mortality), in the shortest realistic time possible, to the levels required to allow the fish stocks to rebuild to biomass levels that can produce MSY. The responsible catch limits proposed by the European Commission in the North-East Atlantic and adjacent waters have seen overexploitation decline drastically over the last number of years. This Fisheries Agreement will bring 59 stocks for which data are available to MSY levels in 2019, as opposed to five stocks in 2009, which is in line with this key objective of achieving MSY levels by 2020. A total package of fish quotas worth €260 million was secured for Irish fishermen for 2019.

Multi-Annual Fisheries Plans

Multi-annual fisheries plans aim to restore and maintain fish stocks at sustainable levels while ensuring the social and economic viability for fishermen operating in certain regions. These plans set out a range of measures to support sustainable management of the fishery in question, including closed areas, strict technical measures on mesh sizes and gear, and careful monitoring, inspection and control. They contain measures to implement the landing obligation as well as safeguards for remedial action where needed. To date, four multi-annual plans have been proposed by the European Commission in line with the Common Fisheries Policy (CFP).

In March 2018, the European Commission proposed a multi-annual plan for management of fisheries in Western Waters, which is extremely important from an Irish perspective. It concerns fisheries exploiting demersal stocks in these waters, namely seabass, cod, megrims, anglerfish, haddock, whiting, hake, blue ling, pollack, plaice, common sole and Norway lobster. Negotiations resulted in a provisional political agreement between the Agriculture and Fisheries Council, the European Commission and the European Parliament in 2018. This plan is on schedule to come into full effect early in 2019.

Fisheries Quota Management in Ireland

In Ireland, quota is a public resource and is managed to ensure that property rights are not granted to individual operators. This is seen as a critical policy in order to ensure that quotas are not concentrated into the hands of large fishing companies whose owners have the financial resources to buy up such rights. In Ireland, any movement towards privatisation and concentration of rights into the hands of large companies would seriously risk fishing vessels losing an economic link with Ireland's coastal communities and undermining the socio-economic importance of the fishing industry in the coastal communities' dependant on fishing. The result of this long standing policy is that there is a balanced spread of sizes and types of fishing vessels who have retained a strong economic link with our coastal communities and have delivered economic activity including vital employment in these communities, where there are very limited alternative economic activities.

The fish quota management system in Ireland is designed to ensure the best possible spread both between fishing vessel operators and take up of quota during the year. The arrangements have been set and developed over many years since the commencement of the Common Fisheries Policy and the introduction of quotas. Each year at the December Fisheries Council, Ministers set the overall catch limits (Total Allowable Catches) for fish stocks within European waters. Each Member State gets a set amount of these limits (known as quotas) based on historical track record in the fishery and the principle of 'Relative Stability'. There are three categories of species to which quotas apply, including whitefish species, pelagic species and deep sea species. It is the responsibility of each Member State to manage their fisheries within these quotas and to allocate their quotas among their fishers.

Quota Management Advisory Committee (QMAC)

Under the arrangements to manage Ireland's fishing quotas, a formal Quota Management Advisory Committee (QMAC), involving fishing industry representatives from the catching and processing sectors meet regularly (currently each month), and as far as possible, the Minister for Agriculture, Food and the Marine follows their recommendations for regimes for particular stocks. Additional meetings are organised as required to discuss specific issues in particular fisheries that may arise.

A key objective of whitefish quota management is the avoidance of very early closure of fisheries through rapid exhaustion of quota. This is important because our whitefish fisheries are mixed and an early closure may lead to discarding of marketable fish. The whitefish quotas (about 28 stocks) are currently managed on the basis of catch limits set for one calendar month. For some stocks at certain times of the year, the catch limits may be set for a two or three month period. The catch limit set generally involves a quantity for smaller vessels (under 55 feet/16.76 metres) and double that quantity for larger vessels (at or over 55 feet/16.76 metres). Vessels using certain fishing gear may receive increased catch limits for certain stocks.

The QMAC operate by examining in detail each month the operation of each fishery, available quota and uptake patterns for the different métiers of fishing vessels, including inshore fishing vessels. There are detailed discussions each month on allocations taking account of the divergent situation of the fleet, including that of smaller inshore fishing vessels, and of the market. The Committee may also take account of the weather/sea conditions in the preceding quota period and the impact this may have had on the industry during that period, particularly in respect of the smaller vessels. It also has the possibility of recommending additional quota allocations to incentivise the introduction of environmentally friendly fishing gear in particular fisheries or for particular types of vessels. The Minister introduces statutory provisions that, in most cases, give legal effect to the recommendations of the QMAC and which are enforceable by the Sea Fisheries Protection Authority and the Irish Naval Service.

There are eight principal managed pelagic stocks (mackerel, Celtic Sea herring, North-West herring, Atlanto-Scandian herring, horse mackerel, blue whiting, boarfish and albacore tuna) and the particular management of each is further subdivided between various sectors of the fleet. The fishing of pelagic species is generally confined to the spring and autumn months, with the fisheries being opened and closed by the Minister on the basis of industry recommendations and catch levels.

Any amendments or changes to the overarching policy on management arrangements are determined by the Minister following detailed analysis and full consultation with stakeholders, in particular the fishing industry.

Landing Obligation – Reducing Unwanted Catches and Eliminating Discards

The 2013 reformed Common Fisheries Policy introduced new measures that would impact the management of Irish quotas, in particular the 'landing obligation' (also known as the 'discards ban'). The landing obligation was phased in over a number of years, starting in 2015 with pelagic fisheries, and extending to demersal fisheries on a phased basis during 2016, 2017 and 2018. The landing obligation has been fully implemented from 1 January 2019. While welcoming the full implementation of the discards ban, the Minister for Agriculture, Food and the Marine, Michael Creed TD, has also acknowledged the challenges facing the Irish fishing industry.

EU Landing Obligation Seminar

BIM held a seminar on the landing obligation in Páirc Uí Chaoimh, Co. Cork, in November 2018 with over 100 participants from the seafood sector in attendance.

The seminar sought to inform attendees on the new rules and the exemptions that apply from 1 January 2019 when the landing obligation came fully into force. It also highlighted the need for greater monitoring and recording of catches and new policy initiatives designed to ease implementation. Issues around the handling and storage of unwanted catches of small fish that have to be landed under the landing obligation as well as potential uses for these catches were also discussed.

The last part of the seminar showcased available technical and innovative solutions to help fishermen adapt. Two significant technical developments to addressing the challenge for fishermen will be more selective fishing gear and the avoidance of areas with high concentrations of small fish.

At the conference, the Marine Institute discussed mapping of areas with high concentrations of undersized fish as well as the planned introduction of a new app for fishermen which would identify these areas. The Department of Agriculture, Food and the Marine discussed the exemptions that apply to the new obligation while the Sea Fisheries Protection Authority outlined how it intends to monitor catches in 2019.

The landing obligation aims to reduce the levels of unwanted catches, the fish species that unintentionally end up in fishermen's nets. As the landing obligation requires all caught fish to be counted against quotas, including unwanted species, its introduction represents a radical change in fisheries management to encourage more selective fishing procedures.

EU H2020 DiscardLess Research Project

In 2018, under the EU Horizon 2020 funded DiscardLess project, the Marine Institute examined the 'choke' species issue. This is where in a mixed fishery (e.g. cod whiting and haddock in the Celtic Sea) a fisher could run out of quota for one species, while still having quota for other commercially valuable species. This leads to reduced economic return for the fisher and the country. Research showed that both gear changes, and behavioural changes (e.g. fishing tactics) could mitigate the losses to some extent, but not remove them.

During this work, Irish research developed an online application (app) that can be used by fishers to show were they are likely to encounter a given species or size of fish, and so be able to avoid or target them as appropriate to their quota allocations. The app was presented to policy makers and industry at a special workshop on the Landings Obligation held in Cork in November 2018. The reaction was very positive and several skippers have agreed to further test the app and provide feedback.

DiscardLess was a four year transnational funded project, where researchers and stakeholders worked together to help reduce discards in European fisheries. The project started in early 2015, and concluded in February 2019. The results (including the app) will be integrated into Discard Mitigation Strategies (DMS) proposing cost-effective solutions at all stages of the seafood supply chain.

Quota Balancing System

One such means to support the implementation of the discards ban is the phased introduction of a quota balancing system. This system has been developed at the request of, and with the assistance of, the Quota Management Advisory Committee. The quota balancing system is a conservation measure that will aid the Minister for Agriculture, Food and the Marine in matching available quota to actual catch so that incentives to discard are reduced. Quota balancing means that where a vessel exceeds its catch limit, the excess catch retained on board and landed will be subject to quota balancing and any excess must be paid back by means of a deduction from a future allocation. Quota balancing by the Department of Agriculture, Food and the Marine is fully independent of any action being considered or taken by the control authorities.

A pilot quota balancing scheme for pelagic stocks was introduced by Minister Creed on 1 January 2018 and has been well received by the fishing industry. Following a public consultation, the Minister has adopted a pilot quota balancing policy for whitefish stocks and it is intended that the pilot quota balancing policy for whitefish stocks will apply from 1 July 2019. The pilot quota balancing policy promotes conservation of Irish fishing quotas and also supports coherence between the discards ban and the effective management of the quotas.

The Stock Book – Scientific Advice on a €1.3 billion Resource

Throughout 2018, the Marine Institute continued to evolve the delivery of its advisory services on commercially exploited fish stocks in the waters around Ireland. The primary mechanism to deliver these services is the Stock Book, which was presented to the Minister for Agriculture, Food and the Marine, Michael Creed TD, in November 2018. The Stock Book was used in the negotiations with the EU on fixing fishing opportunities for the Irish fleet for 2019. The Stock Book provided the latest scientific information on over 58 commercially exploited fish stocks where Ireland has a quota under the Common Fisheries Policy. The overall 2018 fishing opportunities for all fleets exploiting these stocks amounted to €1.35 billion. Ireland's share of these fishing opportunities amounted to €222 million in 2018 and represents 17% by tonnes and 16% by value. The data in the Stock Book was also used to inform the 2018 Sustainability Assessment which the Minister presented to the Oireachtas in November 2018.

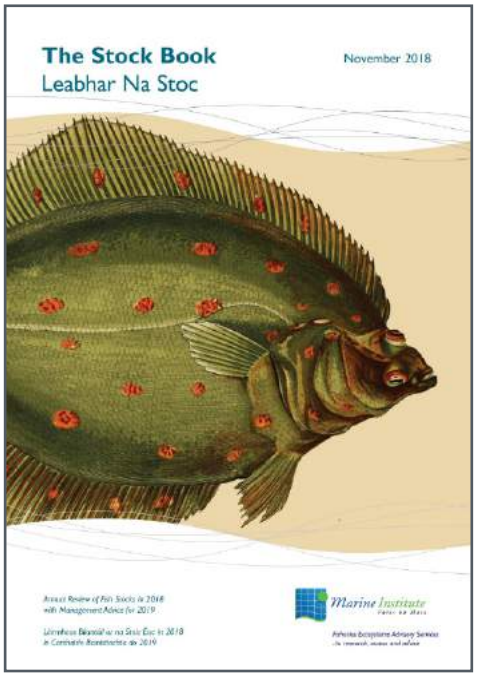


Figure 8. The Stock Book, Marine Institute, 2018

In 2018, funded under the European Maritime and Fisheries Fund, the Marine Institute introduced an interactive version of the Stock Book which allows the general public to explore the information dynamically (https://shiny.marine.ie/stockbook/). The Institute further developed the information in Ireland's Marine Atlas (https://atlas.marine.ie), appending information on fisheries resources, which is discoverable and downloadable by the public.

Data Collection Scheme

The European Maritime and Fisheries Fund (EMFF) Data Collection Scheme funds the data and its analysis to underpin the scientific advice required for the implementation of the Common Fisheries Policy. It is a legal requirement under the EU Data Collection Framework (Council Regulation (EC) No 2017/1004 of 17 May 2017). The 2018 national data collection programme was successfully executed and the 2019 programme submitted and approved.

The national programme includes catch sampling at sea and in ports, six internationally coordinated research survey programmes, inshore and diadromous sampling and surveys, collection of transversal data and the socio-economic evaluation of the fishing, fish processing and aquaculture sectors. The total investment in data collection in 2018 was approximately €7.8 million.

Biological data was collected at sea on board commercial and research vessels and in fishing ports around the coast as part of ports based sampling. Some 110 at sea trips, 65 inshore shellfish observer trips and 288 port sampling trips for demersal stocks were completed in 2018.

A biological sampling programme for the diadromous species salmon and eel was carried out and included surveys in the freshwater, trap returns and the national coded wire tag programme. Six internationally coordinated offshore research programmes at sea were completed, comprising 206

sea days and 2,054 scientific sea days. Survey data was used to provide fisheries independent data for stock assessment for blue whiting, North-West and Celtic Sea herring, boarfish, mackerel, horse mackerel, nephrops, anglerfish, megrim, and mixed demersal fish stocks, comprising over €4 million of the data collection budget for 2018. Thirteen inshore shellfish surveys provided data for oyster, cockle, scallop, surfclam and razorfish.

The economic situation of the aquaculture and processing industry sectors was evaluated by Bord Iascaigh Mhara (BIM) through the collection of census data, economic sample surveys and audited accounts from the Companies Registration Office (CRO).

International coordination of fisheries data collection and analysis was achieved through the participation at and contribution to 64 ICES (International Council for the Exploration of the Sea) and EU scientific expert groups directly related to the Data Collection Scheme for 2018. Regional coordination of the data collection was achieved through the DCF regional coordination group of the North Atlantic and the establishment of 12 intersessional subgroups. The collected data was disseminated via 25 official DCF data calls to the key scientific end users ICES, Scientific, Technical and Economic Committee for Fisheries (STECF), the European Commission and the DCF regional coordination groups.

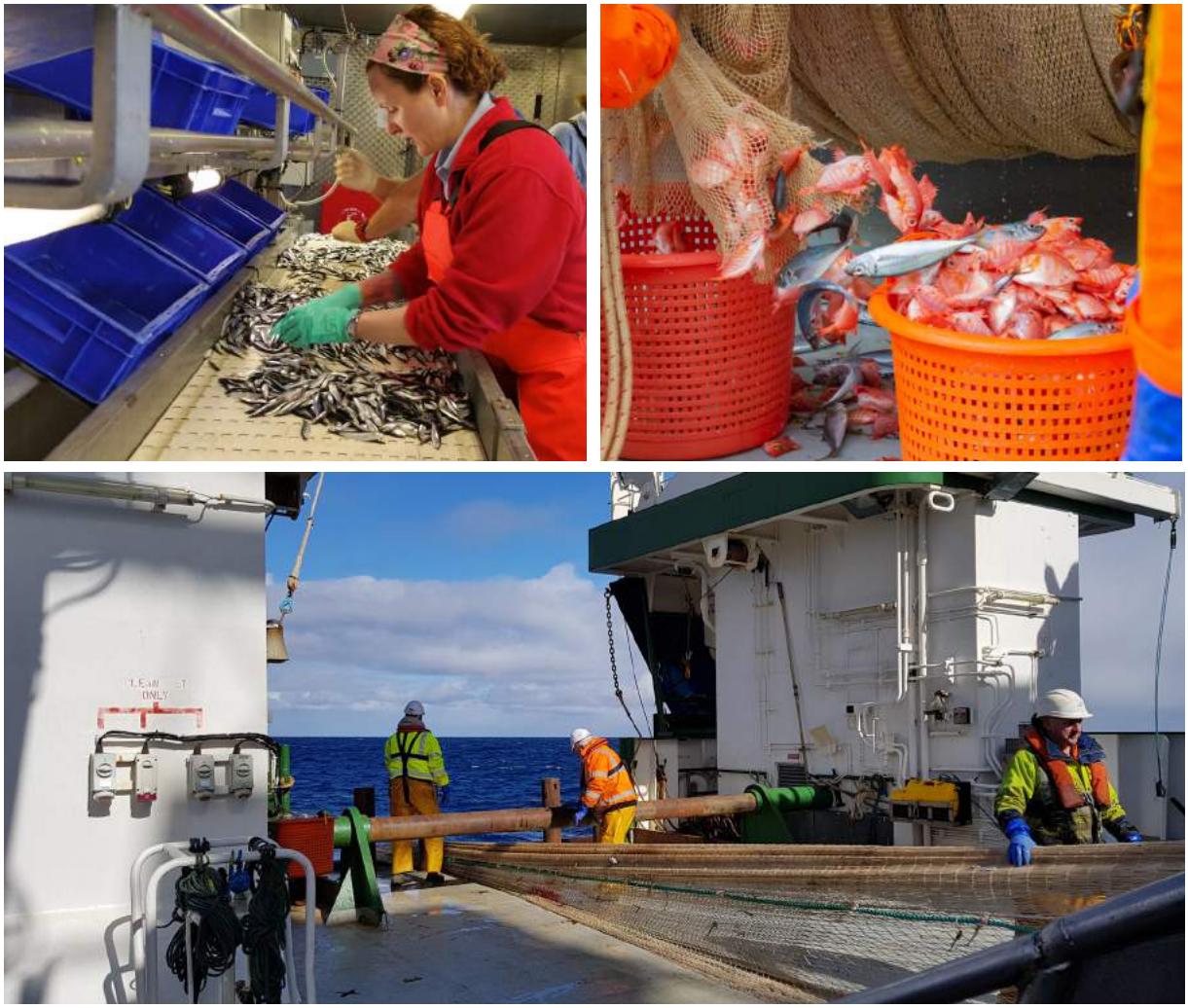


Figure 9. Photos courtesy of the Fisheries Ecosystem Advisory Services and Graham Johnston, Marine Institute

The Irish Anglerfish and Megrim Survey

In 2018, Irish vessels landed more than seven thousand tonnes of anglerfish and megrim, worth around €23 million at first sale. This makes anglerfish and megrim the two most valuable bottom-dwelling fish species for the Irish fishing industry.

Until recently, the state of the anglerfish stocks around Ireland was unknown and catch advice was based on a trawl survey that was unable to clearly identify trends in the population. To address this, the Marine Institute established a new dedicated survey that covers the majority of the stock distribution and which can detect changes in abundance from year-to-year. Anglerfish and megrim have a similar distribution area, so it is expected that the survey will also benefit the megrim stock assessment.

The new Irish Anglerfish and Megrim Survey (IAMS) series began in 2016 under the Data Collection Scheme of the European Maritime and Fisheries Fund (EMFF) Operational Programme 2014-2020. The design of the survey is based on the existing Scottish Anglerfish and Megrim survey and the Irish Industry-Science Partnership (ISP) surveys that were carried out on commercial vessels in 2006, 2007 and 2009. The Irish and Scottish surveys are closely coordinated and together cover the Northern North Sea, West of Scotland, Rockall and the West and South-West of Ireland. The trawl was designed in cooperation with the Scottish industry and is based on a successful commercial design by Jackson Trawls in Peterhead. The catchability of the trawl has been studied in detail, allowing correction of the catches for escapement and herding.

The IAMS takes place in spring of each year on the RV *Celtic Explorer*. The survey covers an area of 220,500km^2, which is more than twice the surface area of Ireland. The survey takes 32 days to complete and fishing operations take place around the clock. Twelve scientists work on 12-hour shifts and sort between 500kg and 5,000kg of fish per shift. Around 30,000 fish are measured during a survey. On average, the survey catches around 2,300 anglerfish and about 1,500 megrim per year. The density of anglerfish in the survey area varies from 2 to 120 fish per km^2. For megrim this figure is between 0 and 100 fish per km^2.

The new IAMS detected a strong increase in abundance of anglerfish in recent years when compared to the (ISP) surveys in the same area 10 years before. This increase in abundance is also apparent in commercial catch rates and is in line with increases in abundance in neighbouring stocks.

The International Council for the Exploration of the Sea (ICES) provides catch advice to the European Commission, which is used to set total allowable catches (TACs). In 2018, ICES evaluated all available data for anglerfish stocks and developed and evaluated new stock assessment models. The Marine Institute took a leading role in developing a full analytical assessment for anglerfish in the Celtic Seas and Biscay. The inclusion of the new survey was an integral part of this. The new assessment was accepted by ICES and is now used to provide catch advice.

Figure 10. The survey trawl gear

Figure 11. A young anglerfish

Figure 12. The survey trawl gear

Figure 13. A mature anglerfish

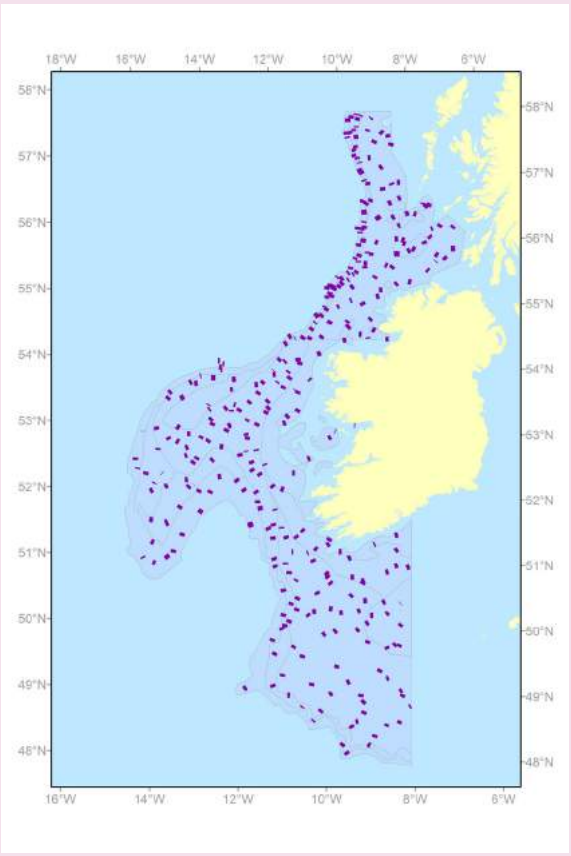


Figure 14. The purple lines indicate the trawl locations of the last three years. Image courtesy of the Marine Institute

Photos courtesy of Fisheries Ecosystems Advisory Services, Jonathan White and Hans Gerritsen, Marine Institute

Fair Regulation for a Sustainable Future

Good regulation is pivotal to the achievement of the collective ambitions for the development of Ireland's seafood industry. It ensures that Ireland's shared marine resources are sustainable for future generations, and that consumers at home and abroad can consume Ireland's seafood safely. Consumer trust in the quality, provenance and safety of our seafood produce is vital to safeguarding the growing reputation it enjoys across the world.

As the regulator for the sea fisheries and seafood sectors, the Sea Fisheries Protection Authority (SFPA) plays a key role. SFPA is dedicated to promoting compliance, verifying it and, where necessary, enforcing sea fisheries and seafood safety laws for all areas under its remit. This includes all fishing vessels operating within Ireland's 200-mile limit, over 2,000 Irish registered fishing vessels, wherever they operate, and all seafood produced in Ireland's 170 seafood-processing companies.

Inshore Shellfisheries – A Key Coastal Resource

In February 2018, the Marine Institute and Bord Iascaigh Mhara jointly published its Shellfish Stocks and Fisheries Review for the major shellfish species on which the Irish inshore fleet is dependent. The 2018 programme of assessment includes a suite of annual surveys of bivalve (oysters, clams, cockles, scallop) resources which reports on distribution, biomass and age/size/grade structure and economic value. For crustacean fisheries an 'at sea observer programme' was also completed in 2018 to obtain biological and catch and effort data for the fleet. The resulting indicators are reported in the Review.

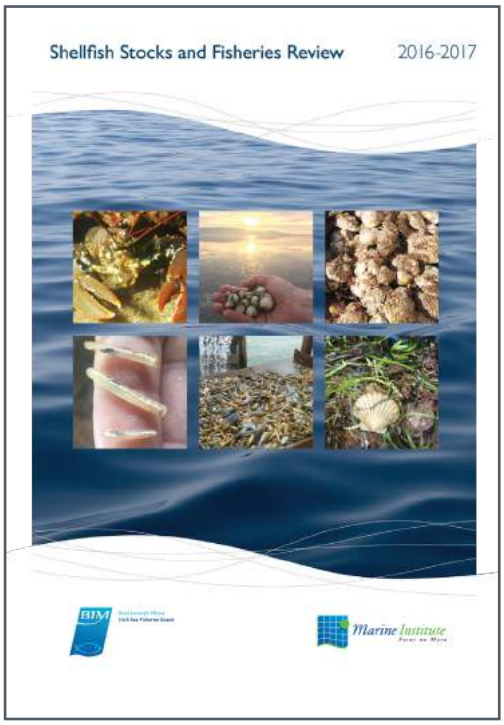


Figure 15. Shellfish Stocks and Fisheries Review, Marine Institute, BIM, 2018

The Shellfish assessment programme was presented to the Department of Agriculture, Food and the Marine (DAFM) and the industry representative structures (Regional Inshore Fisheries Forums – RIFFs, and the National Inshore Fisheries Forum – NIFF). Additional advice and discussions on management of shellfish resources continued with the RIFFs and NIFF throughout 2018. New management measures and procedures were adopted as a result of these interactions. These include new protocols for opening of new previously unexploited bivalve fisheries under management plans to avoid over fishing and to maintain stable economic activity. New technical measures for crab were agreed. A review of the lobster v-notch programme was completed and presented at regional RIFF meetings. This is being used to design the future implementation of the programme which is funded by the European Maritime and Fisheries Fund.

Additional products and services produced in 2018 included the Shellfish Atlas, which profiles the distribution and value of shellfish resources in Irish coastal waters. An assessment of fishing activity (value and volume) inside and outside of the six nautical mile limit was also produced for DAFM as input into the public consultation on limiting the size of trawling vessels which could fish inside six nautical miles.

Increased Protection to Waters inside Ireland's Six Mile Limit – Minister Announces Ban on Large Trawlers

In December 2018, the Minister for Agriculture, Food and the Marine, Michael Creed TD, announced the outcome of a review of trawling activity inside the six nautical mile zone. Having undertaken a detailed evaluation, the Minister decided that from 1 January 2020 vessels over 18 metres will be excluded from trawling inside six nautical miles and the baselines, with the exception of trawling for sprat only, which will be phased out by 31 December 2021.

As trawling for sprat is an activity that takes place largely inside the six nautical miles zone, this transition period is to allow affected vessels time to adjust. A total allowable catch up to 2,000 tonnes of sprat will be permitted for over 18 metre vessels inside six nautical miles and the baselines during 2020, reducing to 1,000 tonnes in 2021, with all trawling activity by over 18 metre vessels inside six nautical miles and inside the baselines being entirely curtailed from 2022 onwards.

The extensive public consultation, which ran as part of this review, took place between April and June 2018, and attracted over nine hundred submissions, representing a wide diversity of views. A vast majority of the submissions, including submissions from the National Inshore Fisheries Forum (NIFF), environmental NGOs, small scale fishermen, and residents in coastal areas, strongly supported introducing restrictions on trawling inside the six nautical mile zone. All of the producer organisations and the Irish Fish Producers and Exporters Association were opposed to any changes.

In environmental terms, large vessels trawling can have a significant impact on both fish stocks and important coastal marine environments. Scientific studies indicate that certain species of fish spend their 'nursery years' in shallower waters around the coast before moving offshore and protecting these fish from large scale trawling events will provide obvious benefits.

Economically, small scale and island fishermen are strongly reliant on inshore waters and the changes announced by the Minister should also bring benefits for these fishermen. The new measures will also provide for further sustainable development for the small scale inshore and sea angling sectors, which the Government has committed to in the Programme for a Partnership Government, which outlines the Government's policy priorities over the coming years.

In March 2019, the Minister issued Policy Directive 1 of 2019 to the Registrar General of Fishing Boats to give effect to the measures announced by the Minister. While some concerns were raised by the producer organisations, the decision was widely praised by the inshore industry, the NIFF, for example, terming the decision "brave … and, in the long term, benefit[ting] everyone" and the National Inshore Fisherman's Association and the National Inshore Fisherman's Organisation calling it "undoubtedly the most significant policy decision made in the history of the state in terms of supporting Ireland's inshore fishing sector. From a social, economic, environmental and moral perspective this was the right decision…to make."

Building Stakeholder Capacity – Inshore Fisheries Forums

Bord Iascaigh Mhara (BIM) continued to act as secretariat to both the National Inshore Fisheries Forum (NIFF) and the Regional Inshore Fisheries Forums (RIFFs) during 2018. In the year under review the NIFF continued to bring together a network of representatives from the six RIFFs. These forums represent a unique opportunity to develop and improve the sustainability of Ireland's valuable inshore fishery.

Significant outcomes of the process of Inshore Fisheries Forum meetings in 2018 included:

I. Inshore Fisheries Strategy

2018 saw the completion of the Irish Inshore Fisheries Sector Strategy 2019-2023. This strategy was informed by a lengthy and thorough engagement and consultation process with the sector.

The engagement and participation of the inshore sector has been paramount from the beginning, allowing the sector to take ownership of the process and the final product.

The NIFF worked with Department of Agriculture, Food and the Marine, BIM, the Marine Institute and the Sea Fisheries Protection Authority to develop a Strategy for the Irish Inshore Fisheries Sector for the remainder of the current European Maritime and Fisheries Fund (EMFF) Operational Programme.

Industry input was crucial throughout the process of development, through the RIFF members in the initial consultation in December 2017 and the close to 50 RIFF members that attended the strategy development workshop in February 2018 and the five NIFF members on the Steering Group. Further work by the Steering Group in March and April led to the development of an Inshore Strategy Consultation Document.

The consultation document identified issues affecting the sector, set out a vision and strategic direction for the inshore sector until 2023 and identified key objectives. Exactly how this vision and the objectives were to be achieved was deliberately not set out in the document as this is where the consultation process was looking to tap into the inshore sectors' knowledge and experience to come up with realistic and practical ideas for actions that will bring the strategy to fruition.

The feedback received informed the actions to implement the adopted objectives and the final draft strategy. This draft was subsequently adopted by NIFF in December 2018 and the Inshore Fisheries Strategy was launched in February 2019.

Figure 16. L to R: Pictured at the launch of the Inshore Strategy Consultation Document Jim O'Toole, CEO BIM; Mr. Michael Creed TD, Minister for Agriculture, Food and the Marine, Trudy McIntyre; and Kieran Calnan, Chairman, BIM. Photo courtesy of BIM

II. Minimum Conservation Reference Sizes
Further conservation measure proposals were brought forward by RIFFs to NIFF during 2018, specifically to increase the minimum conservation reference size (MCRS) for razor clams and brown crab, both of which went to public consultation in early 2018. The increase in MCRS for razor clams was introduced by Statutory Instrument in May 2018. The introduction of an increased MCRS for brown crab of 140mm proved more complex due to the fact that Irish vessels also fish crab outside Irish territorial waters and these issues were not full resolved by the year end. It is anticipated however that the increased MCRS will be introduced in 2019.

III. Operation of the Inshore Fisheries Forums
A comprehensive set of procedures for the operation of the forums was developed during 2018. The process of forum membership renewal is due to commence following the launch of the Inshore Fisheries Strategy in early 2019.

Action 12

Continue to implement EU Natura 2000 legislation (Birds and Habitats Directives).

Marine Special Areas of Conservation (SACs) and Special Protected Areas (SPAs)

To support future licensing decisions in 2019, full Appropriate Assessments for marine SACs and SPAs were conducted 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, and Blacksod Bay/ Broadhaven SPA. These assessments are required to satisfy requirements under the Birds and Habitats EU Directives, as well as national legislation. Additionally, ongoing monitoring of mitigation measures in relation to oyster culture and bird interactions continues in Dungarvan SPA and the Bannow Bay SPA.

An 18 month national monitoring programme for the six marine habitats listed in Annex I of the Habitats Directive was commissioned by the Department of Culture, Heritage and the Gaeltacht (DCHG) in 2016 and completed in 2018.

DCHG marine mammal monitoring of coastal and marine Natura 2000 sites has continued on a national/regional basis as appropriate. This includes targeted site-based surveys for both species of seal breeding around Ireland and transect surveys of bottle-nosed dolphin and porpoises in SACs designated for those species. It also included a repeat two-part nationwide assessment of seal population size and distribution in 2017 and 2018.

DCHG continues to engage with and work in partnership with the Department of Agriculture Food and the Marine, the Marine Institute, Bord Iascaigh Mhara, Sea Fisheries Protection Authority, Inland Fisheries Ireland and other stakeholders including industry and the National Inshore Fisheries Forum concerning sustainable resource exploitation and interactions between commercial fishing, angling, aquaculture and species protected under the Habitats Directive and the Wildlife Acts. Further details are available under Action 10.

Action 13a

Maintain and where appropriate, expand key marine observations/sentinel sites for Essential Climate Variables (ECVs) as endorsed by the UNFCCC Global Climate Observing System (GCOS). Such measurements (collected, quality assessed and analysed on an on-going basis) are essential to support improved regional modelling, scenario development, forecasting and climate impact risk assessment.

Advancing Ocean and Climate Observation and Monitoring

The Marine Institute works in collaboration with state agencies and higher education institutions to coordinate Ireland's contribution to ocean observations into national and international partnerships. These international, regional and localised forecasting services support Ireland's challenge in responding and adapting to changes in oceans and climate. The Institute's ocean observing activities include ship-based (e.g. national research vessels, RV *Celtic Explorer* and RV *Celtic Voyager*) and autonomous platforms (e.g. national weather buoys, gliders, Argo floats, observatory, and tide gauges) to measure and collect marine data that are essential to understanding climate change, water quality, food security and energy resources.

Figure 17. ICES Report on Ocean Climate, 2018

Ireland, through active participation by Marine Institute scientists, contributed to the 2017 annual ICES Report on Ocean Climate, a science-based assessment of the North Atlantic Ocean conditions prepared each year by the ICES (International Council for the Exploration of the Sea) Working Group on Oceanic Hydrography. Published in November 2018, the report outlines:

- Accelerated freshening in the upper ocean, first observed in the eastern subpolar North Atlantic in 2016, persisted into 2017, and expanded to include the southern Norwegian Sea. Notably, the freshening was accompanied by above-average temperatures.
- Air and sea surface temperatures were higher than normal across most of the region, with the exception of the central subpolar North Atlantic and Baltic Sea.
- Ice cover in the Barents Sea remained very low.
- Following a five year period of increasing heat content, the upper layer of the Norwegian Sea reached a new record-high value.
- The gradual freshening of upper waters (100m-400m), first observed in the North-East Subtropical Gyre, is now widespread, having reached western Iberian waters and the Canaries.
- In the western North Atlantic, ocean temperatures were near normal or slightly cooler than normal in the north (the Labrador and Newfoundland shelves) and warmer than normal in the south (along the North-East US shelf).

Full details are available from the published report available on www.ices.dk.

Annual Southern Oceanographic Rockall Ocean Climate Survey

Since 2006, the Marine Institute has carried out an annual oceanographic cruise focused on the deep waters of the Rockall Trough, west of Ireland. This survey is part of a wider international effort to monitor ocean climate change in the North Atlantic. The emerging repeat hydrographic section time series from the South Rockall Trough was completed nine times since it began (eight in winter and one in summer). Bad weather hampered efforts in 2015 and 2016, and only a partial section of the South Rockall Trough was completed in 2017.

Full ocean water depth (top to bottom) in situ essential climate and ocean variable data are collected along a southern hydrographic section in the Rockall Trough each year aboard the RV *Celtic Explorer*. Changes in water properties such as temperature, salinity and oxygen, which vary inter-annually and at decadal time scales, are measured on the survey. The ocean physics and chemistry data collected allow scientists to identify different water masses that travel through the Rockall Trough. The North Atlantic Current, often referred to as the Gulf Stream by the public, transports heat and salt from lower latitudes in the south, through the Rockall Trough and poleward into the Norwegian and Arctic Seas (part of the upper limb of the Atlantic Meridional Overturning Circulation). Deep water is formed in the subpolar Atlantic where near surface warm salty water mixes with colder fresher Arctic water, which then cools, sinks by convection to greater depths, and is exported southward. Since there is more than one transport pathway northward and southward, the Irish survey data are combined with international datasets collected in the region to support the ongoing transnational efforts to understand changes in the North Atlantic.

The main goal of the ocean climate cruise is to repeat a hydrographic section across the South Rockall Trough every year as part of an international effort to build a time series that can contribute to ocean climate research. Scientists monitor the inter-annual and decadal variability of physical and biogeochemical (e.g. carbon and nutrient measurements) variables and water mass characteristics in the region from the deep water, the continental margin and in shelf waters where environmental change can impact ecosystems through many trophic levels. Annual sampling of the offshore deep water section ensures the current dataset is extended into a long-term time series. Availability of hydrographic data is scarce in deep waters to the west of Ireland.

Ireland is not the only country who carries out this type of annual hydrographic survey. Other International Council for the Exploration of the Sea (ICES) member countries also collect repeat hydrographic section data in different regions of the North Atlantic. As part of the Global Ocean Observation System, the collected data is submitted to the ICES Working Group on Oceanic Hydrography (WGOH) and openly shared through the ICES database. All datasets collected in the North Atlantic are combined to help scientists build a picture of changing conditions in the North Atlantic over time and an annual report is published called the ICES Report on Ocean Climate (IROC), which summarises the most recent status and trends of ocean temperature and salinity in the ICES region. Data in the IROC is from ship based CTD (conductivity, temperature, depth) standard sections, ocean data buoys and inshore long term monitoring stations.

In 2018, the Irish survey collected environmental data at CTD stations on the Irish shelf. Stations occupied included Stations 1-10 along the 53° N shelf sea section. Plankton net samples were collected at Stations 4, 8 and at the Galway Bay Observatory where an additional CTD cast was completed. Rough seas prevented CTD casts in South Rockall Trough deep waters, however, three Argo floats were successfully deployed at Stations 18, 20 and 22. Ship ADCP (Acoustic Doppler Current Profiler) acquired water current data and surface underway data (CTD, DO [dissolved oxygen], pCO_2 [partial pressure of carbon dioxide] etc.) were recorded for the cruise duration. A small number of samples were collected from the underway system in Galway Bay, while sheltering from the worst of the weather.

The 2018 survey was seriously hampered by poor weather, with worst conditions experienced mid-cruise making it impossible to complete the key target stations in the South Rockall Trough. As a result, a decision was made to move the survey to June 2019 to give a higher probability of success with the weather.

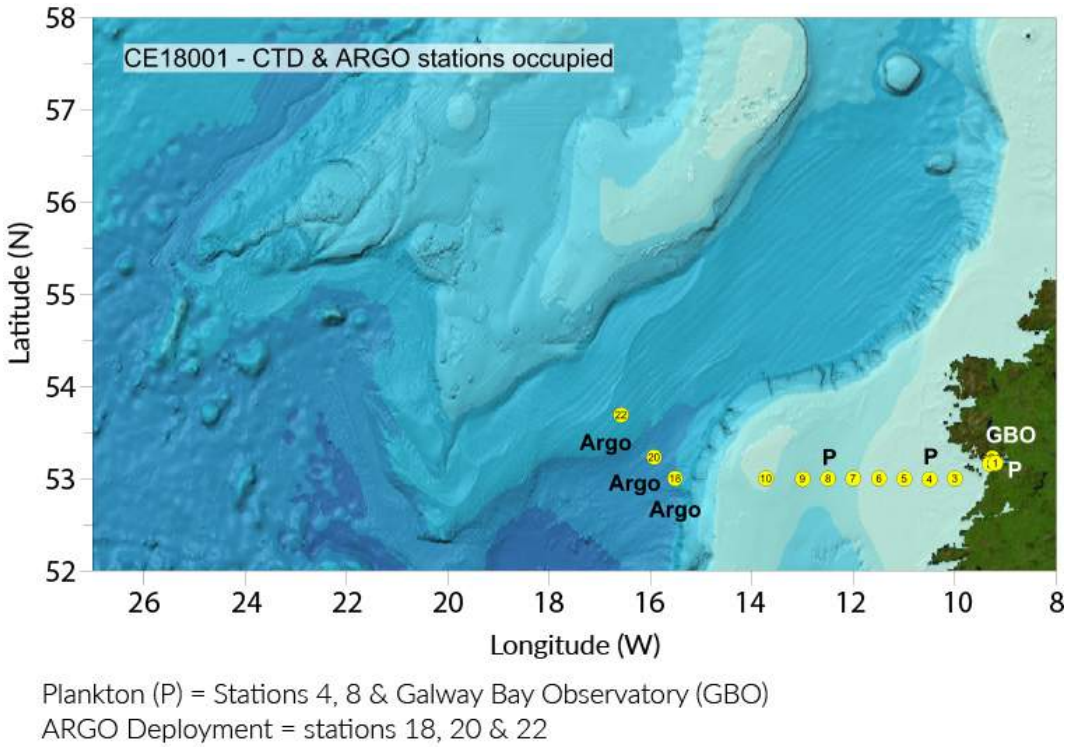


Figure 18. Stations occupied on Cruise, February 2018. CTD cast stations 1-10 on the 53° N shelf repeat section occupied. Three Argo floats successfully deployed at Stations 18, 20 and 22 in the S Rockall Trough where bad weather hampered CTD deployments. Plankton (P) nets deployed at Stations 4, 8 and at the Galway Bay Observatory (GBO) where a CTD cast was completed.

Observing the Chemistry of Our Oceans and Ocean Acidification Variables

The Marine Institute, working closely with scientists from NUI Galway on ocean chemistry parameters, participated in the southern Oceanographic Rockall Ocean Climate Survey on the RV *Celtic Explorer* in 2018 (see above) and also undertook the winter environmental survey in coastal and shelf waters on board the RV *Celtic Voyager*. Both of these surveys collect data on essential ocean/climate variables including carbon system/ocean acidification variables.

A new mooring was established under the Interreg VA Compass project at Mace Head, deploying sensors for measuring partial pressure of carbon dioxide (pCO_2), potential Hydrogen (pH) (seaFET), and nitrate, and supported by a water sampling regime for quality assuring sensor data and collecting data for additional parameters using reference laboratory methods.

Following the installation of a surface pCO_2 measurement system on the RV *Celtic Explorer* in 2017, data from this platform has been processed with a view to reporting to international CO_2 data atlas (SOCAT). NUI Galway has also installed a similar system on the RV *Celtic Voyager* under the Marine Institute funded VOCAB project. The four year project aims to address some of the gaps in our current knowledge of the vulnerability of selected marine ecosystems in Irish waters to ocean acidification, by exploring some of the complex biogeochemical processes occurring at fine scales in selected ecosystems, and by studying the larger scale biogeochemistry of ocean waters impinging on those ecosystems.

Identifying Common Climate Change-related Vulnerabilities and Solutions in European Coastal Areas

The Joint Programming Initiative (JPI) Climate ERA4CS CoCliME research project Co-development of CLimate services for Adaptation to Changing Marine Ecosystems, coordinated by the Marine Institute and working with Irish partner Bantry Marine Research Station, continued activities to co-develop user-driven climate services for the Irish seafood sector. This includes examining the effect of climate change on harmful algal blooms (HABs) dynamics in European waters. This information is used to co-develop relevant climate services for end users such as shellfish farmers, tourists, health and environmental agencies, to prevent and adapt to the impacts of HABs in future climate change scenarios. In 2018, scientists from the Marine Institute and Bantry Marine Research Station met with stakeholders in the south west of Ireland to better understand needs and expectations for climate services.

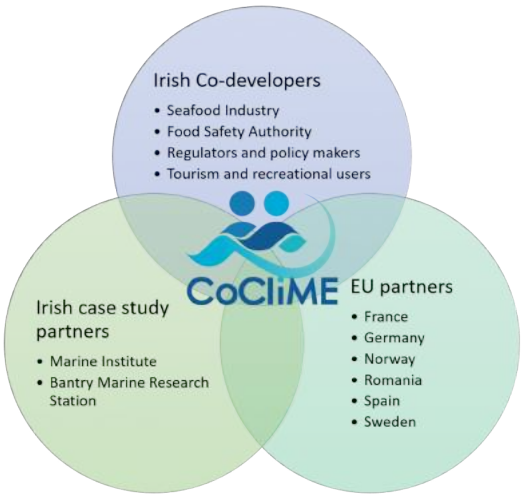


Figure 19. Source www.coclime.eu

The project comprises 11 European partners and is co-funded by Ireland's Environmental Protection Agency. Further details on the Irish Atlantic Case Study is available on www.coclime.eu/Irish-Atlantic

A4: Aigéin, Aeráid, agus Athrú Atlantaigh A4 €2 million Climate Change Project Funded

Following a call for research proposals by the Marine Institute in September 2018 in the area of 'Oceans in a Changing Climate', €2 million in funding was awarded in December 2018 for a major project on Atlantic climate change. The A4 project, led by Maynooth ICARUS Climate Research Centre also includes researchers from Trinity College Dublin, as well as international partners from the UK, Germany and the US.

The project aims to build significant additional national capacity in Ireland in physical oceanography and climate change research, which 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.

The research team will work with scientists in Ireland and internationally to enhance the use of existing and new marine infrastructures and increase Ireland's capabilities to provide essential information on the ocean supporting enhanced forecasting capabilities and contributing to adaptation and mitigation strategies and actions. Over the five year period, the project is examining three areas in which substantial progress can be made: ongoing Atlantic change, sea level rise, and decadal climate prediction.

The project's international partners include the UK National Oceanography Centre; the UK Met Office; the Scottish Association for Marine Science; University of Bremen, Federal Maritime and Hydrographic Agency (BSH) and University of Hamburg, Germany; and US partners the National Center for Atmospheric Research (NOAA) and Tufts University.

The project is funded by the Marine Institute under the Marine Research Programme 2014-2020, co-funded by the European Regional Development Fund. A4 stands for aigéin (oceans), aeráid (climate), agus athrú Atlantaigh (Atlantic change).

Developing an Integrated Atlantic Ocean Observing System

As part of the EU funded AtlantOS project, researchers at the Marine Institute are working with international partners to examine needs to be addressed in the next ten years to facilitate an enhanced, integrated, fit-for-purpose ocean observing system. This includes inputting into the development of a Blueprint Vision to 2030.

Specifically, in 2018, a cost and feasibility study on present and planned systems, assessing the readiness and feasibility of different technologies was completed. This was the first time a concerted effort was made to collect financial data on the Atlantic Ocean Observing Networks with significant input from network representatives including AtlantOS partners and the wider community.

Main Conclusions of the report:

- There is a requirement for more up-to-date and accurate data on the expenditure of ocean observing systems in the Atlantic.
- The observing networks investigated in this study are currently funded through a combination of national governmental and research project funds.
- All networks involved in the study have plans to upgrade and expand their present system and to address gaps in their capacities for ocean observations.
- Many of the networks investigated in this study are reliant on time-limited research funds since sustained funding is currently unavailable.

Key Recommendations from the report:

- Establish a common cost accounting approach to allow a more detailed analysis of the financial expenditure of the Atlantic Ocean observing networks.
- Use the financial data gathered in this study to inform discussions on sustained funding for Atlantic Ocean observing networks.
- Provide the required (personnel and financial) resources to allow a more in-depth study of all operating and delayed mode in situ activities in the Atlantic.
- Enable an international body, of repute in ocean observation, to lead and coordinate the continuation of annual reporting on the costs (CAPEX and OPEX) to run the networks.

This work is informing future discussions and decisions on sustained funding in countries bordering the Atlantic. The full technical report is available on www.atlantos-h2020.eu

Autonomous Observation Equipment

National Argo Programme

Ireland, through the Marine Institute, and facilitated by support from the Department of Agriculture, Food and the Marine, was granted full membership to the Euro-Argo ERIC in 2016. Through its participation in Euro-Argo, a European Research Infrastructure Consortium (ERIC), the Marine Institute has joined key players in the international global earth observation and monitoring effort. The Institute's participation in the Euro-Argo ERIC allows Ireland to build national capacity in the ocean observation sphere and to leverage substantial opportunities in Horizon 2020 and other EU research and infrastructure funding mechanisms. It also places Ireland at the centre of global efforts to address the potential impacts of climate change. Throughout 2018, the Marine Institute continued in its role as vice-chair of the European Argo Management Board, which supervises the work of the Euro-Argo ERIC and ensures that it operates in accordance with its strategic roadmap.

The Marine Institute took delivery of Ireland's first biogeochemical (BGC) monitoring Argo float in early 2018. The BGC float significantly increases Ireland's ability to monitor additional parameters such as dissolved oxygen, pH, chlorophyll and fluorescence. Also in 2018, the Institute increased its ability to monitor dissolved oxygen via the Argo programme through the procurement of Ireland's first dissolved oxygen monitoring core Argo floats.

Ireland deployed four core Argo floats (monitoring temperature and salinity) in the North Atlantic in 2018. Argo sampling provides critical long-term data on seasonal and inter-annual variability of the global ocean circulation. Through Argo, the systematic estimation of the heat and fresh water budgets (storage, transport, and atmospheric fluxes) is now possible. Argo is strongly complementary to satellite observations where float data can be used to ground-truth satellite data. The Argo data are assimilated with those from satellites into ocean circulation and climate models, in support of research and operational applications. The contribution from the Argo array is integrated into the Copernicus programme and the Global Earth Observation System of Systems (GEOSS).

National Glider Programme

The Marine Institute operates a marine glider called *Laochra Na Mara* that is operated from the RV *Celtic Explorer* or RV *Celtic Voyager* and may also be operated from other appropriate vessels. The glider is capable of operating for 12-15 days autonomously whilst collecting oceanographic data to depths of 1,000m. The glider measures parameters such as conductivity, temperature, depth, fluorescence, turbidity and dissolved oxygen.

The *Laochra Na Mara* was successfully operated on two science missions in 2018. Although challenging weather conditions prohibited the deployment of the glider via the open climate cruise, 2018 provided additional equipment upgrades, testing time and deployment. This included deployment in the deepwater canyons to the south west of Ireland as part of NUI Galway's PANiC (Propagation of Acoustic Noise in Canyons) survey being carried out as part of the research undertaken by the Science Foundation Ireland (SFI) Centre for Research in Applied Geoscience (iCrag).

2019 will see continued use and deployment of *Laochra Na Mara*, as well as the procurement of two additional gliders funded through the SFI Research Infrastructure Programme.

Strengthening National Ocean Modelling Capabilities

The range of modelling services provided by the Marine Institute expanded in 2018. A flagship EU oceanographic operational programme, the Copernicus Marine Environment Monitoring Service (CMEMS), entered its second phase in 2018. The Marine Institute, having successfully contributed to the development of a biogeochemical marine forecasting service for the Iberia-Biscay-Ireland (IBI) region in years 2015-2018, secured a further contract for the period 2018-2020. The work includes the validating of biogeochemical forecasting and hindcasting models of the IBI region and also the provision of scientific advice.

The modelling team in the Institute are also developing biogeochemical Ocean Monitoring Indicators that will be published in the CMEMS Ocean State Report (OSR). The OSR provides a comprehensive and state-of-the art assessment of the state of the global ocean and European regional seas for the ocean scientific community as well as for policy and decision-makers.

EU funded research projects gained momentum in 2018. Notably, the Marine Institute developed numerical modelling capacity 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, H2020); and development of climate services for aquaculture industry (Co-Clime, JPI Climate ERA4CS).

Developing Practical Products and Services for Marine and Coastal Stakeholders

The Marine Institute continues to provide freely available and 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 from the numerical model outputs and from the observing systems.

Through the EU funded AtlantOS project, researchers at the Institute developed a weather window tool that provides real-time access to observations and model forecasts of seas state that assists in planning day-to-day operations. Other products such as an aquaculture site selection 'proof of concept' support tool that assesses regional oceanographic conditions in order to identify suitable aquaculture sites. A best practice on 'how to create a weekly HAB bulletin' was published in the Best Practice repository (https://www.oceanbestpractices.net/) maintained by the International Oceanographic Data and Information Exchange (IODE) of the UNESCO-IOC as an Intergovernmental Oceanographic Commission (IODE, Global Ocean Observing System) coordinated activity.

The Institute also continued its 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 knowledge to An Garda Síochána to assist with investigations.

CHERISH

The CHERISH project (Climate, Heritage and Environments of Reefs, Islands and Headlands) – 'Climate Change and Coastal Heritage' – is a €5.2 million five year project funded by the European Union's Ireland Wales 2014-2020 European Territorial Co-operation (ETC) programme. The project will support specialist organisations in Ireland and Wales to employ cutting-edge technologies to analyse coastal and island archaeology and heritage sites most affected by climate change, coastal erosion, storminess and rising sea levels.

Geological Survey Ireland together with the Discovery Programme: Centre for Archaeology and Innovation Ireland (Heritage Council) are collaborating with The Royal Commission on the Ancient and Historical Monuments of Wales (Project Lead) and the Aberystwyth University: Department of Geography and Earth Sciences on this project as well as communities in counties Meath, Dublin, Wexford, Waterford and Kerry.

In 2018, marine multibeam and sub-bottom surveying continued with 150 km^2 of bathymetric coverage in CHERISH areas. The RV *Keary* travelled to Wales in August 2018 and mapped 12 km^2. Results include an almost seamless onshore-offshore map of Puffin Island NE Anglesey, which will be completed using unmanned aerial vehicle (UAV) photogrammetry within the intertidal area.

Figure 20. Hook Lighthouse. Photo courtesy of the Department of Communications, Climate Action and Environment

The Irish Marine Data Buoy Observation Network

New Investment Programme

Established in 2000, and formerly known as the Irish National Weather Buoy Network, the Network of buoys provides hourly reports of near surface marine meteorological data. The data consists of measurements of air temperature and humidity, atmospheric pressure, wind speed and direction, as well as oceanographic data including sea surface temperature, wave height and period, and salinity.

Figure 21. The next generation weather buoy in Galway harbour awaiting deployment on an extended offshore test.

In 2018 an additional investment of €300,000 was provided by the Department of Agriculture, Food and the Marine to the Marine Institute; bringing the total investment to over €700,000 for the Network in 2018. This investment will enable the upgrade of the Network with new generation buoy platforms and a suite of sensors, replacing the current technology that has been in use since 2008. This new annual investment also supports a broader range of essential climate observations.

A recent Science Foundation Ireland (SFI) research infrastructure award (ElRoos) 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. This technically challenging addition to the suite of measurements will add a tool to assist the research community in assessing ocean acidification.

Technical Developments

During recent years, the Marine Institute has rolled out a series of modifications to the standard buoy platforms in use to improve reliability. In addition, a long-term research programme involving the UK Met Office and a French company, Mobilis, resulted in what is one of the most advanced deep field weather observing platforms currently available world-wide.

Marine Institute technical staff have also developed an advanced data collection system, which is based on open source hardware and software solutions. The system was tested over the winter 2018/2019 and data quality has been verified by Met Éireann as being of a sufficiently high standard.

Following a competitive tender process, an Irish-based company has submitted a design proposal for a new buoy platform. The development of buoy platforms by a number of Irish small and medium-sized enterprises (SMEs) is a significant step towards marine weather observing systems being developed and built in Ireland.

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.

Over coming years, data collection and management will be streamlined, maintaining not only the acquisition of data to shore, but also its archive and dissemination, including hourly transmission to EU met services and beyond.

Action 35c

Establish permanent tidal monitoring infrastructure (national tide gauge network) around the coast of Ireland.

Irish National Tide Gauge Network

The Irish National Tide Gauge Network (INTGN) monitors sea level around the Irish coast. The network is operated by the Marine Institute in partnership with other national and local stakeholders, including the Office of Public Works (OPW) and a number of Local Authorities. As sea level relative to land level change is a key ECV (Essential Climate Variable) with regards to climate adaptation and coastal resilience, significant efforts are ongoing to build the Network.

In 2018, the INTGN reached a critical mass of activity and entered a new developmental phase. Each area – from the base station and underlying data processing and management, to operations and maintenance – is steadily developing the work from the early stage project into a mature pre-operational programme. Taking the OPW monitoring sites into account, a total of 22 permanent maintained marine stations are now online.

Over the last year, project partners have been working towards bringing all stations to within a certainty of better than 1cm. All remote monitoring nodes are now true real time, with data being monitored and reported into the central base station every five minutes. This ensures timely provision of data via the web to stakeholders and the public. Additional locations are also now available from the 'free at the point of service' web mounted tidal prediction system (www.marine.ie/Home/site-area/data-services/marine-forecasts/tidal-predictions).

The underlying architecture of the Network has also been extended to integrate a number of river monitoring sites, specifically the Network developed by researchers at the Marine Institute's Newport Research Facility in Co. Mayo.

The period through to 2021 will see two more GLOSS (Global Sea Level Observing System) standard tide gauges added to the currently operating system established by the OPW at Portmore Pier, Malin Head in 2017. Consultation and evaluation has arrived at two GLOSS sites: Howth Harbour (an upgrade to an existing installation that was established in 2006) and Union Hall Harbour (a new site) that have been funded in 2018 under a Science Foundation Ireland (SFI) Research Infrastructure award (ElRoos Project). This will include adjacent continuously monitored land level stations to remove uncertainties in sea level change due to isostatic variability (the equilibrium that exists between parts of the earth's crust which means land level can change over a range of time scales).

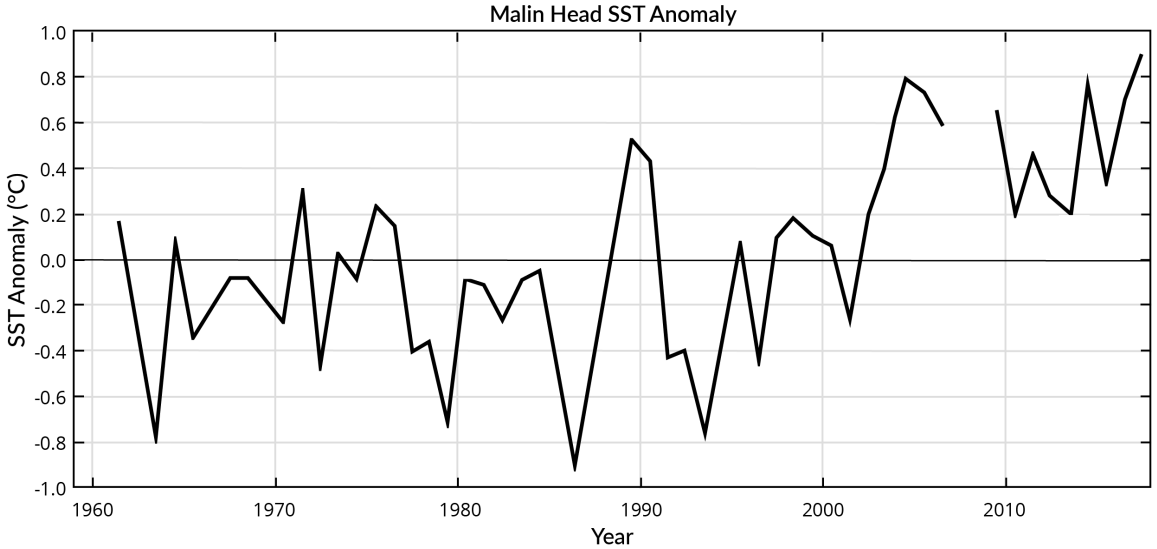


Figure 22. Celtic Seas: Temperature at the Malin Head coastal station (55.39°N, 7.38°W). Citation: González-Pola, C., Larsen, K. M. H., Fratantoni, P., and Beszczynska-Möller, A. (Eds). 2018. ICES Report on Ocean Climate 2017. ICES Cooperative Research Report No. 345. 119 pp. http://doi.org/10.17895/ices.pub.4625

The long-term, ultra-high precision temperature data being collected at Ballycotton (East Cork) and the Portmore Pier (Malin Head) are now well established, feeding background climatological data into central archives of temperature, a fundamental climate change indicator. Figure 22 shows a consistent upward trend since the late 1980s. In the case of Malin Head this work is building on a time series that started in the late 1950s by Met Éireann. These data, together with comparable data sets worldwide, are now collated by international bodies responsible for analysis and dissemination to the scientific community and policy makers.

Action 14

Implement Ireland's National Biodiversity Plan "Actions for Biodiversity, 2011-2016", to conserve and restore biodiversity and ecosystem services in the marine environment.

The 3rd National Biodiversity Action Plan was launched in October 2017 for the period 2017-2021. Objective 5 relates to marine biodiversity – 'Conserve and restore biodiversity and ecosystem services in the marine environment' – and the Plan outlines actions to be achieved in order to fulfil this objective.

The Department of Culture, Heritage and the Gaeltacht continued to collaborate with the Marine Institute, Bord Iascaigh Mhara and other stakeholders in relation to rolling out integrated projects, e.g. under the European Maritime and Fisheries Fund (EMFF) Biodiversity Scheme, in order to address sectoral issues and policy areas of joint concern. The Plan contains a number of actions associated with EU and national marine policies such as implementing the Marine Strategy Framework Directive, the Water Framework Directive, the Common Fisheries Policy and the Habitats Directive. Updates on the implementation of these policies are available under Actions 9 to 12.

ObSERVE Programme

In October 2014, the Department of Communications, Climate Action and Environment (DCCAE) in partnership with the National Parks and Wildlife Service (NPWS) of the Department of Culture, Heritage and the Gaeltacht (DCHG) established the innovative ObSERVE Programme. The aim of the ObSERVE Programme is to greatly improve our knowledge and understanding of protected offshore species and sensitive habitats through high quality, state-of-the-art data collection across Ireland's extensive Exclusive Economic Zone. Information generated and analysed under ObSERVE is expected to feed into the sustainable management of offshore activities and appropriate marine conservation strategies.

The dynamic 'Atlantic Margin', where Ireland's continental shelf merges into deeper oceanic basins, has been a key focus of this work as it is of growing interest to marine industry but also historically an area with significant gaps in environmental information.

ObSERVE involved a combined Government investment of €2.8 million in two distinct projects – ObSERVE Aerial and ObSERVE Acoustic. ObSERVE Aerial consisted of a series of high quality aerial surveys for whales, dolphins, seabirds and other marine life over a significant portion of Ireland's Exclusive Economic Zone across two summers and two winters, and carried out three further intensive seabird surveys in the western Irish Sea. The second project, ObSERVE Acoustic, tapped into the array of underwater sounds made by more than 20 species of whales, dolphins and porpoises, in order to learn more about their occurrence, distribution, abundance and migration habits, particularly those species that are rarely seen. Both projects began work in the spring of 2015 and were completed in October 2018. ObSERVE has resulted in a vastly improved understanding of cetacean and seabird occurrence, abundance and seasonal variability.

The final reports and data from both Acoustic and Aerial Projects were published on the DCCAE website in November 2018. It is clear from these drafts that robust, high-quality data on seabird and cetacean distribution and abundance in the Irish offshore has been gathered by the two survey methods employed. This data will go some way towards informing Ireland's next Article 17 report to the EU Commission (an obligation under the EU Habitats Directive) as well as underpinning appropriate management and regulatory actions for the sustainable development of the Irish offshore.

DCCAE has committed to work in 2019 with the NPWS of DCHG to scope, and allocate resources to, a Phase II of the ObSERVE Programme.

Further details are available under Actions 8 and 21.

Figure 23. A selection of photos ObSERVE Programme. Photos courtesy of Department of Communications, Climate Action and Environment. Photograghers Rossa Meade, GMIT, and Stephanie Levesque, Irish Whale and Dolphin Group.

European Maritime and Fisheries Fund (EMFF) Marine Biodiversity Scheme

Under the Marine Biodiversity Scheme of the EMFF Operational Programme, the Marine Institute conducted 13 projects in 2018, some of which will continue until 2020. The projects address the overall aim of the Scheme to promote good fisheries and aquaculture management and to protect biodiversity in marine habitats, in order to support the Common Fisheries Policy (CFP) and ensure compliance with the Habitats and Birds Directives and the Marine Strategy Framework Directive (MSFD).

Three projects were carried out on species restoration to define the critical habitats of native oysters, crayfish, ray and skates, and to identify critical management measures required to support species recovery. To assess fisheries habitat interaction, data continues to be collected for small-scale fisheries in and close to Natura sites, while further offshore areas of reefs were mapped in 2018 with a second dedicated remotely operated vehicle survey. Appropriate Assessments for aquaculture activities in Natura sites continue to be carried out and mitigation measures are developed and monitored. The estimation of bycatch of protected, endangered and threatened species (PET) in commercial fisheries and its sustainability assessment is an important consideration in the implementation of the CFP, the MSFD (Descriptor 1) and the Habitats and Bird's Directives.

Ireland records all bycatch on its observer programme for commercial inshore and offshore fleet métiers, and in addition has increased its sampling effort in fisheries, which are considered to pose the highest risk to bycatch in an enhanced bycatch programme. Improved biodiversity monitoring is tested through feasibility projects on aerial surveys and adding value to routine fisheries surveys with additional data collection on marine mammals and benthic habitats. To further support MSFD implementation, reference points of maximum sustainable yield are developed for keystone fish species and those vulnerable to fishing, while an informatics project aims to integrate and visualise fisheries data of different sources to support ecosystem based management.

Stakeholder communication is an important aspect of managing the EMFF Marine Biodiversity Scheme and regular communication meetings are held at a local and national scale. A new website (www.emff.marine.ie) launched in June 2018 is being used to disseminate project details and outputs.

A dedicated EMFF Marine Biodiversity Information event was held in Dublin in November 2018 to inform stakeholders about the activities carried out under the scheme. Twelve presentations were grouped around the main three themes of Natura and MSFD support under EMFF, and habitat and species restoration. Interactive displays fostered the close communication between scientists and stakeholders. Stakeholders included industry, environmental NGOs, community action groups, government departments and state agencies, as well as the European Commission.

Invasive Alien Species (IAS)

The presence of invasive alien species (IAS) is a threat to marine biodiversity and can have serious economic and ecological consequences. The challenges posed by IAS are recognised at the highest policy levels in Ireland and the European Union. For example, actions to address IAS are identified in Ireland's National Biodiversity Action Plan and National Marine Planning Framework Baseline Report, and in the EU Marine Strategy Framework Directive (MSFD) and Habitats Directive.

Significant data gaps around surveillance systems for marine invasive alien species in Ireland and a lack of understanding of their spatial distribution in coastal and nearshore habitats have been recognised for some time. A systematic thorough survey using the latest molecular tools, has not been conducted to enable the accurate mapping of their incidence and potential spread. To address this gap, the Marine and Freshwater Research Centre at the Galway-Mayo Institute of Technology, are carrying out a two year research project on IAS distribution in Ireland's coastal waters and habitats, in coordination with the Marine Institute. This work is focused on developing molecular surveillance methods using environmental DNA (eDNA), and comparing results from this evolving methodology alongside traditional survey and taxonomic methods. The goal of this work is to provide baseline reference data on marine IAS from water column and coastal benthic habitats. These data will be useful for reporting under the MSFD, and for identifying potential management actions to address risks.

The project involves a series of targeted field studies that will encompass a range of coastal environments and locations at a national scale, including a number of candidate sentinel locations that have shown high risk of introduction in conjunction with recognised IAS pathways and vectors. A focused eDNA study will monitor the occurrence and spread of the invasive species Didemnun vexillum, a non-native invasive ascidian. It is believed to have originated in Japan, but now has an established population in Irish waters. It impacts on shellfish culture and fisheries, and causes fouling of marine structures and shipping infrastructure.

The project will also develop experiments to monitor the interactions and potential impacts of non-native Pacific oysters (M. gigas) and native oysters (O. edulis). The Pacific oyster is cultivated in dedicated aquaculture sites, but it has also shown evidence of establishment in natural habitats with feral populations detected in a number of Irish coastal areas. It can compete with the native species for settlement area and is a possible vector for disease and parasites.

This project aims to improve our spatial knowledge of marine invasive taxa in Irish coastal habitats, and provide a fit-for-purpose surveillance system that can be used to enable early detection and rapid response of new IAS that may enter Ireland's marine habitats. The outputs of the project will be a data catalogue of non-native marine species detected, maps of IAS incidence and distribution and a guidance manual of surveillance methods. These outputs will contribute to improved control of IAS introductions.

This research Initiative is part of a wider series of ongoing technical studies to support marine spatial planning and decision making required for MSFD reporting. The Blue Growth & Marine Spatial Planning Scheme is established under Union Priority 6 (Integrated Maritime Policy) of Ireland's European Maritime and Fisheries Fund (EMFF) Operational Programme, co-funded by the Irish Government and the EU. See Action 1a for further details.

Action 15

Promote further research into economic values of marine biodiversity and ecosystem services to ensure best practice planning and management of the ocean resource.

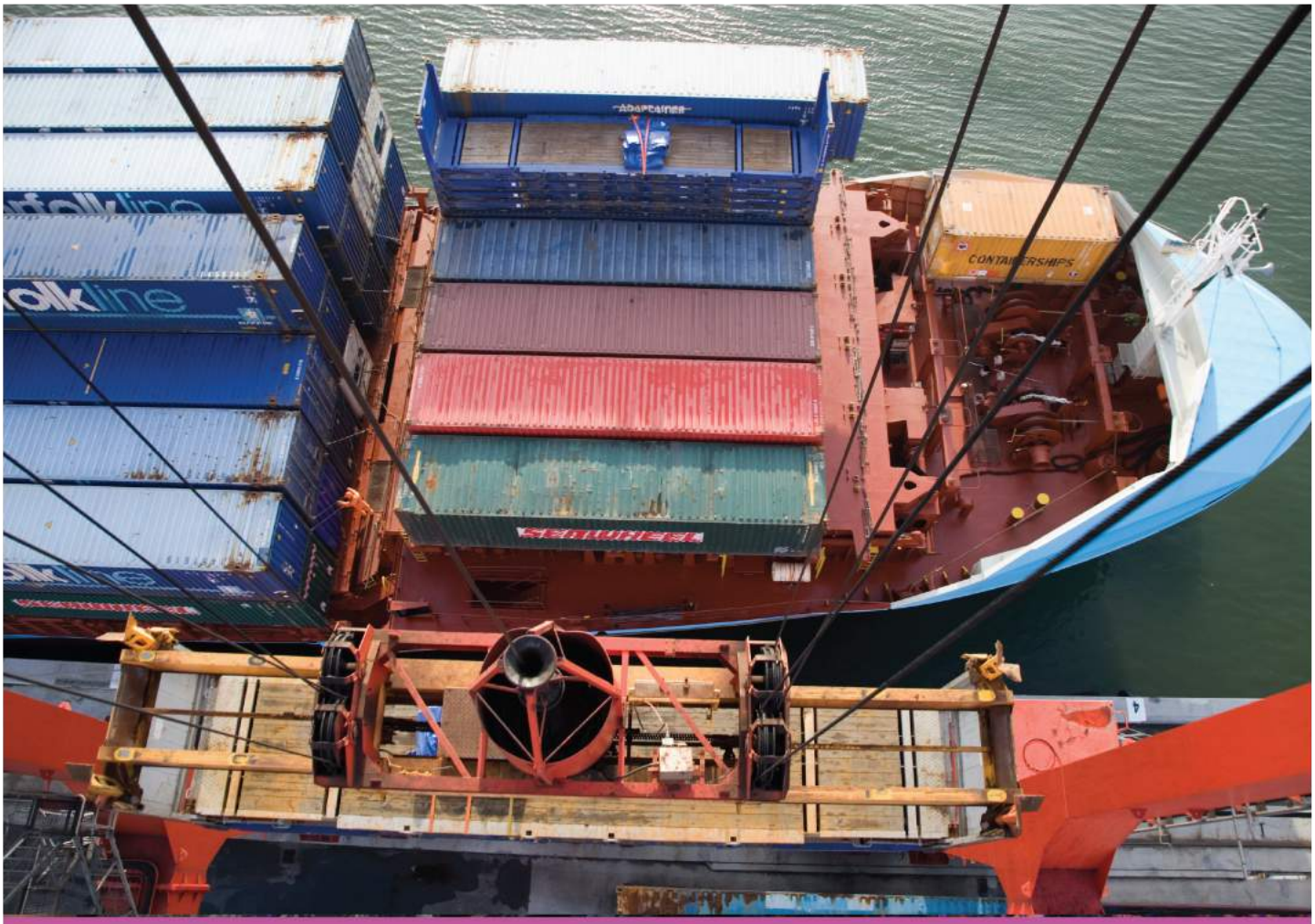
Ecosystems Services in Marine Spatial Planning (MSP)

As the applicability and quality of the data sets for spatial mapping purposes continue to be explored by the Marine Institute as part of the scientific and technical services it is providing the marine planners in Department of Housing, Planning and Local Government, additional related studies are ongoing with additional work commencing in 2019. These studies aims to address data gaps related to the economic value of marine biodiversity, and how to express such values spatially for planning purposes – including vulnerabilities to biodiversity-derived ecosystem services from an exploration of MSP roadmaps and planning scenarios.

This ongoing work, funded under Ireland's European Maritime and Fisheries Fund (EMFF) Operational Programme, includes explorations into how biodiversity-derived ecosystem services from climate change may change and can be mapped, empirical studies to better map Ireland's seaweed resource, and methods development and surveys to map concentrations of marine invasive species whose impacts are widely recognised to adversely impact biodiversity. Details of this project and other Marine Institute managed EMFF funded projects are available on www.emff.marine.ie.

In April 2019, the European Marine Board published it's latest Future Science Brief on 'Valuing Marine Ecosystem Services – Taking into account the value of ecosystem benefits in the Blue Economy | European Marine Board'. The report was co-authored by Dr Stephen Hynes, SEMRU, NUI Galway, and builds on research conducted by NUI Galway and Galway-Mayo Institute of Technology, funded by the Environmental Protection Agency.

Figure 24. Communicating the blue ecosystem services benefits at the British Irish Parliament Assembly, May 2019.



Business Development, Marketing & Promotion

Creating the right conditions for business, branding and building on Ireland's reputation as a high-tech, innovative economy, are critical for harnessing our ocean wealth.

- Harnessing Our Ocean Wealth

Photo courtesy of David Branigan

Business Development, Marketing & Promotion

Action 16

Strengthen and develop a common message and theme that promotes Irish marine products and services using high standards of environmental compliance (the 'Clean Green' brand).

Responsibly Sourced Seafood

BIM continues to run its certification to standards such as the Responsibly Sourced Seafood (RSS) Standard for wild catch – internationally recognised to ISO 17065 – to ensure the sustainability of the raw material through independently certified management practices. To complement the sustainability elements of the RSS, Ireland has launched a Government backed programme of Fishery Improvement Projects (FIPs).

FIPs are recognised globally as a means of identifying and communicating measurable actions to improve the management and sustainability of fisheries with participation to date accounting for circa 45% of the value of seafood landings by the Irish fleet.

BIM's RSS standard complements Bord Bia's Origin Green sustainability initiative. Through the standard, BIM provides technical assistance with the development of Origin Green plans in which seafood companies set targets concerning their raw material sourcing policies and operational impacts. The combined offering provides an accredited, independently certified raw material supply that helps meets the increasing demands by retailers for sustainably caught seafood. BIM provided support to several seafood companies in 2018 in respect of their Origin Green plans.

Fishery Improvement Projects

During 2018, BIM continued to support the development of Fishery Improvement Projects (FIPs) to promote responsible and sustainable fishing practices in conjunction with BIM's Responsibly Sourced Seafood (RSS) Standard and Bord Bia's Origin Green sustainability programme.

To date, BIM working with the industry have initiated four fishery improvement projects. These FIPs cover key Irish fisheries for brown crab, Nephrops, Albacore tuna and whitefish (hake, megrim and monkfish). During 2018, the whitefish FIP has been extended to include haddock and whiting. Combined, the FIPs cover around 45% of the total seafood landings by value by the Irish fleet.

Fishermen, co-operatives and processors with an interest in the fisheries are participating in the projects. In addition to providing forums for participatory discussions between key stakeholders they help industry to develop and implement a roadmap for change, particularly in terms of challenging fisheries legislation such as the EU's landing obligation. Further details are provided under Action 10.

The FIPs have oversight from an internationally recognised NGO – Sustainable Fisheries Partnership (SFP) – that records and tracks information on the progress of global fishery improvement projects. The goal is that the fisheries achieve certification under the Marine Stewardship Council (MSC), which is well-renowned in the market place as assurance to retailers and consumers of sustainable fisheries.

Certified Quality Aquaculture (CQA) Programme

BIM's Certified Quality Aquaculture (CQA) Programme supports the production of high-class farmed Irish seafood and provides a means of differentiating aquaculture products in the marketplace through eco, organic and quality labelling. The Programme was developed by a Technical Advisory Committee with representatives from all parts of the supply chain, from feed to fork. It is a business-to-customer assurance, which is managed according to ISO 17065, and uses aquaculture facilities as its unit of certification.

The CQA Standards are separated into modules that cover different areas of activity on a farmed fish production site or processing plant.

Currently, 100% of salmon grown in Ireland is organically certified via either BIM's Certified Quality Aquaculture Scheme (CQA) or another organic certification body with BIM's CQA Standard receiving full equivalence to the Global Seafood Sustainability initiative benchmarking in 2019.

Green Seafood Businesses

Bord Iascaigh Mhara (BIM) continued to focus on a wider sustainability plan to assist seafood processing companies with a resource efficiency management support through its Green Seafood Business Programme throughout 2018. The Programme asks 'How can seafood companies and processors operate in a manner that is kinder to the environment while also saving costs and improving efficiencies?'

Established in 2012, BIM's Green Seafood Business Programme has assisted over 35 companies to achieve significant cost savings and efficiencies in key overheads namely, water usage, energy consumption, transport costs and waste management. Identifying improvement in these areas enables the companies to set targets for their Origin Green Sustainability Charter. A number of initiatives were active in 2018. A summary of these is provided below.

Water Stewardship Framework – Phase 1, Water Mapping Project

The Water Stewardship Framework is developed by the Environmental Protection Agency (EPA) Community of Practice for Large Water Users (comprised of Irish-based firms along with key national stakeholders and development agencies involved in environmental/water management and sustainability). The initiative focuses on addressing water management needs and challenges on site and on collaborative development of specialised water management tools and techniques for facilities based on lean principles and international best practice.

In 2018, BIM helped four seafood processing companies to implement practices under phase 1 of the Water Stewardship Framework through its Water Mapping Project. The Framework aims to assist seafood small and medium-sized enterprises (SMEs) on their journey towards better water stewardship. BIM's work with industry in 2018 resulted in the creation of a high-level site water map for the seafood processing facilities involved. The results addressed Phase 1 of the Framework and assisted the participant companies to achieve their Origin Green water targets in 2018.

BIM are commencing work on the next phase, Site Level Monitoring, in 2019. On-site monitoring will deliver significant benefits including the identification of water optimisation opportunities across the facilities and help with diagnosing water-related incidents and identifying leaks.

Green Seafood Business of the Year 2018

The Burren Smokehouse in Co. Clare was recognised as 'Green Seafood Business of the Year' at the annual Green Awards that took place in Dublin in February 2018. The Burren Smokehouse is renowned for its premium and award winning Irish organic salmon and mackerel products and has demonstrated consistency in the use of innovative ways to improve business, including building sustainable practices into operations.

Supported by BIM's Green Seafood Business Programme, the company had made major reductions in energy, with savings of 29%, and waste reduction both in food waste and waste to landfill by 19%. These results were achieved through investment in energy efficient equipment in addition to a change in work practices and commitment to the local community, education and networking.

Burren Smokehouse sources 100% Irish Organic Salmon from the west coast of Ireland and is a verified member of Origin Green and the Burren Code of Practice for the Burren Ecotourism Network and Burren Geopark.

The Green Seafood Business award is sponsored by Bord Iascaigh Mhara and recognises seafood companies that are exceling in sustainable business practices.

Figure 25. Birgitta Heiden Curtin, Burren Smokehouse receiving the 'Green Seafood Business of the Year' award from Jim O'Toole, CEO of BIM. Photo courtesy of BIM

Participation in EU Sustainability Projects

In 2018, the Green Seafood Business Programme undertook a number of innovative sustainability projects. The North-West Europe Interreg funded Food Heroes project involves several European countries and focuses on a number of food categories, with BIM taking a lead in the area of seafood (focused on salmon and whitefish sectors). The aim of the project is to apply a co-creative approach in adding value to food by-products through the development of innovative products and/or processes. Meetings in 2018 assisted in developing a number of project ideas with the seafood processing industry. Further details are available on https://foodheroesaward.eu

Figure 26. Food Heroes poster. Image courtesy of BIM

The piSCES (Smart Cluster Energy Systems for the seafood processing industry) project is an Interreg funded projec with Welsh and Irish partners. With Irish participants Waterford Institute of Technology and BIM, the project is developing software technology which optimises the seafood processors interaction with their national electricity grid to enable cost savings on electricity. piSCES is supported by the European Regional Development Fund through the Ireland Wales Cooperation programme. The project commenced in 2017 and is due to finish in 2020. Further details are available on http://pisces-smartenergy.eu/

National Seafood Safety Programmes

The Sea Fisheries Protection Authority (SFPA) is responsible for the control of the food safety systems around seafood production by fishermen or fish farmers throughout the production chain, as far as, but not including, retail (which is supervised by the HSE).

Official Control of Food Business Operations

The SFPA approves seafood establishments that handle or process fishery products and live bivalve molluscs, along with freezer vessels. It verifies labelling claims and compliance with hygiene regulations. It also fulfils a key function in responding to food incidents and complaints as to the nature, substance or safety of a seafood product. During 2018, the SFPA undertook 2,110 inspections and official control checks, with three food safety case files ending in successful prosecutions. There was a substantial review of unclosed case files and progress towards a protocol with the Director of Public Prosecutions (DPP). As a result of these inspections, the SFPA issued the following food safety enforcement notices:

- 10 Compliance Notices under Statutory Instrument 432 of 2009
- 1 Improvement Notice under the Food Safety Authority of Ireland (FSAI) Act 1998
- 1 Prohibition Order under the FSAI Act 1998
- 7,168 health certificates issued for 95,117 tonnes of produce exported to third countries
- 766 catch certificates verified and validated for 14,099 tonnes of produce for trade with third countries
- 36 landings by third country vessels with 42,807 tonnes of produce

Official Control of Bivalve Mollusc Production

As the Competent Authority (CA) for the enforcement of seafood safety legislation in Ireland, the SFPA acts as an official agency of the Food Safety Authority of Ireland (FSAI), operating under a service contract to implement, manage and monitor the National Microbiological Sampling Programme of shellfish production areas. The SFPA is the CA for shellfish hygiene controls in Ireland while the Marine Institute is the National Reference Laboratory for both microbiological and biotoxin monitoring of shellfish. The SFPA and the Marine Institute work jointly to deliver the programme for monitoring shellfish, for producer, customer and consumer alike.

The SFPA continues to maintain Ireland's shellfish classification system, which classifies production areas according to water quality in line with European food regulations and has consequences for how shellfish may be placed on the market. In 2018, as part of the Shellfish Monitoring Programme, 1,682 microbiological samples were sent for analysis as part of the annual review of the classification of shellfish production areas issued by the SFPA.

Engagement at national, regional and port level with fishery operators both in the catching and processing sectors and providing informed and expert advice to operators, particularly when specific non-compliances arise, is an important aspect of the SFPA's work. During 2018, the SFPA attended an industry working group on shellfish exports, which included discussions on norovirus considerations. As a result, interim guidance on the management of norovirus in oysters was issued to shellfish producers. This involved collaboration between the SFPA, FSAI, Marine Institute and Bord Iascaigh Mhara. SFPA's participation in the European Food Safety Authority (EFSA) Norovirus Baseline Survey will help inform and advise on the impact of any proposed regulations. There were also ongoing technical certification contacts with third countries, and meetings with industry on certification of crab exports to China and Hong Kong.

Health Certificates

Irish seafood produced in accordance with EU law enjoys free market access throughout the EU. For the growing trade to countries outside the EU, specific obligations exist to demonstrate compliance with seafood safety requirements, which require the Competent Authority to issue a 'Health Certificate' for each consignment. The Health Certificates, issued by the SFPA, confirm that the produce being exported has been handled under satisfactory hygiene conditions and that the premises from which it is being dispatched is under the supervision of the SFPA.

7,168 consignments of seafood, totalling 95,117 tonnes and 25 species, were exported from 62 food business operators to 46 countries outside of the EU in 2018.

Irish National Reference Laboratory for Marine Biotoxins and Shellfish Microbiology

As the EU designated Irish National Reference Laboratory for both marine biotoxins and shellfish microbiology, the Shellfish Safety Unit of the Marine Institute carries out a number of programmes to protect consumers' health and ensure Ireland's compliance with EU regulations on food safety, as outlined by the European Commission. 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 Food Safety Authority of Ireland (FSAI) with strong industry collaboration as part of national official controls on seafood safety.

Programmes of activity include testing for biotoxins in shellfish flesh, monitoring seawater for harmful phytoplankton species, and assessing microbial contamination in classified shellfish production areas as required under the Shellfish Waters Directive 2006/113/EC. Naturally occurring biotoxins in shellfish are monitored using chemical analyses to detect the presence of toxins and their causative organisms. This is supported by phytoplankton monitoring and molecular biological assays. In cooperation with the SFPA and the shellfish industry, 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 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 south west for two weeks in April. Following this, a summer closure due to DSP affected 14 areas in the south west 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 an 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. This is in contrast to 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.

Developing Accessible and Timely Online Seafood Safety Services

The Marine Institute's 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. The system used in the Marine Institute is called HABs (Harmful Algal Blooms) and this has been in place since 2002.

Over the past two years the system has been redeveloped in a joint exercise carried out by a team made up of IT developers, scientists and industry. In 2018, a major development was the launch of the first stage website upgrade 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, and has already improved the monitoring efficiency of shellfish production areas. This allows the Marine Institute to perform a vital food safety role in a more efficient and effective manner.

A further development in 2018 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 the database, photo documentation reviewing, and publication of results.

Action 17

Give a clear message to investors that Ireland is 'open for, and a good place to do, marine business' domestically and internationally and continue to market and promote business opportunities associated with the marine through the IDA, EI, IMDO, Bord Bia, BIM, Údarás na Gaeltachta, Fáilte Ireland.

Action 18

Continue to market and develop Ireland as a world-class location for international shipping services.

Action 20

Progress a number of targeted emerging business development opportunities (e.g. offshore renewables, offshore services, maritime security and safety, shipping logistics and transport, ICT and sensors, biotechnology). This would include the collection/collation of market intelligence and foresight and the promotion of clusters using SmartOcean and IMERC as vehicles for innovation-led commercial development.

Ocean Energy Ireland

International Conference on Ocean Energy

In June 2018, Sustainable Energy Authority of Ireland (SEAI) sponsored the Ocean Energy Ireland exhibit at the 7th International Conference on Ocean Energy (ICOE) in France. This global event draws attendees from the European, American and Australasian renewable energy communities. The conference aims to stimulate collaboration between companies, researchers and test centres. It brings together stakeholders from across the ocean energy sector (tidal, wave, salinity gradient, ocean thermal energy) to discuss recent updates on research, technology transfer efforts and technological demonstrations.

Experts from SEAI, MaREI Research Centre and Ireland's Ocean Energy test centres (Lir National Ocean Test Facility in Cork, SmartBay Marine and Renewable Energy Test Site in Galway) were on hand to discuss Ireland's test infrastructures and promote Ireland's capability and expertise in the sector.

Ocean Energy Europe 2018 Conference

Stakeholders representing Ocean Energy Ireland and SEAI exhibited at the Ocean Energy Europe 2018 Conference (OEE2018), which took place at the Edinburgh International Conference Centre.

The conference is organised by Ocean Energy Europe (OEE), an industry association representing the ocean energy sector in Europe, including Europe's leading utilities, industrialists and research institutes. The OEE conference is one of the highlights of Europe's ocean energy calendar. It brings together stakeholders from across the ocean energy sector to share the industry's most recent developments. The conference provides opportunities to network and obtain access to the decision makers, thought leaders, investors and entrepreneurs, including representatives from the European Commission.

Floating Offshore Wind Workshop Organised by the Norwegian Offshore Wind Cluster

Irish authorities and researchers presented an update on the developments in Ireland at a Floating Offshore Wind Workshop organised by the Norwegian Embassy in Dublin in December 2018. The workshop was organised in cooperation with the Norwegian Offshore Wind Cluster. The purpose of the meeting was to strengthen the relationship between Norway and Ireland; facilitating a closer collaboration between Irish and Norwegian authorities, enterprises and research organisations. The workshop focused on the current situation for developing renewable energy in Ireland and also provided Irish and Norwegian companies the opportunity to explore potential collaborative research programmes. Updates were provided by the Department of Communications, Climate Action and Environment, SEAI, Department of Housing, Planning and Local Government, MaREI, Enterprise Ireland and the Irish Maritime Development Office. Irish test facilities such as SmartBay Ireland, were also profiled.

Ocean Power Innovation Network

The Interreg North-West Europe OPIN project (Ocean Power Innovation Network) is a three year project running from October 2018 to December 2022. OPIN will design, test and deliver an innovation model to build cross-sectoral collaboration, to accelerate growth of the ocean energy sector and its supply chains. OPIN aims to build an environment where small and medium-sized enterprises (SMEs) can collaborate transnationally, and across sectors, and build wider supply chains for the ocean energy sector. OPIN activities include the growth of a transnational cross sector network, challenge calls for cross-sectoral collaborative innovation projects, and tailored support to SMEs. Irish partners include SEAI, as lead partner, with the Marine Renewables Industry Association (MRIA), ESB and Enterprise Ireland as associate partners.

Marine Energy Alliance

The Interreg North-West Europe MEA (Marine Energy Alliance) project is a four year project running from May 2018 to May 2022. The aim of MEA is to progress the technical and commercial maturity level of early-stage (TRL 3-4) marine energy technology companies with the overall goal of reducing the risk of device failure in subsequent demonstration phases. Irish Partners include Exceedence Ltd and MaREI.

IPORES – A Review of Irish Ports Offshore Renewable Energy Services

The Irish Maritime Development Office published an updated review of the IPORES report in February 2019. The report describes the readiness of Irish ports to support the development of the offshore renewable energy industry in Ireland and the important role they will play in the supply chain.

The report finds that Irish ports are well positioned to provide the services required within the timeframe associated with the roll-out of the industry in Ireland. Irish ports have exhibited a capacity to respond positively to commercial opportunities and will do so again as the offshore renewable energy industry grows. The commercial opportunities that will arise for ports will be in the construction, assembly, servicing and maintenance of devices, and in accommodating other supply chain activities on port estates.

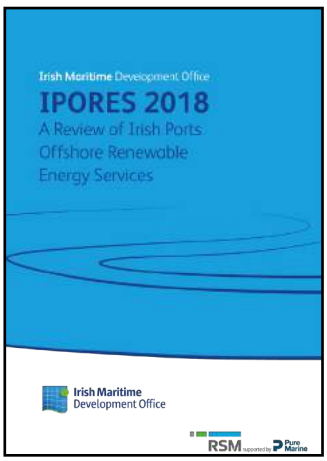


Figure 27. Irish Ports Offshore Renewable Energy Services (IPORES), IMDO, 2018

The report builds on the 2012 IPORES report and for each port or harbour, reflects the current position in the offshore renewable energy market, existing projects and pipeline, and the future potential.

The study involved a detailed stakeholder consultation process and analysis of all ports around the island of Ireland. This includes a comparison with a number of key ports in the UK, Denmark and Germany that provide renewable energy services. The report also provides a number of recommendations including the establishment of clear targets to deliver new offshore ocean renewable projects at Irish ports leading to new investment and employment opportunities. A copy of the report can be found on www.imdo.ie.

Marine Ireland

2018 saw a continued multi-agency focus on promoting the 'Marine Ireland' brand at home and internationally. This included a number of targeted business development activities in the ocean energy/offshore renewables sector (as outlined above) as well as a number of cross-sectoral events and activities. A number of these activities are highlighted below.

Marine Ireland
Your Blue Edge

Irish Marine Industry Network (IMIN)

Enterprise Ireland, with other agency support, continued to develop the Irish Marine Industry Network (IMIN). The Network held three events in 2018:

- A familiarisation visit by the Network to the Ringaskiddy campus in February 2018, where the members visited the Naval Base, toured a Naval Service vessel, had a networking dinner on the Base, and the following morning visited the Lir Ocean Test Facility, MaREI and the National Maritime College of Ireland.
- A networking event held as part of the Our Ocean Wealth Summit in Galway in June 2018.
- A familiarisation visit to Dun Laoghaire in September 2018, where IMIN members toured the Irish Lights building, the Geological Survey Ireland Research Vessel *Keary* and finished with a networking dinner in association with the Enterprise Ireland Middle Eastern Ports/Harbours Inward Buyer Delegation. The event was addressed by Minister of State for Higher Education, Mary Mitchell O' Connor, TD.

IMIN membership stands at over 430 members, with new members joining on a weekly basis. The intention is to expand IMIN in 2019 and hold a series of events directed at building business relationships and showcasing Irish capability in the sector to overseas stakeholders. Work will also commence on building an online and social media presence for the network.

Marine Ireland Tradeshow

The 'Marine Ireland Trade Show' took place in a purpose-built marquee at Galway Docks in late June to coincide with the 2018 Our Ocean Wealth Summit. Organised by Enterprise Ireland, the event provided a unique opportunity for businesses to showcase their products and services to a national and international audience. More than 45 businesses exhibited over the two days across a diverse range of marine products and services (marine construction and engineering, ICT, offshore renewables, maritime surveillance and security, environmental management and data services, as well as marine robotics and other technologies.)

Oceanology International

The Irish Maritime Development Office (IMDO), together with Enterprise Ireland, hosted a number of Irish companies at an Irish Pavilion at Oceanology International in London in March 2018. The companies exhibited under the 'Marine Ireland' brand, which was established in 2017 to communicate Ireland's marine opportunities both nationally and internationally. The companies included SmartBay Ireland, Seatech, JFC Marine, XOcean, Technology from Ideas and Techworks Marine. The objective of the Pavilion was to promote Irish organisations providing products and services for global marine markets and to promote Ireland as an attractive location for inward investment into the blue economy.

Figure 28. Oceanology International 2018. Photos courtesy of the IMDO and Enterprise Ireland

Supporting Marine SMEs – Enterprise Ireland

Enterprise Ireland (EI) continued to work with a number of agencies aimed at supporting 'Marine Ireland' and a range of Irish small and medium-sized enterprises (SMEs) in the marine sector using various funding mechanisms. A number of client companies in the marine engineering, construction, Internet of Things (IoT) and advanced technologies, and offshore renewables sectors were directly supported in 2018. In addition to these standard supports, additional projects in the marine sector included:

- The Trade Show element of the Our Ocean Wealth Summit in Galway in June 2018. Companies in the marine construction, IoT, offshore renewables, maritime surveillance/security, environmental data collection and marine robotics showcased their capability to a national and international audience.
- The Our Ocean Wealth Summit in 2018 also saw the launch of an EI Competitive Start Fund (CSF) for Marine Start-Ups – following a selection process, three start-ups were selected for support.
- following a call in 2017, funding for a Marine Incubation Manager based in Ringaskiddy in Cork. The Manager is providing a national support service to marine start-ups in Ireland and is engaged with a number of early stage companies in a range of sub-sectors.
- Through its Small Business Innovation Research (SBIR) mechanism, funding is being provided for Dun Laoghaire Rathdown County Council and Waterford County Council to explore new technologies for monitoring marine bathing water quality in real time.
- Regional Enterprise Development Fund (REDF) funding, administered by EI, has been awarded to two key projects in the marine sector: the Páirc na Mara facility in Cill Chiaráin, where a nine-hectare park will comprise a variety of marine related activities. The vision for the site includes a fish hatchery, a shellfish holding facility, research and development units, a slipway or pier and business units for start-ups). The Clare Maritime Economic Zone (MEZ), where a facility will be developed to provide specialist infrastructure and accommodation for maritime and cruise liner related training on the Clare side of the Shannon Estuary.
- Working in association with the IMDO, EI hosted a 'Marine Ireland' stand at Oceanology International, the hi-tech marine trade show in London in March 2018. The stand showcased a number of Irish SMEs in the sector.
- In September of 2018, EI with the support of the IMDO brought a group of Middle Eastern stakeholders in the ports and harbours sector to Ireland. The three day trip showcased a range of Irish companies and capabilities to the inward buyer delegation, including a number of Irish companies with technologies in the smart harbours/ports area.
- Irish marine SMEs were also featured in a Ministerial Trade Mission to Scotland in September 2018. A number of Irish SMEs presented on their capability in the offshore wind sector. The expansion of this industry in the UK was noted by EI and work began on building an understanding of the needs of the industry and of the potential of Irish SMEs to provide a range of products and services.
- the further development of the Irish Marine Industry Network (IMIN).

IMDO – Promoting Ireland's Maritime and Shipping Services

During 2018, the Irish Maritime Development Office (IMDO) arranged and participated in many initiatives and events that highlighted Ireland's value proposition as a venue for maritime business. These included:

- Dublin Finance Summit
- Maritime Commerce Forum meetings
- Irish Marine Industry Network (IMIN) meetings and events (see above)
- Our Ocean Wealth Summit (Panel discussion on 'Maritime Commerce, Brexit and Ireland's Opportunity')
- EU Events – Shortsea Shipping/Connecting Europe Facility Conferences
- An initiative with French ports
- Hosting a delegation from the United Arab Emirates
- Launch of the IPORES Report

The IMDO has continued its participation in international networks such as the Bluetech Cluster Alliance to promote cooperation with other international clusters. Other national clusters have emerged which also feed into the broader IMIN network. This includes the Marine Professional Services group and the Maritime IoT cluster at Dublin City University (DCU).

Maritime Commerce Forum

The IMDO continued to organise and host its biannual Maritime Commerce Forum in 2018, recognising the strategic importance of this sector for increased jobs and economic growth in Ireland's maritime domain. Given the evolvement of the sector towards new finance models and technology, Ireland has a strong value proposition to grow its global services into the shipping, shipping services, offshore renewables and maritime technologies sector. Two events were held in 2018, in March and November. These meetings were held in association with PwC and included speakers and attendees from the ICT, finance, professional services, ports and shipping sectors.

Trade Mission from the United Arab Emirates to Ireland

Organised by Enterprise Ireland, with support from the IMDO, a group of Middle Eastern stakeholders were hosted in Ireland. The three day trip showcased a range of Irish companies and capabilities to the Inward Buyer delegation, including a number of Irish companies with technologies in the Smart Harbours/Ports area. The delegation's itinerary included:

- Visiting the maritime cluster in Cork – consisting of the National Maritime College of Ireland (NMCI), MaREI, and the Port of Cork
- An Irish industry showcase at East Point Business Park in Dublin
- A visit of the UAE Infrastructure Minister to meet key officials at the offices of the IMDO
- A tour of the Commissioners of Irish Lights and a networking dinner in Dun Laoghaire

A memorandum of understanding was signed between the NMCI (Cork Institute of Technology) and counterparts in the United Arab Emirates (UAE).

A follow up visit of Irish companies to the UAE to meet with organisations and attend UAE Maritime week will take place later in 2019.

Figure 29. UAE Minister for Infrastructure and Maritime, H.E. Abdullah bin Mohammed Belhaif Al Nuaimi, Trade Mission to Ireland, September 2018. Photo courtesy of Enterprise Ireland and the IMDO

Initiative with French Ports

The IMDO facilitated and supported engagement between Irish and French ports and worked collaboratively with the French Embassy to host visits from representatives of the ports industry in France. This initiative is closely linked to overcoming the challenges posed by Brexit by developing new routes to market for Irish Industry and new opportunities for Irish ports to expand their route networks. Meetings were hosted by the French Embassy in June and November 2018 and dialogue continues between interested parties in the Irish and French ports industry. A memorandum of understanding has been signed by French and Irish ports that consolidates progress.

Figure 30. Workshop Between French and Irish Ports July 2018. Photo courtesy of Dublin Port and the IMDO

Motorways of the Sea Seminar, Limerick – May 2018

In May 2018, a seminar on 'Understanding the Opportunities from the EU' was hosted by Shannon Foynes Port Company in Limerick. The 'Motorways of the Sea' concept, which has significant funding available, aims to introduce new inter-modal maritime-based logistics chains in Europe, which should improve Ireland's transport organisation in the years to come.

The seminar was arranged following a discussion at a smaller gathering in Brussels also organised by Shannon Foynes Port Company, at which EU officials were briefed about the opportunity that the Shannon Estuary presents from an Irish and European perspective. Together with the risks presented by Brexit, the seminar heard of the growing recognition of the opportunity that investment in maritime infrastructure can bring about for the region and country.

Norwegian Offshore Wind Cluster

In December 2018, the IMDO were involved in an offshore wind event organised by the Norwegian Embassy and Norwegian Ambassador to Ireland. This follows on from a series of activities developed to promote cooperation in relation to a number of areas of common strategic areas of interest. Liam Lacey, Director of the IMDO, spoke about the opportunities in Irish ports to support the development of marine renewable energy in Ireland. An outward trade mission to Stavenger and a presence at Norshipping in Oslo are planned as follow up activities for 2019.

Cruise Tourism

Cruise Europe is a business-to-business network of cruise ports and destinations in Northern and Atlantic Europe which aims to match the potential of the ongoing growth of the cruise industry internationally with the diversity of experiences available to passengers in the region. This network is currently chaired by Port of Cork. In 2018, Cruise Europe organised a meeting in Dublin to discuss the potential effects of Brexit on the industry.

A total of 422 cruise vessels called to ports in both Ireland and Northern Ireland in 2018. This is a 26% increase compared to the previous year. Cruise traffic to Ireland has more than doubled since 2011. Dublin is the largest destination for cruise liners in Ireland, with 150 vessel calls, an increase of 23 from the previous year. Cork had the greatest increase in cruise calls with 31 additional callings, totalling 93 calls into the port, bringing an additional 58,604 passengers. The total number of passengers visiting ports on the island of Ireland in 2018 reached 157,867.

The growth in cruise tourism in Ireland mirrors the international trend, which has resulted in year-on-year progress this decade. The Cruise Liners International Association forecast global cruise passenger numbers to grow from 28.2 million to 30 million in 2019, an increase of 53% compared to 2011.

Ireland as a Centre for International Shipping Services

The IMDO is one of the key stakeholders involved in supporting the development of an International Shipping Services Centre (ISSC) in Ireland. Developments in 2018 saw the establishment of a number of stakeholder groups to advance key elements of the project. A number of regional stakeholders are focused on the opportunity to deliver this flagship project in Cork with the movement of Port of Cork offices to Ringaskiddy and the planned urban regeneration of Cork docklands. In addition to stakeholder meetings locally, a session was held in relation to the ISSC Cork at the Our Ocean Wealth Summit in Galway.

The IMDO also sponsored and participated in a session at the Financial Centres Summit in October 2018. The event gave a platform to further promote the opportunity for Ireland of developing a centre of excellence that can somewhat replicate the previous ambitions Ireland had in the context of the International Financial Services Centre in Dublin. A report was prepared by PwC on the potential economic impact for Cork and Cork's value proposition.

Further details on the IMDO's activities are available udner International and North/South Cooperation.

Bord Bia Expands Its Reach into the Asian Markets

According to official export statistics from Eurostat, the share of Irish seafood exports to international markets stood at approximately 30% of total exports in 2018. Exports to the four main Asian markets – China, Hong Kong, South Korea and Japan – together increased by an estimated 19% in value terms in 2018 compared to 2017. Overall, these four Asian markets accounted for almost 14% of total seafood export values. Taking into account the wider South East Asian markets to include Taiwan, Vietnam, Singapore, Malaysia and Thailand, this region accounted for over 15% of total export values in 2018. This compares to a share of just 7% of seafood export values in 2013, demonstrating the increased focus by the Irish sector and Bord Bia in its market development and promotional efforts in this region over the last number of years.

In 2018, Ireland exported approximately €570 million worth of seafood (this excludes seaweed, fish fats/oils and fish meal) to more than 70 markets around the world, with Japan an increasingly important destination.

Japanese Market

Bord Bia has identified Japan as a growth market for Irish seafood exports. Seafood exports to this market reached €16 million in 2018, growing by 60% compared to 2016, with mackerel the key species exported, accounting for 50% of total seafood exports. Irish exports of horse mackerel grew by 65% between 2017 and 2018. Japan is now Ireland's second largest market for the Irish horse mackerel and its third largest market for Irish mackerel.

In recognition of the potential for growth in Japan, Bord Bia has invested in 'feet on the street' resources since early 2018 to increase its physical presence and to support pelagic and other seafood categories to identify opportunities in this market.

In support of the Irish seafood sector in developing business in this market, Bord Bia has undertaken a number of initiatives in an effort to further grow sales. Bord Bia brought the taste of Irish seafood to the attention of Japanese consumers through its third annual promotion with the leading retail group, Aeon. In partnership with Aeon, Bord Bia promoted a range of four Irish mackerel, horse mackerel and herring products through an extensive promotion in 100 Aeon retail outlets across Japan. The range of Irish pelagic products on sale through Aeon were sampled in all 100 stores during the campaign, and aimed to raise awareness about the quality and sustainability credentials of seafood from Ireland. To support the tasting programme, Bord Bia developed a range of point of sale material to help Japanese consumers identify and recognise the origin of the products in-store, for example an Irish seafood leaflet was made available in all stores to help educate Japanese consumers about Irish seafood and its unique attributes.

A new addition to the promotion was the involvement of Guinness who promoted their beer products in conjunction with Irish seafood in Aeon's liquor outlets. Across 50 of these outlets, they offered Japanese consumers samples of Irish Guinness and mirin-marinated Irish pelagic fish on St. Patrick's Day.

Other initiatives undertaken by Bord Bia in this market included the coordination of an inward journalist itinerary in November 2018 from the Suisan Keizai Daily News Company. The Suisan Keizai Daily News is Japan's largest seafood/fishery trade/industry newspaper and features up-to-date international seafood market trends, government policies, Japanese private sector movements and activity highlights. The editor of this newspaper travelled to Ireland for a week long itinerary visiting eight Irish seafood processors. The result of this visit was a series of 10 individual articles profiling the Irish seafood processors and the main exporters to Japan, which gave fantastic coverage to Irish seafood and helped to raise the profile in this market. Such was the success of this visit that the editor will return to Ireland in May 2019 for another week long itinerary visiting a range of other Irish seafood exporters around the coast.

During the last three years, Bord Bia has also invested in the coordination of an Ireland Pavilion at the Japan International Seafood and Technology Expo in Tokyo. This is the leading seafood trade show in Japan and gives the Irish seafood sector an excellent platform to promote their products to the Japanese seafood trade and to meet target customers on a one-to-one basis. Bord Bia intends to have a presence at this trade event again in 2019, demonstrating its ongoing commitment to this market. To further raise awareness about Ireland as a destination for quality seafood, Bord Bia is developing a business-to-consumer (B2C) campaign in Japan to coincide with Irish presence at the Japanese seafood show. This campaign will aim to educate Japanese consumers about the quality and taste credentials of Irish seafood and encourage them to seek out Irish seafood products in-store.

In addition, and as a reflection of the prioritisation of the Japanese market for Irish food and drink exports, Bord Bia has recently opened an office in Tokyo to work on identifying new sales opportunities for the Irish industry and to work closely with customers in this market to raise the profile of Irish food and drink.

Figure 31. Irish Pavillion at the 2018 Japan International Seafood and Technology Expo in Tokyo. Photo courtesy of Bord Bia

Chinese Market

Bord Bia has also been very active in developing markets for Irish seafood into China. Irish seafood exports to China increased by 68% in value terms between 2017 and 2018. This equated to an export value of €46 million and moves China into fifth position in terms of export markets for Irish seafood. Seafood export volumes to China increased by 32% during this same period, which indicates a very strong increase in average prices for seafood exported into China increasing by 28% to reach an average price per tonne (across all species) of €3,625.96/tonne. Excellent performances were recorded across all key species exported to China during 2018 with mackerel exports growing by 63%; oysters by 92%; crab by 375%; and molluscs by 576%.

The top five species exported to China in 2018 were:

1. All formats of crab accounting for an estimated 35% value share
2. Mackerel at 18% value share
3. Oysters, 12%
4. All types of molluscs, 23%
5. Horse mackerel, 6%

Other species exported in small quantities are langoustines and lobsters. Some excellent performances were recorded in export values across all key species in 2018 as Chinese buyers continue to appreciate the quality of Irish seafood on offer to this market.

China is now Ireland's second most import market for Irish crab, oysters, molluscs and mackerel and the fourth largest market for Irish lobster.

Figure 32. Ireland Pavillion at the China Fisheries Seafood Expo in 2018. Photo courtesy of Bord Bia

The growing importance of China as a destination for Irish seafood is largely driven by an increased focus by Irish exporters in growing sales in this region through regular in-market visits, participation at international trade shows and the allocation of on the ground sales resources in China to grow sales and develop a strong presence. These efforts are supported by Bord Bia's trade development programme in this market. Over the last number of years, Bord Bia has been very successful in encouraging high-end Chinese retail and foodservice customers to visit Ireland to meet with Irish seafood processors on a one-to-one basis and many of these itineraries have led to direct business for a range of Irish seafood exporters.

Marketplace International 2018, Bord Bia's flagship trade event, under the banner of 'Origin Green', took place in April 2018, whereby Chinese buyers participated in both pre-arranged meetings as well as 15 customised itineraries, three of which were dedicated solely to seafood. These itineraries were very effective in generating new business for the sector, providing Irish companies with an excellent opportunity to showcase their processing facilities and also allowing customers to see first-hand the world-class environment in which Irish seafood is produced. These visits also provided a guarantee to Chinese customers on traceability, sustainability and food safety, all key issues of growing concern to the Chinese middle class consumer.

In addition, in line with the explosion of online sales and marketing in China, Bord Bia has taken a lead position establishing a premium WeChat account to promote and present Irish seafood at both trade and consumer level. Bord Bia is actively engaged with online sales platforms such as TMall as a new route to market for Irish exporters. Bord Bia also coordinates regular online Irish seafood promotions with a range of internet platforms in China.

Bord Bia has also invested in an Ireland Pavilion at the China Fisheries and Seafood Expo every year since 2011. This Expo is the largest seafood trade event in Asia, with in excess of 29,000 visitors attending annually from over 100 countries and takes place in Qingdao, China. In 2018, Bord Bia's Ireland Stand had a record seventeen Irish seafood companies exhibiting. Similar attendance is expected on the Ireland Stand in November 2019 as Irish exporters continue to focus their efforts on this market.

Work is underway to build on the momentum and further increase exports of premium Irish seafood to China. Bord Bia is planning to concentrate its promotional efforts on increasing a greater awareness of species from Ireland such as blue lobster, langoustines and mussels whilst at the same time, consolidating the position of more established species such as brown crab and Irish oysters in the market. Targeting premium chefs, media and key opinion formers, Bord Bia is planning to coordinate a series of cookery demonstrations in Beijing and Shanghai, focusing on introducing recipes for these species that are new to the Chinese market. The campaign will assist the Irish processing sector to sell their ranges to distributors servicing the premium restaurants and hotels in these two key locations. In addition, Chinese consumers will be educated and informed through a comprehensive programme of in-store tastings with a number of supermarket retail chains.

Other marketing initatives undertaken by Bord Bia in support of the seafood sector in the Chinese market include:

- Coordination of a series of in-store, online and foodservice promotions with key customers in China to raise awareness about Irish seafood and drive sales
- The coordination of inward buyer visits to Ireland annually to facilitate one-to-one meetings between Irish seafood exporters and Chinese customers
- Design and printing of promotional material on the Irish seafood sector in Chinese for supply at trade shows and one-to-one buyer meetings

- Undertaking trade research in the market to identify, interview and profile Chinese seafood importers, distributors and retailers to understand their seafood import requirements and interest in sourcing from Ireland
- Preparations for launching a business-to-business (B2B) campaign in China with a view to raising awareness about species from Ireland such as langoustines with the Chinese trade.

South Korea

Bord Bia is also actively targeting opportunities for the Irish seafood sector in South Korea, which is currently Ireland's largest export market for molluscs (mainly whelks) accounting for a 70% share of total exports of this product category in 2018.

Bord Bia has conducted extensive research on the pelagic market in Korea and identified strong potential for Irish mackerel in this market. A number of very attractive potential buyers have been identified, interviewed and profiled for the Irish sector. Bord Bia is now working with the Irish pelagic sector in helping to facilitate one-to-one contact with these Korean customers through a series of inward missions planned to Ireland in 2019. Bord Bia has also extensively researched the potential for Irish live crab and lobster in this market and through its new Japanese office, which also covers Korea, Bord Bia is working with these customers to help connect with the Irish industry.

Figure 33. Minister for Culture, Heritage and the Gaeltacht, Ms. Josepha Madigan TD, attending Bord Bia's Japanese in-store promotion in Tokyo. Photo courtesy of Bord Bia

Fáilte Ireland Experience Development

During 2018, the Wild Atlantic Way continued to build brand equity; countered seasonality by inspiring incremental short breaks (March-May and September-October); and tackled regionality in growing the domestic and international market along the route with an emphasis north of Galway.

All activity was delivered through motivating and impactful campaigns anchored in the creative idea 'Embrace the Wild Atlantic Way of Life', expanding awareness of the brand beyond name and logo. Fáilte Ireland's integrated marketing approach amplified campaign bursts, building credibility and depth of brand understanding through earned and owned channels of public relations, social and content, complementing Fáilte Ireland's paid creative and media channels.

2018 saw a number of Visitor Experience Development Plans funded and developed along the route. See Action 19 for further details.

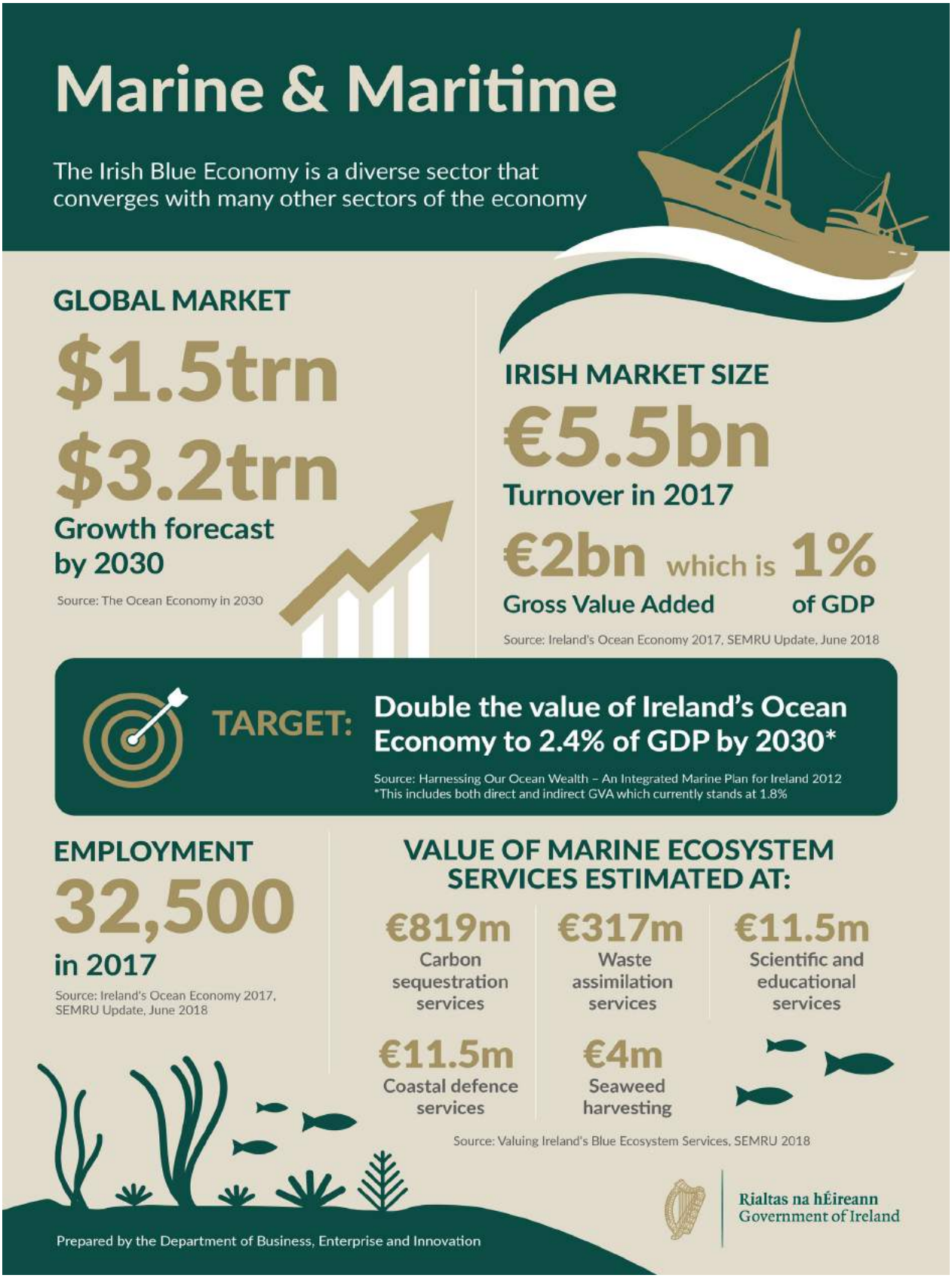


Figure 34. In 2018, the Department of Business, Enterprise and Innovation (DBEI) undertook a process to develop a series of briefings on 16 important sectors, which included the Marine and Maritime. This is as a resource both within DBEI, its offices and agencies, and across other government departments and agencies to inform briefing materials, speeches and policy development. Sectoral Briefs are available on the DBEI website.

Action 19

Encourage and facilitate coastal communities to avail of existing and future marine enterprise opportunities, e.g. through:

- Training programmes
- Business supports
- Provision of specialist marketing and investment advice, market intelligence and consumer research.

Páirc na Mara, Cill Chiaráin

Údarás na Gaeltachta is continuing with the process to develop Páirc na Mara, a new marine innovation park which is to be developed in Cill Chiaráin in the Connemara Gaeltacht of Co. Galway. Engineers and planning consultants are engaged in developing the detailed planning applications bearing in mind the ecological sensitivity of the area. Údarás na Gaeltachta made a call for expressions of interest to locate businesses on the site and received 23 qualified expressions across a wide range of marine business sectors, and with over 200 full time jobs identified to fully staff and operate those companies. In addition, in cooperation with the local community of Iorras Aithneach, Údarás has employed a local development manager working to support the development plan for the area, of which Páirc na Mara is central.

The Páirc na Mara development site is located on a brownfield site on the southern edge of the Connemara Gaeltacht situated approximately 72 km west of Galway City. The site is approximately nine hectares and will provide the infrastructure and facilities to support the establishment and expansion of a cross-section of marine enterprises. These enterprises will develop innovative products and services drawing on the local bioresource (finfish, shellfish, seaweed and other renewable species) creating employment, economic regeneration and added value through targeting national and export markets.

Dr Micheál Ó'Cinnéide, former executive Director of the Environmental Protection Agency and of the Marine Institute, has taken up the role of Chairman of the Project Advisory Group (Coiste Comhairleach) comprising of the key strategic regional institutional stakeholders from the public development and regulatory agencies, higher education Institutions (HEIs) and industry networks. The recently launched Irish Bio-Economy Foundation is now also participating on the Advisory Group. This collaborative partnership provides a planning and consultative forum which integrates the resources of those public bodies who discharge statutory responsibilities in the planning, regulatory and development fields, as well as specialists from research and academic institutions who are committed to the sustainable development of the marine resource within the region.

The masterplan for Páirc na Mara will enable Údarás na Gaeltachta and its partners to develop an internationally recognised development facility, which will act as a catalyst to coordinate and drive the growth of the marine sector and attract public and private sector investment in support of marine technical development. Specifically, it will deliver infrastructure and services which will translate RTDI (Research, Technology, Development and Innovation) potential into new products and services, targeting new international markets, increasing levels of innovation, research, commercialisation and new enterprise formation. Such coordinated and strategic investment will secure increases in productivity, growth and employment across the marine sector.

To date, the key implementation outcomes in relation to the Páirc na Mara development concept have included:

- Managing the call for 'Expressions of Interest' from existing and potential investors in the marine sector
- Appointment of consultants to undertake detailed ecological and engineering studies for full planning application
- Ongoing discussions with private investors concerning a detailed assessment of commercial development projects and new market opportunities
- Ongoing discussions with the European Commission, the Assembly of European Regions (AER), Permanent Representation of Ireland to EU etc. in relation to funding and development opportunities on a transnational and international level
- Discussions and forward planning for collaborative programming with regional HEIs, and with international partners in the Boston/New England area, the Marine Innovation Park in Iceland, and in Scotland

Páirc na Mara, Marine Innovation and Development Centre (MIDC)

A key milestone was reached when the Marine Innovation and Development Centre (MIDC) facility secured Regional Enterprise Development Fund (REDF) funding from Enterprise Ireland towards its development as a cornerstone of the infrastructure facility at Páirc na Mara. This marine innovation and development centre will provide the necessary business development supports and facilities to assist innovative start-ups in the sector. It will also support the growth, productivity and innovative capacity of existing small and medium-sized enterprises (SMEs) trading in the marine sector.

To this end, a designated activity company has been set up between Údarás na Gaeltachta, NUI Galway and Galway-Mayo Institute of Technology (GMIT) for the operation and management of this highly important facility for the development of marine business in Ireland.

Drawing on the expertise and resources of GMIT, NUI Galway and other HEIs as relevant, and through collaborative programming of specialist supports and development interventions to be agreed with Bord Iascaigh Mhara, the Marine Institute, the Education and Training Boards, Skillsnet and other stakeholders, the MIDC facility will offer a range of focused services. These will include:

- Assisting marine enterprises in gaining access to new markets
- Delivering bespoke training, skills and business development programmes designed against a comprehensive analysis of industry needs and opportunities for growth within the seafood and marine bioresource sector

These services will realise significant opportunities for joint value co-creation, rapid prototyping, and validation and for scale-up in innovation and business development processes. Rather than duplicate existing research facilities in NUI Galway (e.g. Carna Research Station), GMIT and the Marine Institute, the Páirc na Mara MIDC will integrate and localise the research supports and facilities of each of these partner institutions as the underpinning research and development infrastructure for the overall Páirc na Mara development project. Early stage research and innovation activities driven by these research and development institutions will provide and strengthen the innovation pipeline for business incubation, enterprise development and commercial scale-up activities at the MIDC. The project promoters are committed to ensuring that this integrated facility will be recognised as a key dimension of the regional research and business development infrastructure, which will act as a catalyst for consolidating and growing the existing range of marine resource enterprises and also facilitate the sustainable, commercial exploitation of the natural bioresource base.

€6 Million Investment in Fisheries Local Action Groups (FLAGs) Projects

Since its establishment, the FLAG Programme has gone from strength to strength. In a major departure from previous fisheries funding programmes it involves a partnership approach between a state agency, Bord Iascaigh Mhara (BIM), and coastal communities to develop a Local Development Strategy (LDS) and allocate funding to implement that Strategy. The community, state and productive sectors, particularly the seafood sector, determine their own development priorities for local development through the LDS and then select the projects to implement that Strategy.

BIM assists FLAGs to deliver projects under this programme through administering supports via grant aid, training and on the ground facilitation with dedicated FLAG coordinators in each region. In addition, the FLAG boards consider all applications for support and select projects for funding (EMFF).

2018 became the most successful year yet for the Irish FLAGs Programme, seeing 285 projects approved with a total investment of over €6 million and grant aid of over €4 million.

Projects aimed at promoting or retaining employment in coastal communities, particularly adding value to seafood products, coastal tourism and fisheries infrastructure, secured €2.9 million (over 70% of the funding approved). Community projects were also well supported; primarily the enhancement of facilities and holding community events, securing nearly €750,000. Projects on heritage, lifelong learning and the environment were also funded.

FLAG	Total Investment	Total Grant Aid
North	€390,571	€257,789
North East	€336,563	€238,451
North West	€308,878	€189,201
West	€681,293	€405,410
South	€520,504	€279,341
South East	€456,757	€312,092
South West	€414,218	€266,161
Total	**€3,108,784**	**€1,948,445**

Table 3: FLAG Investments 2018

Networking and Cooperation Across the Seven Fisheries Local Action Groups (FLAGs)

The first meeting of the FLAG Networking and Cooperation forum was held in September 2018. Attended by the FLAG Chairs and Bord Iascaigh Mhara (BIM), the aim of the Group is to support networking and cooperation projects between the seven FLAGs and also between Irish FLAGs and those from other member states or similar entities implementing Community Led Local Development (CLLD). A wide range of issues were discussed including an update on projects, communications, publicity and the proposed Networking and Cooperation Scheme.

Figure 35. Pictured at the event are members of the North West FLAG L-R Top row, Paul Downes, BIM, Lenny Clifford, Johnny Woodlock, David Pryor. Bottom row Gilles Van de Walle, Garret O'Brien. Photo courtesy of BIM

Figure 36. L to R: Finnian O'Sullivan, South FLAG; Noel McDonagh, South East FLAG; Gareth O'Brien, North East FLAG; Padraic de Bhaldraithe, West FLAG; Kevin Flannery, South West FLAG; Gerry Gallagher, North FLAG and Gerard Hasset North West FLAG. Photo courtesy of BIM

Profiling 2018 FLAG Projects

South FLAG
Solar energy, lighting up a remote landing site

During winter months in Bere Island, on the south west tip of Ireland, daylight can be in short supply. John Orpen, a small-scale fisherman, found himself restricted to landing his catch only during daylight hours as his remote landing site had no lighting. With the idea that a solar light may be the solution, John approached the local South FLAG for advice and funding. On the recommendation of the FLAG, John discussed the project with a local electrical engineer. The collaboration resulted in the design of a solar battery powered light system that is independent of the mains connection, activated by a fob or monitor sensor that will last for up to 20 years. The housing for the battery, solar light post and plinth that can withstand the environmental conditions of the west coast of Ireland was fabricated locally.

Figure 37. Local fisherman, John Orpen at the new solar light on Bere Island. Photo courtesy of BIM

The new light system has greatly improved safety and working conditions for the fisherman and extended his working hours. In addition, a template has been created that can be utilised in other remote areas providing work for local engineers in remote coastal communities.

West FLAG
Boosting a seaweed business on the Irish offshore Islands

Blath na Mara hand harvests wild seaweed on the unspoilt shores of Inis Mór. Its main product was originally dried organic milled or whole seaweed, brought to market wholesale. The heritage and quality of the product, however, offered opportunities to reach new markets and satisfy the expectations of a progressive customer base. The company's specialised drying process ensures the seaweed retains its important nutrients, providing customers with a series of health benefits as well as a premium taste.

Figure 38. Seaweed. Photo courtesy of BIM

To help Blath na Mara avail of this new opportunity, FLAG West provided funding and expertise in a variety of areas, including business enterprise and marketing. It also linked the company to other stakeholders in the area. FLAG assistance has facilitated an upgrade to the existing premises and processing facility, which will help Blath na Mara to grow its product range and provide scope for new product development. The project has also encouraged this family company to explore the area of food and educational tourism for seaweed on the Aran Islands.

"FLAG West has assisted the transition of Blath na Mara from a source of supplementary income for one person to a viable business now employing four full-time people. As part of a small island community this is hugely valuable to the sustainability of our island's economy and on a personal level has facilitated the return of a young family to the island", Jenny O´Halloran, Blath Na Mara.

It's hoped that this can be a good example of business development in an isolated area for the whole FLAG area and the rest of the country. The West FLAG supports business development among some of the most marginalised and remote communities in the country, including offshore islands and native Irish speaking communities.

South West FLAG
Purchase of equipment to enhance native flat oyster stocks through spat collection in Tralee Bay

A fisheries cooperative has embraced the use of new technology to ensure the sustainability of its native oyster stocks. By adopting spat collectors ('coupelles') used in France, the Tralee Oyster Fisheries Society has offered a brighter future to its oyster fishers and the local tradition they represent.

Figure 39. Checking oyster spat settlement plates in Tralee Bay. Photo courtesy of BIM

Tralee Oyster Fisheries Society (TOFS) is vested with the management of the wild oyster fishery in Tralee Bay. The not-for-profit cooperative manages the natural resource for the whole community. In 2016, TOFS included 78 boats which harvested 180 tonnes of flat oysters with a value of €1.17 million. Tralee Bay has significant natural reproduction capability for native oysters (European flat oyster *Ostrea edulis*) and, to maintain a healthy oyster stock, they also run a spat collection programme.

In recent years, the stock has been seriously limited by the lack of suitable settlement substrate which is critical for reproduction. The additional substrate had traditionally come from mussel shells which are no longer in plentiful supply due to the market preference for in-shell mussels. TOFS were aware of different technology being used in France and a visit to French oyster producers using 'coupelles' allowed them to see them in operation. Through discussions, they learnt how they could be used effectively in the tidal conditions of Tralee Bay.

The local FLAG helped TOFS invest in these oysters spat collectors, and associated equipment, with the aim of providing an alternative habitat where spat can settle and increasing the levels of natural substrate, essential for optimal recruitment. The technology has been introduced to their whole fishery, which expects to see its levels of oyster spat increase.

The project has allowed Tralee Oyster Fisheries Society to innovate by searching for existing technology and applying it to their fishery on a large scale. The project has increased the power and effectiveness of the cooperative to manage a common resource for its members on behalf of the Irish State. Concrete results in the levels of oyster spat are not expected to be seen before spring 2019, with significant increases not expected before 2020.

Taste the Atlantic – A Seafood Journey

Taste the Atlantic is a collaboration between Bord Iascaigh Mhara (BIM) and Fáilte Ireland highlighting key producers of a range of seafood along the Wild Atlantic Way. By the end of 2018, 21 producers were involved in the project.

In addition to the fish species caught along the coast, the trail also highlights a range of aquaculture species such as salmon, mussels, oysters and abalone. Each producer represents a unique way of telling their story of how they work with the Atlantic Ocean along the coast of Ireland. Starting in Malin Head and stretching the full length of the Wild Atlantic Way, the 21 businesses dotted along the route provide visitors with a whole range of activities; from six different salmon smokehouses or learning about the history of oyster culture, to experiencing the taste of mussels taken straight from the sea.

Fáilte Ireland has also assisted each of the producers to develop a business that is suitable for Ireland's ever growing tourist industry. One of the main benefits include developing a local market where the customer comes to the producers and also offers a chance to meet the people who are earning their livelihood from the Atlantic.

In 2018, Joan Mulloy was appointed ambassador for the Taste the Atlantic Trail to help profile the importance of local aquaculture business to tourists and visitors along the Wild Atlantic Way. In the same year, Joan became the first Irish woman to take part in the Solitaire du Figaro. Joan's professional sailing profile and her family mussel farming background will continue to create awareness of the Taste the Atlantic brand in 2019.

Education is also a vital component of the Taste the Atlantic Trail, with four information brochures available along the route and online detailing how salmon, mussels, oysters and abalone are produced. To further support this educational initiative there are exhibitions on the history and culture of oysters in Doagh Famine Museum in Malin Head and another one in Lissadell House in Co. Sligo, with further exhibitions planned in the future. Information on the culture of mussels can also be seen in Teddy O'Sullivan's Bar in Tuosist in Co. Kerry. These locations, coupled with tours of a number of farms, provide the public with a real opportunity to discover the work and craft involved in producing premium mussels and oysters.

Enhanced information signs were installed at strategic points along the Trail to provide tourists with details on the culture of the key species produced on the Taste the Atlantic route.

Figure 40. Jim O'Toole, BIM CEO pictured with Joan Mulloy, the first Irish female to sail the Solitaire du Figaro. Photo courtesy of BIM

Figure 41. Joan Mulloy, arriving in Galway ahead of SeaFest 2018 in her Figaro yacht. Photo courtesy of BIM

National Seafood Awards 2018

The winners of the Bord Iascaigh Mhara (BIM) National Seafood Awards 2018 were announced at the end of November 2018 at a gala dinner awards ceremony.

Since beginning in 2016, BIM's biennial awards are dedicated to recognising the achievements of individuals and businesses revolutionising the Irish seafood sector.

There were 11 award winners in total on the night chosen from 37 finalists representing the fishing, aquaculture, seafood processing and retail sectors. Two special awards, the BIM Lifetime Achievement award and the BIM Best Student award, were also presented on the night.

BIM Lifetime Achievement Award

The role of women in the Irish seafood sector was celebrated at the awards with veteran seafood professional Margaret Downey-Harrington from Castletownbere, West Cork honoured for her contribution to the Irish seafood industry. Margaret's career has spanned more than 60 years and she is a founding member of Mná na Mara, the first national network for women in fisheries.

BIM Best Student Award

BIM Best Student award winner Kate Dempsey completed a higher diploma in Aquabusiness in IT Carlow. Kate is Director of the Irish Mussel Seed Company and has recently established an aquaculture analytics company.

The National Seafood Awards recognise people, partnerships and businesses throughout Ireland's vibrant seafood sector under the headings of Innovation, Sustainability, Competitiveness and Skills.

The 2018 winners in each category were:

Innovation

- Best in Aquaculture Innovation – Moyasta Oysters Ltd, Kilrush, Co. Clare
- Best in Fishing Innovation – Galway Bay Inshore Fishermen's Association, Co. Galway
- Best in Processing Innovation – Ocean Veg Ireland Ltd, Ballycastle, Co. Antrim

Sustainability

- Best in Sustainable Aquaculture – Marine Harvest Ireland, Letterkenny, Co. Donegal
- Best in Sustainable Fishing – Alex Crowley, MFV *Emma Lou* T450, Cahersiveen, Co. Kerry
- Best in Sustainable Processing – Connemara Seafoods, Westport, Co. Mayo

Competitiveness

- Aquaculture Enterprise of the Year – Bells Isle Seafoods Ltd, Donegal Town, Co. Donegal
- Fishing Enterprise of the Year – McBride Fishing Company Ltd, Letterkenny, Co. Donegal
- Processing Enterprise of the Year – Atlantis Seafoods Ltd, Rosslare Road, Co. Wexford
- Best Seafood Retailer (Multiple category) – Dunnes Stores, Swords, Co. Dublin
- Best Seafood Retailer (Independent category) – Galway Bay Seafoods Ltd., New Docks, Galway City

The trophies for the 2018 awards carried the theme of sustainability and were made using the fish sculptures that featured in the BIM Sustainable Seafood Garden, which won overall prize at Bloom in 2018.

Wild Atlantic Way – Supporting Communities to Act as Custodians and Advocates

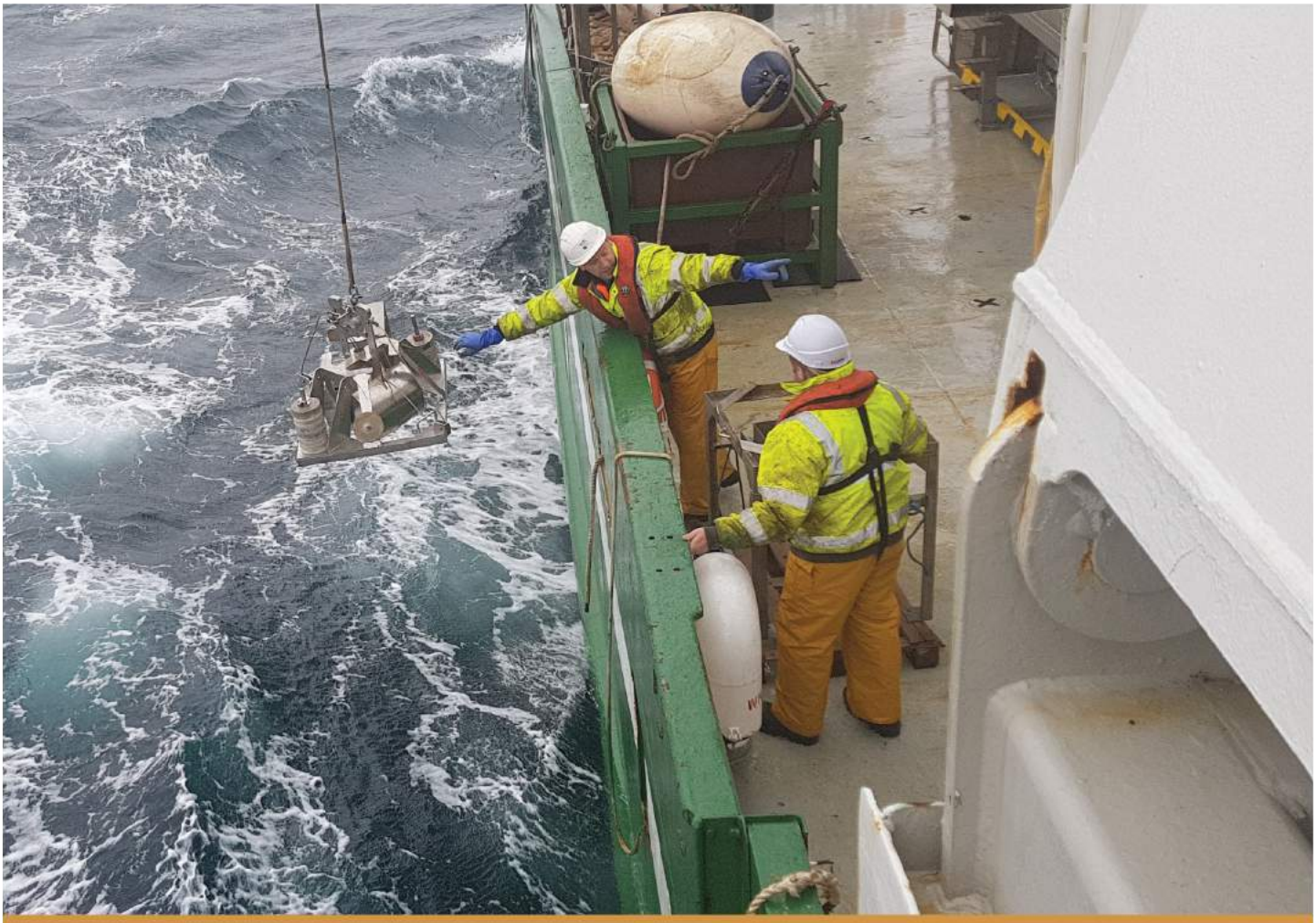
Fáilte Ireland continued to build on Visitor Experience Development Plans (VEDPs), devised to boost international visitors to different locations with high growth potential along the Wild Atlantic Way.

- Working in collaboration with key stakeholders, the Connemara and Aran Islands VEDP was completed in 2017 and implementation commenced in 2018. The plan centres around four key themes (based on the strengths of the area) which bring the plan to life and to which industry partners can align in order to increase their online and offline visibility, and become more attractive to the international visitor.
- The Skellig Coast VEDP was fully implemented in 2018. Over 10 new businesses have established themselves in the area since the launch of the plan.
- The Burren/Cliffs of Moher VEDP was progressed in 2018.
- Other planned VEDPs include: Three Heads (Ballydehob to Kenmare), the Dingle Peninsula, the Haven Coast (Kinsale to Ballydehob), Clew Bay, Inishowen Peninsula, Sligo Coast and Loop Head Peninsula/North Kerry.

In 2018, Fáilte Ireland launched a small grants scheme specifically targeting the Skellig Coast and Connemara/Aran Islands VEDP areas, with the aim of encouraging innovation and experience development in visitor attractions in these regions. The scheme is funding the development of 10 new or enhanced visitor attractions. Fáilte Ireland has also put together a bespoke trade capability building programme for industry partners involved in VEDPs, which includes service excellence, building attractive and saleable experiences for the visitor and the benefits of cross-promoting visitor attractions/activities in the area.

The VEDP process is an inclusive one with key stakeholders, public agencies and private industry coming together to co-create and deliver plans. Sentiment towards this approach has been very strong by all involved.

Figure 42. Connemara and Aran Islands Visitor Experience Development Plans. Source www.failteireland.ie



Research, Knowledge, Technology & Innovation

Research and Development (R&D) and other knowledge-generating activities (e.g. seabed mapping) support sustainable economic growth and job creation through the development of new products and services, facilitate better management and protection of marine ecosystems; and inform policy, governance and regulation of the marine sector

- Harnessing Our Ocean Wealth

Photo courtesy of Graham Johnston

Research, Knowledge, Technology & Innovation

Action 21

Continue to fund strategic marine RTDI (industry, policy and discovery research) through cross-government/agency collaboration across a range of national and international funding mechanisms.

Action 22

Provide direction and focus for expenditure of marine research funding where appropriate through the relevant action plans for priority areas being developed by the Prioritisation Action Group.

Action 27d

Continue to build marine research capacity and capability through targeted national and international research funding.

Information on maximising EU marine research funding opportunities from Horizon 2020 is available under International and North/South Cooperation.

Implementing Ireland's Marine Research & Innovation Strategy through Coordination and Collaboration

Implementation of the National Marine Research & Innovation Strategy 2017-2021 continued in 2018 towards the delivery of the strategy's goals. As part of the strategy's implementing actions a Marine Research Funders' Forum (MRFF) was established by the Marine Institute with two meetings held in 2018 (May and October). The Forum brings together state funding organisations with the aim of enhancing coordination in marine related research funding, whilst also addressing a number of the implementing actions set out in the strategy.

In collaboration with the members of the Forum, another implementing action identified in the strategy commenced in 2018 – the collection and analysis of national marine research investment data. A preliminary analysis of the data provided by the members of the Forum shows in excess of €100 million funding in over 300 research awards to-date during the lifetime of the strategy. The data also shows that approximately 25% of awards are now jointly funded across two or more funders. The initial data analysis also shows that approximately 25% of marine research funding has been won by Irish small and medium-sized enterprises (SMEs). The data collection is ongoing and the Marine Institute, as secretariat to the Group, is liaising with the funders to update its national database of marine research projects developed under the previous strategy. The online database will be published in 2019.

The Marine Infrastructure Providers' Forum was also established in 2018, with the first meeting taking place in September. The aim of the Forum is to enhance national coordination in marine related infrastructures. The two Fora will continue to meet in 2019.

Figure 43. Members of the Marine Research Funders' Forum. Membership includes: Bord Iascaigh Mhara; Department of Agriculture, Food and the Marine; Department of Business, Enterprise and Innovation; Department of Housing, Planning and Local Government; Enterprise Ireland; Environmental Protection Agency; Fáilte Ireland; Geological Survey Ireland; Higher Education Authority; Inland Fisheries Ireland; Irish Research Council; Knowledge Transfer Ireland; Marine Institute; Met Éireann; National Parks and Wildlife Service; Northern & Western Regional Assembly; Science Foundation Ireland; Southern Regional Assembly; Sustainable Energy Authority of Ireland; Teagasc and Údarás na Gaeltachta

Marine Institute Awards €9.2 Million in New Marine Research Investments

€9.29 million in new investments were awarded in 2018 under the Marine Institute's Marine Research Programme. This investment included €2.64 million for access to ship-time on the national research vessels RV *Celtic Explorer* and RV *Celtic Voyager* (136 days awarded for multi-disciplinary/policy support research activities and 53 days for student training). The funding also provided access to the Institute's remotely operated vehicle. The remainder of the investments, €6.65 million, were allocated to new research projects as outlined below.

Co-Funded Programmes

Involvement with co-funded programmes continued in 2018, with five new investments totalling €1.75 million:

- MarTERA (Maritime and Marine Technologies for a new Era) ERA-NET and JPI Oceans – two projects funded with four Irish partners, with Marine Institute investment of €690,000. The projects funded are in the areas of aquaculture technology and robotic vessels

- Environmental Protection Agency (EPA) Research Call 2018 (Climate and Water Pillars) – two awards co-funded jointly by the EPA/Marine Institute and one award also co-funded with Met Éireann, with the Marine Institute's investment amounting to €480,000. Projects are addressing coastal resilience and climate adaptation, climate projections, as well as research into nutrients in the marine and coastal environment

- Science Foundation Ireland (SFI) Investigators Programme – Marine Institute investment of €380,000 for an award co-funded with SFI and Geological Survey Ireland. The new investment is focused on the integration of geoscientific data and forecasting models in predicting coastal change

- BiodivERsA EU JPI – one award co-funded by the European Commission, EPA and the Marine Institute, with the Institute's contribution being €120,000. The research is looking at integrated modelling of climate impacts on freshwater and marine ecosystems

- Sustainable Energy Authority of Ireland (SEAI) Research Call 2018 – one award to be co-funded by SEAI, the Marine Institute and Met Éireann, with a contribution of €80,000 from the Marine Institute. The project is focusing on coupled ocean wave forecasts for Ireland.

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 JPI (Joint Programming Initiative) calls open for submission for transnational proposals in microplastics, blue bioeconomy, marine and maritime technologies and climate research.

Industry-Led Call

In May 2018, the Marine Institute launched its 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 also helps marine companies to develop capacity and capability. The call, an action outlined in the National Marine Research & Innovation Strategy, was well subscribed with 22 proposals received. The Marine Institute awarded 12 grants with a total value of €2.38 million over three years. The awards were made to 12 companies working in collaboration with five higher education institutions. The awards are co-funded under the European Regional Development Fund (ERDF), resulting in a return to the Irish Exchequer. Further details are provided below.

Project Based Awards

In July 2018, the Marine 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 will work in collaboration with Trinity College Dublin and seven international partners from the UK, USA and Germany. The Marine Institute has committed €2 million investment over five years for the project. Further details are available under Action 13a.

Networking and Travel

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 €90,000.

€2.4 Million Industry-Led Awards

In May 2018, the Marine Institute launched the Industry-Led Call to provide assistance for appropriate research activities that support the goals of Harnessing Our Ocean Wealth and the research themes identified in the National Marine Research & Innovation Strategy 2017-2021. The call was designed to address a need in the Irish small and medium-sized enterprise (SME) sector for funding supports to participate in marine related research, to support research and innovation costs for the development of innovative technologies, products and services from existing or new marine-based business.

The Marine Institute awarded 12 grants to marine businesses (in collaboration with five higher education institutions) totalling €2.4 million over three years. The grants of up to €200,000 each are being provided to individual companies and company-led consortia.

Marine Technology

Louth-based marine technology firm, XOcean, was awarded €199,739 in funding over two years aimed at transforming marine monitoring and data collection. The company uses innovative robotics, particularly unmanned vehicles, and IoT (Internet of Things) technology to monitor and collect data at sea. This funding will allow XOcean to research and develop a cost-effective way of deploying and using unmanned technology with multiple sonar devices simultaneously to survey for fish in an area.

A new Smart Data Buoy project by Clare based IDS Monitoring was awarded €196,955 funding to develop a new smart buoy for coastal and inshore environmental monitoring. The project will redesign the physical structure of the buoy; upgrade the system electronics and software including wave sensor components; and develop a standard set of moorings appropriate in almost all weather and water scenarios.

Marine Bioresources

Two projects received funding to support innovative R&D designs to develop new products and services with strong commercialisation potential in the functional foods and aquaculture sectors.

Monaghan-based Bio-Marine Ingredients Ireland (BII) is conducting research with the goal of developing a new health supplement based on blue whiting fish protein. The company, working with partners in the University of Limerick and Dublin City University, has recognised the potential of functional food products derived from blue whiting which could yield enormous benefits for skeletal health, particularly in older people. Experienced in producing the highest quality marine ingredients, BII and their project partners were awarded €200,000 in funding over 18 months to further their research on the new health supplement.

Dublin-based company, Technology From Ideas Ltd (TfI), has been awarded €199,960 in funding to trial a new mooring system for fish cages capable of withstanding more extreme conditions offshore. Having identified a suitable fish farm in the West of Ireland, TfI Marine will work to analyse and monitor the impact of loads on the mooring system, as well as validating various polymer mooring solutions.

Marine Renewable Energy

Eight renewable energy projects were each awarded funding of up to €200,000.

Cork-based company, Ocean Energy and project partner, NUI Galway, were awarded funding in the area of advanced materials for marine energy. The €195,565 in funding, supports research to deliver a validated and commercial method of fibre reinforced polymer (FRP) jointing and construction for application in the marine energy and aquaculture sectors, which could ultimately reduce both capital and operating costs for businesses operating in these sectors.

Gavin & Doherty Geosolutions (GDG) were awarded €199,957 over two years for their research project in partnership with University College Cork (UCC). Predictive sediment transport modelling, validated against field data, will be used to characterise future seabed changes and to quantify the risk for future potential offshore wind developments in the Irish Sea.

Solar Marine Energy Ltd were awarded €195,465 over two years, in partnership with UCC, to progress how solar energy can be harnessed on a floating platform to power an electrolysis unit to produce hydrogen in an electro-fuel form whilst using battery storage for the release of power as and when required. Solar Marine Energy is one of the first companies to design, engineer and manufacture cost-competitive floating solar energy products, Floating Solar Panels, in accordance with Maritime Industry Best Practice.

The Eureka-Sea Wind project proposed by Marine Materials Ireland Ltd (MMI) was awarded €199,816 over two years to develop reliable and efficient floating wind turbine technology based on a novel concept that reduces cost and weight.

Based in Ireland and the USA, Resolute Marine Ltd has developed a successful Oscillating Wave Surge Converter (OWSC) flap system. Now with a funding boost of €199,955, Resolute Marine are aiming to bring the OWSC from concept to robust design that is optimised for locations in developing countries and islands, targeted for commercial installations of innovative wave-powered desalination systems.

Subsea Micropiles was awarded €199,902 for research on the design and temporary installation of two demonstration micropile anchors. The anchor frames will represent structures that will support the foundations of offshore wind turbines or hydrokinetic energy converters. Use of robotically installed micropiles in the subsea environment represents important innovation and potential cost saving for marine renewable energy projects.

Exceedence Ltd and project partner Technology From Ideas Ltd secured €199,532 in funding to research and develop a revolutionary 1kW Inline Gator system. The Inline Gator will harness the natural power of the waves by converting the motion of fish farm cages into electricity thereby mitigating the need for fossil fuels. Wave energy, especially when coupled with the existing mooring system, is seen as a very appealing solution to meet power needs.

W1DA Experience Ltd was awarded €198,763 in funding for the Marine EcoPowa Project in partnership with University of Southampton and UCC. The project aims to create a new generation of medium power (12-15KW/20-30HP) environmentally friendly marine propulsion and energy regeneration systems that will replace what is currently termed as 'outboard motors'.

Early Stage Research Funding – Cullen Fellowships

The Marine Institute funded five Cullen Fellowships in 2018, with a total investment of €430,000, in the following research topics:

- A regional and rural analysis of Ireland's ocean and coastal economies (NUI Galway)
- Next generation sequencing to determine the occurrence of norovirus genotypes (Cork Institute of Technology)
- Vulnerability of life stages of marine calcifiers to changes in ocean chemistry (Trinity College Dublin)
- Culture optimisation and bioactivity of selected toxic Irish microalgae (NUI Galway)
- Evaluating the disease status of velvet crab, brown crab, lobster & shrimp (Galway-Mayo Institute of Technology)

Figure 44. James Fahy and Philip Stephens at the Annual Cullen Workshop in November 2018. James completed his MSc on Shellfish Microbiology with UCD and Philip completed his MSc on Strategic Marketing and Shipping with NUI Galway

This brings the total number of fellows funded under the programme to 27. The Programme provides fellowships to postgraduates (PhD or Masters) to work on projects aligned with the Marine Institute's Strategic Plan; supporting and adding value to the Institute's scientific advice and services provided to Government.

The Annual Cullen Workshop was held in November 2018, with the fellows presenting oral and poster presentations in a diverse range of marine topics (e.g. ocean observations technologies, assessment of finfish/shellfish species, ocean ecosystems and the food web, fish disease control, marine contaminant and toxins, and seaweed assessment).

Disruptive Technologies Innovation Fund

The Disruptive Technologies Innovation Fund (DTIF) is a €500 million fund established under Project Ireland 2040 and is run by the Department of Business, Enterprise and Innovation with administrative support from Enterprise Ireland. Funding is available for co-funded projects involving enterprises and research partners over the period to 2027. The results of the inaugural call were announced in December 2018; with a number of successes in the bioresources and marine sectors. Over €5 million in funding was awarded to four marine companies working in partnership with a NUI Galway, University of Limerick, Dublin City University, Teagasc and the Marine Institute.

In recognition of the agri-food and marine sector's importance and the significant role it plays in maintaining rural economies and communities it was particularly encouraging to see the participation and success of rural based small and medium-sized enterprises (SMEs) under this Call. These industries are vital to the economic stability of the country as a whole and the opportunity for SMEs to collaborate with leading academic institutions will be of enormous benefit in the safeguarding and future growth of the economy, jobs and rural communities.

Marine Projects included among the 27 successful projects:

Project Name	Consortium Members	Project Summary	Award (subject to contract negotiation)
HYDRO-fish: Combining targeted nutraceuticals and traceability technology for a smarter and sustainable Irish fish aquaculture industry	Bio-Marine Ingredients Ireland, NUI Galway, Teagasc, Marine Institute	HYDRO-fish is a multi-disciplinary research programme specifically designed to employ current technologies from other sectors to disrupt and enhance current fish farming practices. The project entails reinforcing the supply chain of Irish salmon production, in particular for organic salmon farming.	€2 million
Optimised commercial-scale cultivation of protein-rich biomass from *Palmaria palmata* for the generation of health enhancing plant based proteinaceous ingredients	Allihies Seafood, Carbery, University of Limerick	This project aims to sustainably generate plant-based proteinaceous ingredients for exploitation as a source of high quality protein and contribute to meeting the growing global demand for plant-based proteinaceous ingredients for animal and human consumption.	€1.8 million
Advanced Environmental Decision Support System for Coastal Areas	Techworks Marine Ltd., Dublin City University	This project will provide an advanced environmental decision support system to address issues such as coastal pollution and flooding. Such a system will provide enhanced insights to coastal industries, local authorities, government agencies and will ultimately benefit Irish society.	€1.1 million

Table 4: Successful Marine projects announced in 2018 as part of the Government's Disruptive Technologies Innovation Fund

The Fund is a key part of the Government's 'Future Jobs' initiative and is aimed at tackling national and global challenges to secure the jobs of the future.

The projects will contribute to achieving the goals of the National Marine Research & Innovation Strategy 2017-2021 and address a number of research themes including Bioresources, Ocean Observation, and Information & Spatial Technologies, Analytics and Modelling.

Geological Survey Ireland Funded Marine Research

In the last three years, Geological Survey Ireland (GSI) has committed €2.3 million to marine research conducted in Ireland including 26 short projects awarded to small and medium-sized enterprises (SMEs), academic researchers and postdoctoral fellowships.

A GSI Griffith Award granted to a researcher at NUI Galway concluded in 2018. This research focused on applications of unmanned aerial vehicles (UAV) technology to measure bathymetry and topography in coastal and marine environments. A GSI funded postdoctoral fellow at Maynooth University has been developing optical remote sensing techniques for bathymetry and seabed mapping in the coast of Ireland.

GSI has also partnered with other national and international funders to jointly fund geoscience research, this includes Science Foundation Ireland's Infrastructure and Investigator Programmes, US-Ireland Fulbright scholarships and the Irish Research Council (IRC).

Through the IRC Enterprise Partnership Scheme, GSI has supported three postdoctoral fellowships in Dublin City University and Maynooth University. A range of topics were investigated from offshore geology of the Irish shelf to applications of multi-resolution imagery, photogrammetry and spatial prediction algorithms for surveying the coastal zone. A Fulbright Scholarship was awarded to Dr Aggeliki Georgiopoulou in University College Dublin for her studies into Submarine Landslide Scar Investigations. Dr Georgiopoulou was based in the US Geological Survey, Woods Hole, Falmouth, Massachusetts for five months during 2018.

During 2018, the Dublin Institute for Advanced Studies (DIAS) established the Insitu MArine Laboratory for Geosystems Research (iMARL) under the Science Foundation Ireland (SFI) Infrastructure Programme in collaboration with GSI. The first network of 18 broadband, ocean-bottom seismometers were deployed offshore Ireland from the RV *Celtic Explorer*.

Three SFI Investigator Programme awards are co-funded by SFI, the Marine Institute and GSI:

- The SEA-SEIS project, led by DIAS and using iMARL equipment, will define the structure, evolution and seismic hazard of the NE Atlantic
- Researchers at University College Cork are mapping, modelling and monitoring key processes and controls on cold-water coral habitats in submarine canyons
- Researchers at Dublin City University are leading a study to integrate multidisciplinary geoscientific data into forecasting modelling and monitoring coastal change (PREDICT)

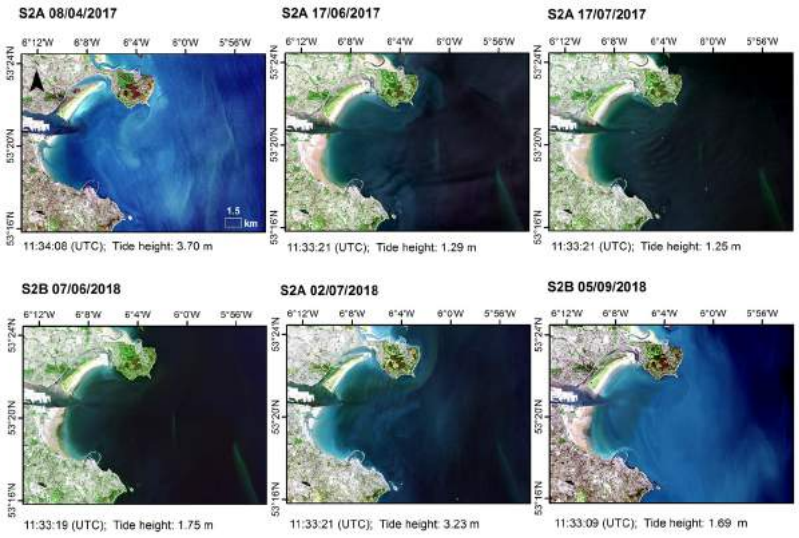


Figure 45. Optical remote sensing for bathymetry and seabed mapping in the coast of Ireland (BaSMal). Imagery courtesy of GSI and Dr. Gema Casal, Postdoctoral researcher, Maynooth University. The BaSMal project is funded by GSI (2017-2019)

DIAS Scientists Launch Major Atlantic Ocean Research Project

The most ambitious deep-ocean research project ever undertaken in Europe was launched in Dublin in April 2018. The iMARL project – led by scientists from Dublin Institute for Advanced Studies (DIAS) – is centred on 18 state-of-the-art ocean bottom seismometers, located deep in the Atlantic Ocean hundreds of kilometres off the west coast of Ireland. The iMARL equipment includes ocean-floor vibration sensors, water temperature sensors and underwater sound recorders. These are used to detect offshore earthquakes, allow imaging of offshore sub-surface geology, and help in the detection of both deep offshore currents (underwater rivers) and offshore seabed disturbances associated with large Atlantic storms. The instruments can track the presence of whales and dolphins; and a pilot tsunami detection capability will also be installed as part of the iMARL project.

iMARL is the 'Insitu MArine Laboratory for geosystems Research' project. The first deployment of the equipment took place in the NE Atlantic in September/October 2018 using the RV *Celtic Explorer*.

Figure 46. Professor Mark Ferguson, Director General of Science Foundation Ireland and Chief Scientific Adviser to the Government of Ireland; Minister of State for Rural Affairs and Natural Resources, Seán Kyne TD, Professor Chris Bean, Senior Professor of Geophysics and Director of the DIAS School of Cosmic Physics and Mr. Koen Verbruggen, Director of Geological Survey Ireland. Photo source www.dias.ie.

Petroleum Infrastructure Programme Trans-Atlantic Source Rock Study

The Petroleum Infrastructure Programme (PIP-ISPSG), Ireland's joint Government-industry petroleum research programme, sponsors research and innovation to benefit the understanding of Ireland's petroleum potential.

A number of significant oil and gas discoveries have been made offshore Newfoundland-Labrador, including recent oil discoveries in the Flemish Pass Basin, but this level of success has so far not been matched offshore Ireland. Research work has shown that prior to the opening of the Atlantic Ocean, the sedimentary basins, where hydrocarbon potential resides, of the Irish Atlantic Margin and offshore Newfoundland-Labrador were once connected and would have shared very similar geology. There is currently a lot of interest in these basins by major oil companies who are exploring both sides of the Atlantic. Many companies who were successful in the first phase of awards in the 2015 Irish Atlantic Margin Licensing Round were also successful in recent call for bids offshore Newfoundland-Labrador.

A major project involving an assessment of geochemical data from all basins offshore Ireland and offshore Newfoundland-Labrador was undertaken. To date no single compilation of historical and recent geochemical information had been conducted to fully integrate the petroleum system evolution over this portion of the North Atlantic. The objective of the project was to compile all existing petroleum geochemical data on source rocks and hydrocarbons offshore Ireland and offshore Newfoundland-Labrador and to infill data gaps with new analytical work with the aim of enhancing our understanding of the petroleum geology of these North Atlantic basins and establishing trends in source rock distribution across the margins. Following a tender process in 2015, the contract was awarded to Beicip-Franlab, who have significant experience in North Atlantic petroleum assessments. Work commenced in October 2015 and was completed in 2018.

Building Capacity and Capability in Coastal and Offshore Marine Surveillance

Through an inter-Departmental Memorandum of Understanding (MoU) and international cooperation, the Department of Communications, Climate Action and Environment and Department of Culture, Heritage and the Gaeltacht ObSERVE Programme, established in 2014, has built national expertise in the area of coastal/offshore marine surveillance, data acquisition, analysis and interpretation. Aerial and acoustic projects, which were completed in 2018, have demonstrated and delivered very significant and tangible capacity building and knowledge transfer into Ireland. Further details on the ObSERVE Programme are available under Actions 8 and 14.

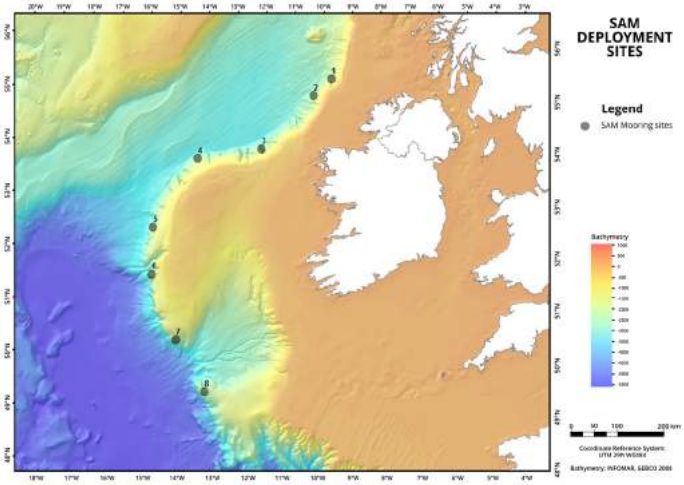


Figure 47. ObSERVE Acoustic project: Map of Ireland and surrounding marine waters showing the positions of eight Static Acoustic Monitoring [SAM] systems for detecting and recording underwater sounds in spring/summer/autumn 2015-16

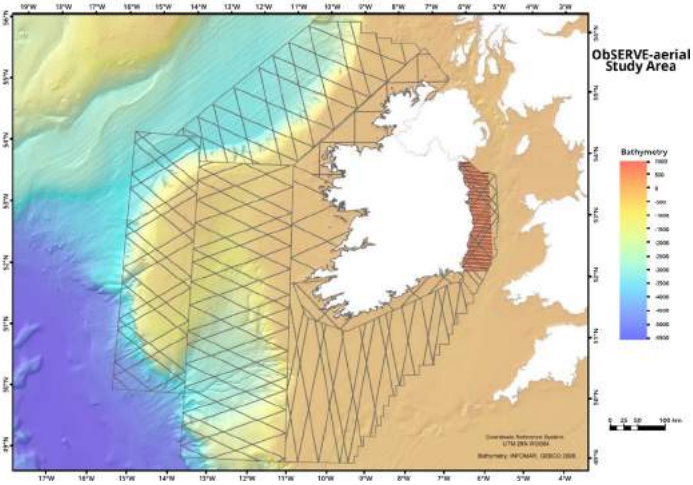


Figure 48. ObSERVE Aerial project: Map of Ireland and surrounding marine waters showing combined aerial survey lines for coverage in summer and winter 2015-17 (grey zig-zag lines) and aerial survey lines targeting seabirds in the Irish Sea in summer/autumn/winter 2016 (red parallel lines).

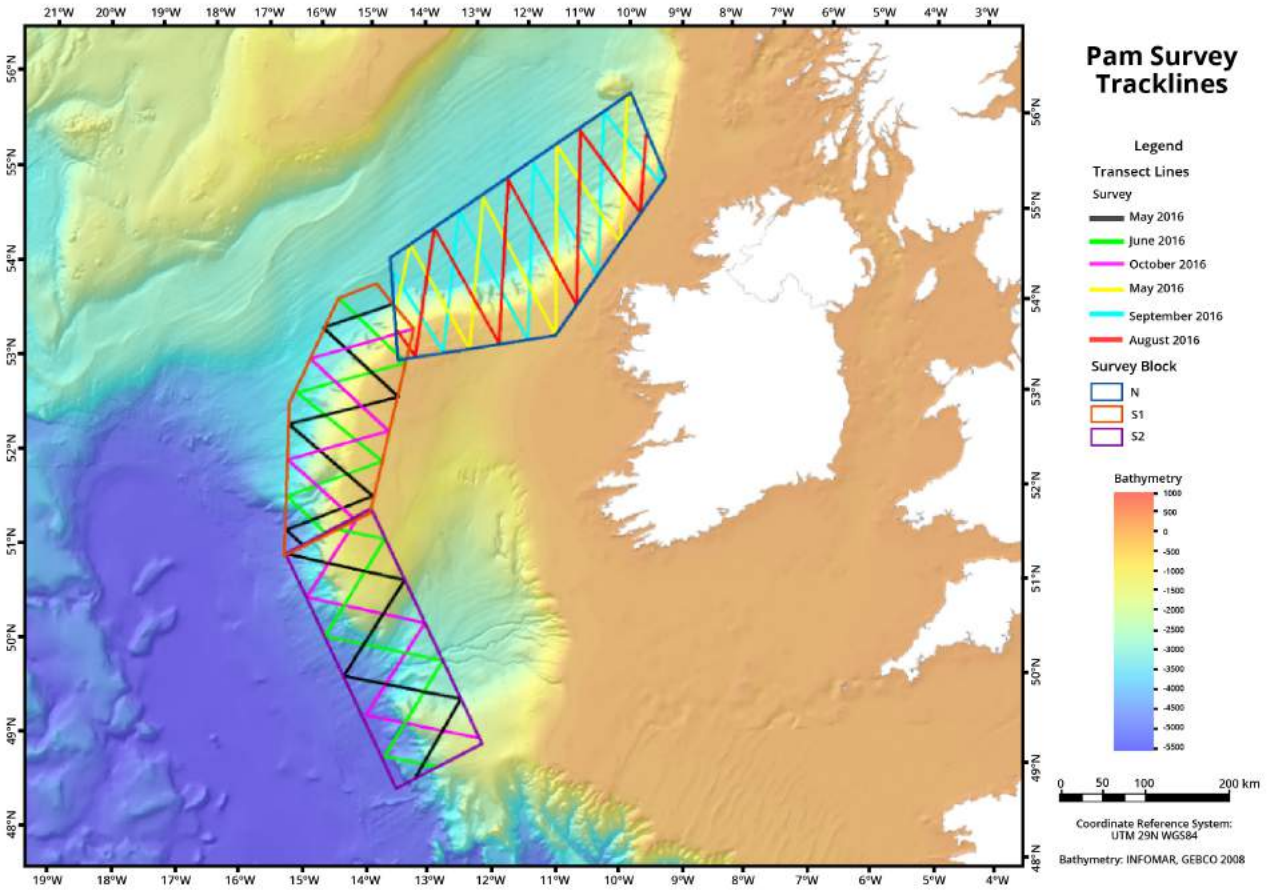


Figure 49. ObSERVE Acoustic project: Map of Ireland and surrounding marine waters showing the colour-coded survey lines for towed Passive Acoustic Monitoring [PAM] of cetaceans, which sampled in spring/summer/autumn 2015-16.

Eating Oily Fish May Help Mothers Have Babies with Healthy Weight and Healthy Guts

A new study from the Science Foundation Ireland Research Centre APC Microbiome Ireland at Teagasc and University College Cork, together with collaborators at Massachusetts General Hospital/ Harvard University, has found that mothers who eat healthy fats from oily fish may help their children form healthy guts and maintain healthy weights throughout their lives.

This research was published in the Microbiome Journal in 2018 and was funded through a Teagasc Walsh Fellowship, and Fulbright Scholarship from the Fulbright Commission of Ireland to Ruairi Robertson and by Science Foundation Ireland through a grant to APC Microbiome Ireland.

Further information is available on www.teagasc.ie

European Maritime and Fisheries Fund (EMFF) Knowledge Gateway Scheme

Bord Iascaigh Mhara's (BIM) Knowledge Gateway Scheme, funded under Ireland's EMFF Operational Programme 2014-2020, supports work in the area of applied research, new species development and commercialisation, research into managing diseases and parasites, as well as knowledge transfer.

In 2018, BIM supported a range of research projects under the scheme on the following topics:

- Reducing the levels of nutrient discharge of selected marine salmon farms to meet the EU Water Framework Directive
- Water quality monitoring to be implemented to assess the performance of the technologies
- Exploring how combinations of fresh water algae and Lemnaceae (duckweed) can improve water quality in integrated multi trophic aquaculture (IMTA) to enhance fish production and result in the production of a high-quality animal feed by-product
- Structural and functional characterisation of novel macroalgal-derived phlorotannins, carotenoids (fucoxanthin) and polysaccharides (fucan) from the brown seaweed *Alaria esculenta*
- To investigate the feasibility of upscaling Irish mussel production through development of offshore sites using innovative culture systems
- Utilise the potential benefits of recirculation aquaculture systems (RSA) to increase the overall size of smolt produced in Ireland with a view to producing the lifecycle at sea to reduce production risk
- Site-specific autogenous vaccine development for improved health and welfare of finfish species including lumpfish, wrasse, salmon and perch in Irish aquaculture.

Further details on these projects are available on www.bim.ie

EMFF Case Study - Recirculating Aquaculture Multitrophic Pond System (RAMPS) Project 2018-2020

Freshwater aquaculture in Europe faces a number of challenges including access to space, licensing limitations and increasing focus on discharges following the implementation of various environmental regulations including the Water Framework Directive. The focus in Ireland has been on expanding the sector in a sustainable manner and there has been particular interest in the development of multitrophic systems which culture a range of species, each benefiting from each other.

Recirculating Aquaculture Multitrophic Pond Systems (RAMPS) is an innovative project being undertaken to explore the potential for a new method of sustainable aquaculture production. Utilising methods incorporated in multitrophic and split pond systems, the project will also address the potential for starch and protein production from duckweed and other aquatic plants for use in the feed, biotechnology, pharmaceutical and bioenergy sectors.

The project concept addresses the requirement for aquaculture to develop an approach aligned to a circular economy; utilising waste streams and outputs to generate further income and utilisation. The project, which is based on two freshwater aquaculture sites, involves the production of trout and perch in split pond systems. These ponds, which were first developed for the catfish sector in North America, utilise paddlewheels and airlifts to circulate water. Fish are kept at low densities in part of the pond whilst the remaining area utilises algae and duckweed to remove the nitrogen and phosphates produced by the fish. The algae also add additional oxygen to the system during photosynthesis. In a split pond system ancillary oxygen provision is only required in part of the system.

Duckweed produced can also be harvested and the project is investigating the potential for utilising this duckweed for protein extraction, biofuels and as an additive in animal feeds, cosmetic and pharmaceutical products. Duckweed, which is the fastest growing plant in the world, can double every 24 hours and is ideally suited to fish farming as it can remove ammonia produced by the fish directly. Initial results from the project have been largely positive and future work will concentrate on developing a life-cycle assessment model to quantify all inputs and outputs from the system.

The fish in the system are fed on organic feed and state-of-the-art sensors continually monitor water quality to ensure optimum conditions are maintained. It's believed that the algae and natural flora in the system also have a probiotic effect on the fish with a natural balance maintained. This is of increasing importance in an era focused on ensuring animal welfare and optimum fish health. The RAMP system has been deployed at two sites for testing, Keywater Fisheries Ltd in Co. Sligo and the Aquamona site in Co. Offaly. It is envisaged that if successful a larger scale facility could be developed which would significantly add to Ireland's freshwater production.

The project is funded under Ireland's EMFF Operational Programme 2014-2020 Knowledge Gateway Scheme.

Figure 50. Aerial view of the Aquamona ramp system.
Photo courtesy of the Department of Agriculture, Food and the Marine

MaREI – Centre for Marine and Renewable Energy

MaREI is the SFI Research Centre for marine and energy research. MaREI's strategic plan provides a framework for the Centre to excel in its mission of addressing urgent global challenges, specifically the low-carbon energy transition, climate action and the blue economy across the marine space. MaREI is focused on two core areas, energy and the marine in order to address these challenges. In implementing these objectives, achievements that were realised during 2018 include: the direct contribution of MaREI research to increasing the EU's 2030 renewable energy targets from 27% to 32%; the launch of MaREI's remotely operated vehicle (ROV) *Étaín*, representing the culmination of significant research and development activities; and the deployment of GKinetic Energy's first 25kW tidal energy device in France, directly building on collaborative research and support provided through MaREI's industry engagement programme.

During this period, MaREI was also successful in securing eight major European projects, including the coordination of one, and grew its cumulative industry portfolio to 66 companies since inception, with 32 repeat engagements, representing the diversification and expansion of individual relationships across multiple Institutions/Research Areas.

MaREI – Overview of Key Achievements in 2018

MaREI is organised into seven Research Areas (RAs). Key highlights for 2018 of four of the RAs is outlined below. Although these RAs are the most closely aligned to the maritime domain, other areas (bioenergy, energy policy and modelling, and Energy management) are also conducting research relevant to the marine sector.

RA1: Marine Renewable Energy Technologies, *underpinning research necessary to support the development of the marine and renewable energy sectors.* Key Achievements in 2018 include:

- Appointment of Prof. Gregorio Iglesias as Professor of Marine Renewable Energy at UCC
- Publication of 27 papers in high-impact journals, along with four PhD graduates and one PhD student studying in the USA as part of a Fulbright Award
- Full commissioning of the test facilities at Lir-NOTF, concluding a three-year €4 million investment
- Under the MARINET 2 Transnational Access Programme, high utilisation rates of both the Lir-NOTF (UCC) and the Large Structures Test Cell (NUIG) during the first two calls of the Programme. The Deep Ocean Basin at Lir-NOTF had the highest number of applications of all 54 facilities
- Success in a number of funding programmes, including the SEAI RD&D Programme, the Marine Institute Industry-Led Awards, and EU Interreg Programmes.
- Commencement of a two year industry-led EirWind collaborative research project, focusing on commercial roll-out of offshore wind energy in Ireland.
- Continued research on the multi-institutional BenchWEC project, which comprises numerical and physical modelling activities, design optimisation, control design and implementation. The project involves partners from University College Cork, Maynooth University, University College Dublin, and Dundalk Institute of Technology.
- Success in MaREI's application to host the Wind Energy Science Conference in Cork in June 2019, with some 900 delegates expected to attend the event
- Visits from over 600 school children to Maynooth during Science Week, which included interactive wave tank and wave energy converter demonstrations. Up to 60 technical and non-technical groups also attended demonstrations at Lir-NOTF.

RA2: Materials and Structures, *reducing costs and risks relating to the design, financing, deployment, operation and maintenance of marine and renewable energy installations.* 2018 highlights include:

- Through R&D projects in collaboration with industry partners, the development of a complete service of design and testing of tidal turbine blades; with accelerated design life testing of tidal turbine blades conducted through mechanical fatigue testing at NUI Galway
- In the Large Structures Test Cell at NUI Galway, one of the blades of the Orbital Marine Power 02 2MW tidal turbine converter will be tested in 2019, both statically and in fatigue. This blade will become the largest tidal turbine blade ever tested in fatigue to its 20-year lifespan in the world. The blade was designed using the MaREI in-house software BladeComp, which is a wind and tidal turbine blade design software that provides a faster, easier and more reliable blade design process. The blade is currently being manufactured in Éire Composites, an SME in Co. Galway
- Funding secured to accelerate the commercialisation of the BladeComp software through the Blackstone LaunchPad entrepreneurial training programme and SFI/NSF I-Corps Entrepreneurship Training Programme
- Development of unique image processing, acquisition and analyses guidelines, hardware, algorithms and benchmarks to address the needs of the offshore infrastructure sector by the Dynamical Systems and Risk Laboratory (DSRL) at University College Dublin, in collaboration with Trinity College Dublin, Capacites France (industry) and University of Nantes, France
- Publication of over 60 peer review journal papers. The group also won a number of national awards, as well as a number of academics taking on leadership roles in a number of international fora.
- Delivery of community-based learning modules, where over 600 students to date have provided solutions for community organisations or charities for engineering problems

RA3: Observations and Operations, *Research addresses fundamental issues relating to the observation and monitoring of marine and renewable energy installations.* Key achievements in 2018 include:

- The launch of the marine renewable energy (MRE) remotely operated vehicle (ROV) *Étaín*. The ROV was built, delivered, commissioned, launched and operated offshore during 2018. The system was trialled during its maiden offshore voyage in Galway Bay, where it was used to test site infrastructure at the SmartBay test site and was featured on RTÉ, TV3, and national printed and social media.
- Commencement of the EU Horizon 2020 funded Marine Robots and MarTERA RoboVass projects. Both projects are related to the use of ROVs and AUVs for offshore infrastructure and installations.
- Combining WRF-CHEM (Weather Research and Forecasting (WRF) model coupled with chemistry) and WRF-Met forecasts into a novel app for air pollution and weather forecasts over Europe.
- Hosting the EMRA (EU-Funded Marine Robotics and Applications) Workshop in Limerick. This event brought together researchers involved in current Horizon 2020 funded marine robotics projects, including industry and policy makers.
- Publication of 27 papers and completion of five PhDs in 2018.
- Receipt of a number of national and international research excellence awards including at the 5th World Conference on Climate Change and also Prof. Colin O'Dowd of NUI Galway became a member of the Academia Europaea.

RA4: Coastal and Marine Systems, *research activities are focused on the analysis of integrated approaches to coastal and marine planning and management in order to facilitate the sustainable development of key marine sectors*. Over the course of 2018 the following were successfully achieved:

- EU Funding awards from Life+ and Interreg secured. Research includes underwater noise and ocean literacy as well as researchers from MaREI working closely with colleagues from i-CRAG SFI Research Centre on mapping offshore habitats (marine protected areas).
- Over 20 peer-reviewed papers published in leading scientific journals, plus a book and seven book chapters, 20 presentations and organisation of 18 workshops.
- A number of appointments to national and international committees and advisory boards.
- Commencement of the Marine Institute funded NAVIGATE project on Ocean Law and Marine Governance. The project brings together marine policy and law experts from MaREI and the School of Law (UCC).
- Completion of UCC-MaREI coordinated SIMCelt project on 'Supporting Implementation of Maritime Spatial Planning in the Celtic Seas', involving regulatory and academic partners from Ireland, England, Scotland, Northern Ireland and France
- Collaboration between MaREI researchers from UCC and Cork Institute of Technology (CIT) with Cork County Council to submit a successful bid for Cork to establish a Climate Action Regional Office (CARO) for the south west of Ireland focused on coastal impacts of climate change.
- Provision of support (online and practical) through Climate Ireland, which is run by UCC with support from the Department of Communications, Climate Action and the Environment and the EPA. This includes providing a dedicated portal and tailored workshops for local authorities throughout the year.
- EPA and Marine Institute joint funding secured by UCC/NUI Galway focusing on Coastal Resilience, with further EPA awards secured focused on implementation of Sustainable Development Goals (SDGs) and climate change indicators to add to another EPA supported project on the 'Status of Ireland's Climate'.
- Award of significant funding from BIM for the Wild Atlantic Mussels (WAM) Project to support a three year study investigating the feasibility of farming mussels in more exposed offshore sites around Ireland.
- EU Horizon 2020 involvement/knowledge-generation, e.g. AQUACROSS (Knowledge, Assessment and Management for Aquatic Biodiversity and Ecosystem Services Across EU Policies), which successfully concluded following a second stakeholder workshop focussed on Lough Erne. AquaSpace (Ecosystem Approach to making Space for Aquaculture) also successfully ended in 2018.

Action 23

Complete the INFOMAR seabed mapping programme, to provide data, products (e.g. databases, charts, physical habitat maps) and services (marine decision support tools) as critical inputs to maritime spatial planning and enablers of infrastructural development, research, education and value-added products. Further develop the role of INFOMAR in:

- Training of Irish graduates in latest techniques in seabed mapping, which are applicable world-wide;
- Utilisation of data in major research projects; and
- Development of collaborative added-value products through engagement with SMEs and the research community.

INFOMAR – Integrated Mapping for the Sustainable Development of Ireland's Marine Resource

INFOMAR, Ireland's seabed mapping programme co-managed by Geological Survey Ireland (GSI) and the Marine Institute, is in its second phase and is scheduled to run until 2026. The programme is funded by the Department of Communications, Climate Action and Environment.

The INFOMAR programme undertook extensive survey activities during 2018 in the offshore and near shore environments. Significant progress was achieved in data integration and map product development, and streamlining accessibility of related digital mapping services. Baseline mapping of Ireland's seabed bathymetry and habitat is crucial for management, conservation and the sustainable development of marine resources. Significant effort in 2018 was directed towards engaging with stakeholders and service users. The year saw the launch of a new website, a successful seminar in Kinsale, Co. Cork and multiple engagements through media activity and high profile events. Through INFOMAR's 'Value Added Exploitation' initiative, the programme team coordinated and supported research, training, education and outreach activities throughout the year. Furthermore, the programme provided international representation at key conferences and committees abroad, and facilitated development activity related to offshore infrastructure and marine renewable energy.

Programme 1 – Data Acquisition, Management and Interpretation

INFOMAR seabed surveys were carried out on the southern Irish coast and offshore, within valuable fisheries areas in the South Celtic Sea. The favourable weather conditions experienced throughout the 2018 survey season allowed for unprecedented seabed mapping coverage with a total of 11,724 km² of seafloor mapped, 52 shipwreck locations and numerous H-notes reports on shoals sent to the United Kingdom Hydrographic Office (UKHO). The INFOMAR inshore fleet successfully operated out to the 30 nautical mile limit for the first time in 2018 as part of a combined GSI/Marine Institute strategy to optimise fleet mapping coverage. A cross-border knowledge exchange initiative between INFOMAR and the Agri-Food Biosciences Institute (AFBI) resulted in a successful collaborative seabed mapping survey of 183 km² in the Irish Sea. Collaboration between INFOMAR, Maynooth University, and the Marine Institute's Fisheries Ecosystem Advisory Services led to 360 sediment samples being acquired for particle size analysis and future input to seabed classification and habitat map products in development. This growing initiative is leveraging routine INFOMAR survey operations, data from third party Marine Institute ship-time research awards, and European Maritime and Fisheries Fund programme support, to deliver results that will underpin multiple national programmes and reporting requirements, including those supporting the Marine Strategy Framework Directive and Marine Spatial Planning.

Programme 2 – Data Integration and Exchange

INFOMAR provides free open source data underpinning a wealth of applications. Data applications are continuously growing, and programme outputs enable quicker decision making, smarter long-term planning, and more sustainable development. Bathymetry data acquired during the 2018 survey season were processed and returned to the office for finalisation and product development according to standard INFOMAR workflows. Digital mapping products generated from the survey data can be downloaded online through INFOMAR WMS (Web Map Services). The INFOMAR website (infomar.ie) underwent a full re-design during 2018 and was officially launched in November at the INFOMAR Seminar in Kinsale, Co. Cork. The new website hosts a wide array of features and improved data viewers, including an improved backscatter tile service, new research and story maps, and an expansion of the INFOMAR downloadable chart series. A new series of seabed substrate mapping products were created and made available online, while a comprehensive review of data services commenced in order to streamline data access, manage legacy datasets and ensure EU metadata standards compliance (INSPIRE). Additionally, habitat mapping data were collated, contributing to INFOMAR, OSPAR, Marine Strategy Framework Directive and Habitats Directive reporting.

Programme 3 – Value Added Exploitation

INFOMAR continues to deliver a range of value added opportunities linked to user demands, commercial markets and external funding sources, while their strategic plan is evolving to meet the requirements and fulfil the objectives of national and international policy including; Harnessing Our Ocean Wealth, Marine Spatial Planning and the National Development Plan. The INFOMAR team have been engaged in supporting significant international and Irish research collaboration, while also providing education, training and capacity build support.

Supporting national habitat monitoring and fisheries management requirements, a significant remotely operated vehicle (ROV) reef habitat mapping programme (SeaRover) was coordinated and carried out along the western continental shelf margin. The work was managed by the Marine Institute's Fisheries Ecosystem Advisory Services, and coordinated and delivered through collaboration between GSI, Marine Institute and the National Parks and Wildlife Service (NPWS), with additional support from Plymouth University, NUI Galway, and Aquafact Ltd. Building on a 2009 and 2017 survey, the study provided extensive shelf break and slope high-definition video footage of offshore reef environment and habitat, a valuable resource for future resource management, and one which yielded the discovery of rare black coral as well as a shark nursery. The 2017-2019 SeaRover programme is funded by the Department of Agriculture, Food and the Marine, through the European Maritime and Fisheries Fund (EMFF), and the National Parks and Wildlife Service.

Through participation in international projects including EMODnet (European Marine Observation and Data Network), AORA (Atlantic Ocean Research Alliance), ASMIWG (Atlantic Seabed Mapping International Working Group), Pro-Atlantic, and CHERISH (Climate, Heritage and Environments of Reefs, Islands and Headlands), Ireland's key role in seabed mapping and associated technology is acknowledged, communicated, and can best be leveraged to avail of future opportunities. Two INFOMAR candidates were accepted for the NIPPON foundation funded postgraduate diploma at the University of New Hampshire with one graduating in 2018 and the other expected to graduate in 2019. These two GEBCO (General Bathymetric Chart of the Oceans) ambassadors will now champion Seabed 2030, the global mapping initiative of the International Hydrographic Organisation (IHO). Extensive networking and public outreach events and activities were supported, including exhibits at the BT Young Scientist Exhibition and SeaFest in 2018. INFOMAR continues to support the Offshore Renewable Energy Development Plan and associated projects such as EirWind.

All three INFOMAR programme areas were addressed at the 2018 Annual INFOMAR Seminar in Kinsale, Co. Cork, where a variety of case studies demonstrating the high impact of INFOMAR support, services, and open data were presented to an international audience, key programme stakeholders, industry, and the marine research community.

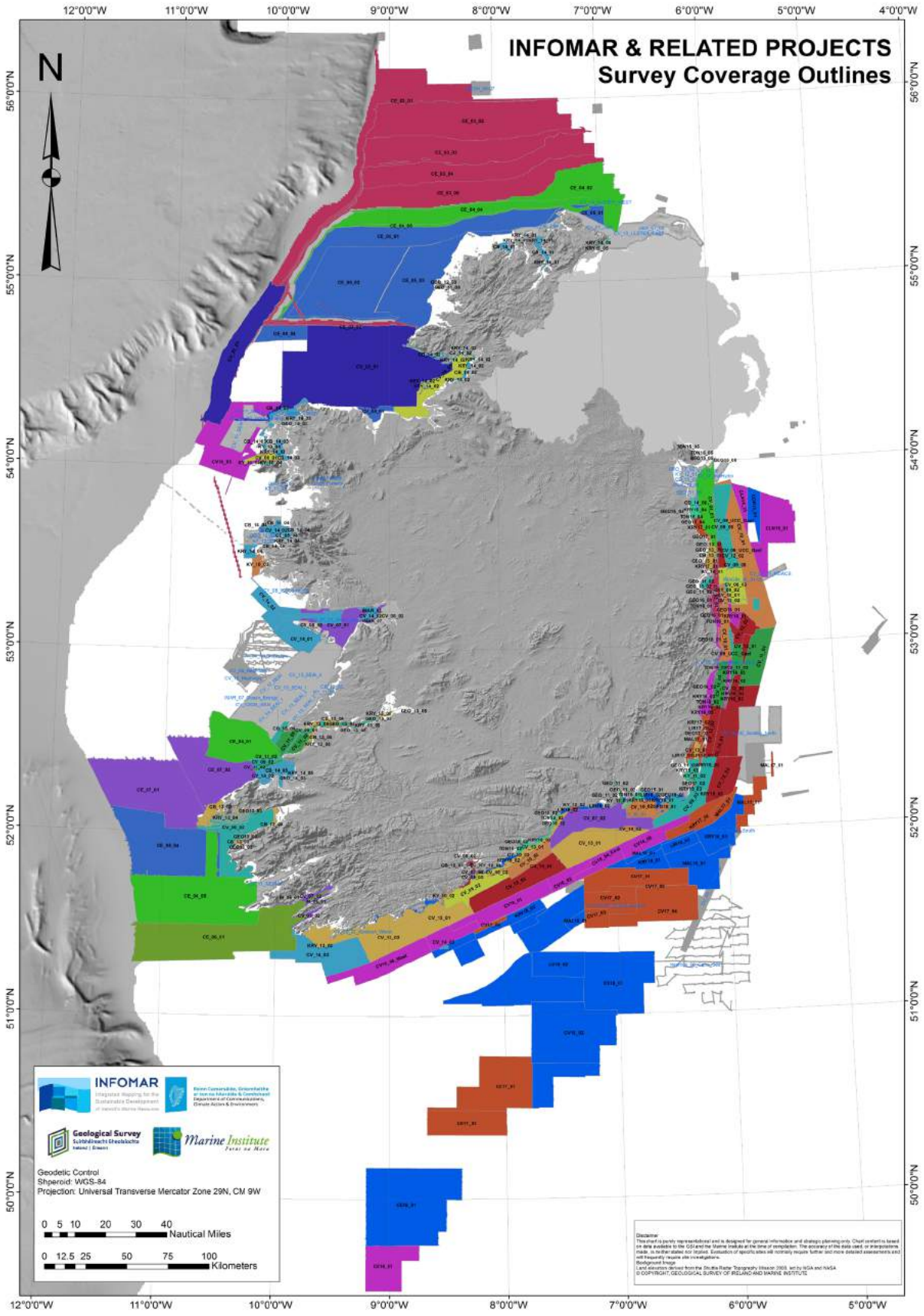


Figure 51. INFOMAR survey coverage 2018

Action 24

Strengthen the collation of marine socio-economic data to ensure the timely availability of marine socioeconomic statistics, providing an evidence base for policy and decision-making, economic forecasting and scenario planning.

Irish Maritime Transport Economist

The 15th edition of the Irish Maritime Transport Economist (IMTE) was published by the Irish Maritime Development Office (IMDO) and launched in April 2018. The publication is a reference text for the maritime industry, which tracks the development of shipping and ports in the context of the overarching national and international factors that influence trade volumes. Total volumes through Irish ports reached record highs in 2018, pointing to the role played by Irish ports as enablers of economic growth. The information contained in the IMTE informs policy in the shipping and ports sectors and was valuable in the analysis of Brexit impacts on the Irish port and shipping sectors.

Figure 52. Irish Maritime Transport Economist, IMDO 2018

Port Capacity Study

In 2018, on behalf of the Department of Transport, Tourism and Sport, the IMDO commissioned a report into the capacity of the Irish ports network. This important study addresses a need identified in National Ports Policy to reassess the capacity of Irish ports from 2018. It is a timely contribution to the debate on the preparedness of Irish ports to meet the challenges of Brexit. The research is also identifying obstacles that could hinder the ports in the vital role they will play in enabling future economic development.

Landbridge Report

The IMDO, working in collaboration with NUI Galway, published a study dealing with the Implications of Brexit on the Use of the Landbridge. The report sheds light on the volume of traffic moving through Irish ports to access EU markets via Great Britain. The report informs ports about the challenges and opportunities and makes a valuable contribution in preparing for Brexit.

The study was commissioned by the Department of Transport, Tourism and Sport in recognition of the strategic importance of the 'UK Landbridge' to the Irish economy and the potential for customs or border controls, resulting from Brexit, to undermine the competitiveness of Irish importers and exporters in accessing the single market. The 'UK Landbridge' describes the movement of Irish imports and exports between Ireland and the European continent via the UK roads and ports network.

The report addresses two specific questions:

1. What is the annual volume of traffic using the UK landbridge?
2. How does the sensitivity of demand of shipping companies for transport services vary, and how does this affect their decision to avail of landbridge or direct services to the European continent?

The report also proposes seven recommendations to mitigate against any negative impacts of Brexit on Irish economic sectors and transport routes. The full report is available on www.imdo.ie

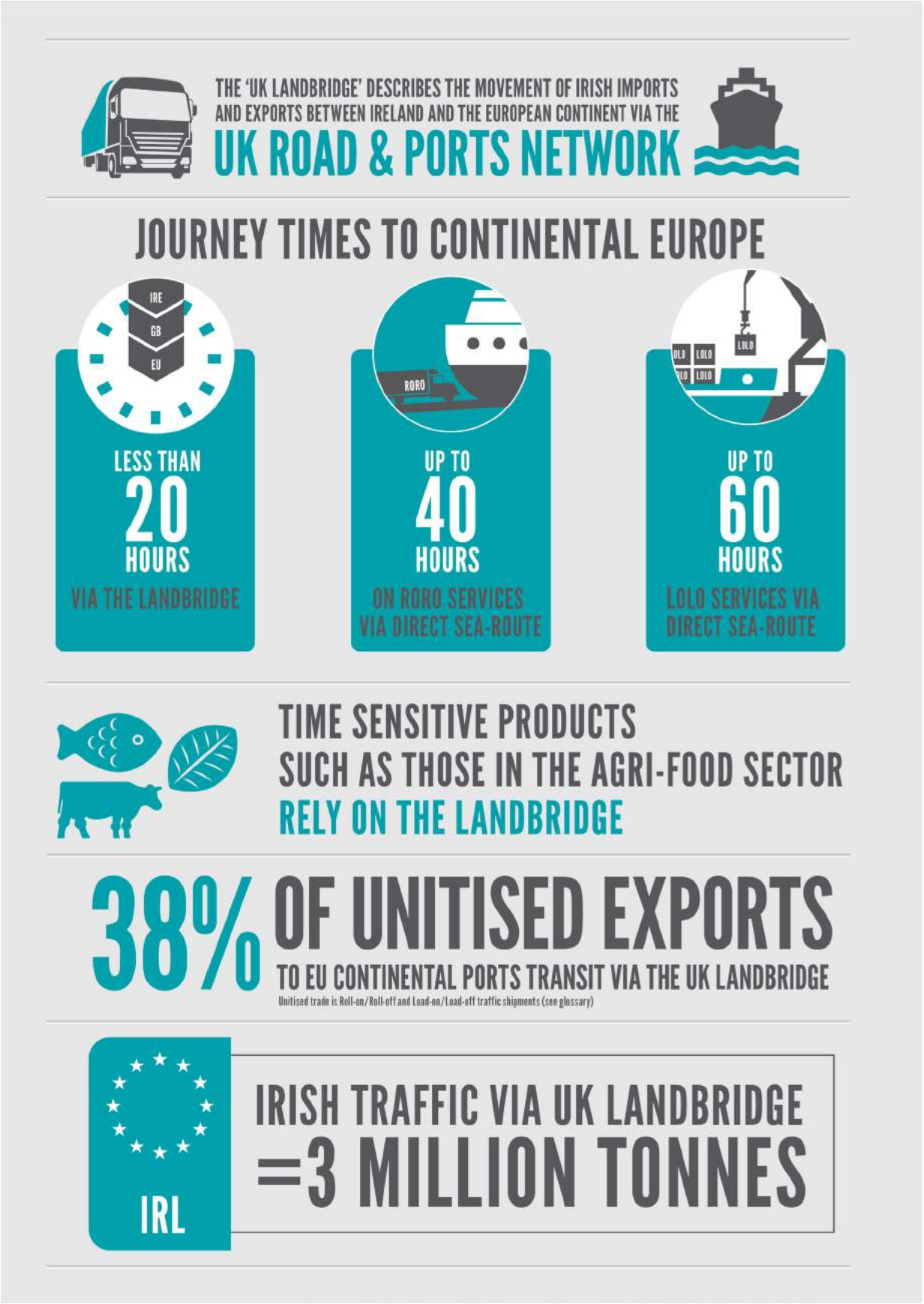


Figure 53. 'Implications of Brexit on the Use of the Landbridge', IMDO, 2018

Building Ireland's Marine Socio-Economic Research Base

Ireland's Ocean Economy

NUI Galway's Socio-Economic Marine Research Unit (SEMRU) released its latest update on Ireland's Ocean Economy in early June 2018 as part of their ongoing process of collection and analysis of marine socio-economic data in Ireland. The updated statistics were launched by Minister Creed at the 2018 Our Ocean Wealth Summit. The figures 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. The 2017 estimates also suggest that Ireland's 'blue economy' continues to grow at a faster pace than the general economy. SEMRU are carrying out their annual survey of businesses in the emerging sectors in 2018/2019 for inclusion in their 2019 update for Government. SEMRU will publish their next Ocean Economy report at the Our Ocean Wealth Summit in Cork.

An update is available under Section 2

A Regional and Rural Analysis of Ireland's Ocean and Coastal Economies

A research project looking at a regional and rural analysis of Ireland's ocean and coastal economies commenced in 2018. Funded under the Marine Institute Cullen Fellowship, the NUI Galway research will provide spatial distribution of marine businesses/maritime clusters in Ireland, including regional and rural distribution at various spatial scales (rural, county, and regional). It will also look at potential rural and regional impact of projected growth scenarios for the sectors as outlined in Ireland's Integrated Marine Plan – Harnessing Our Ocean Wealth.

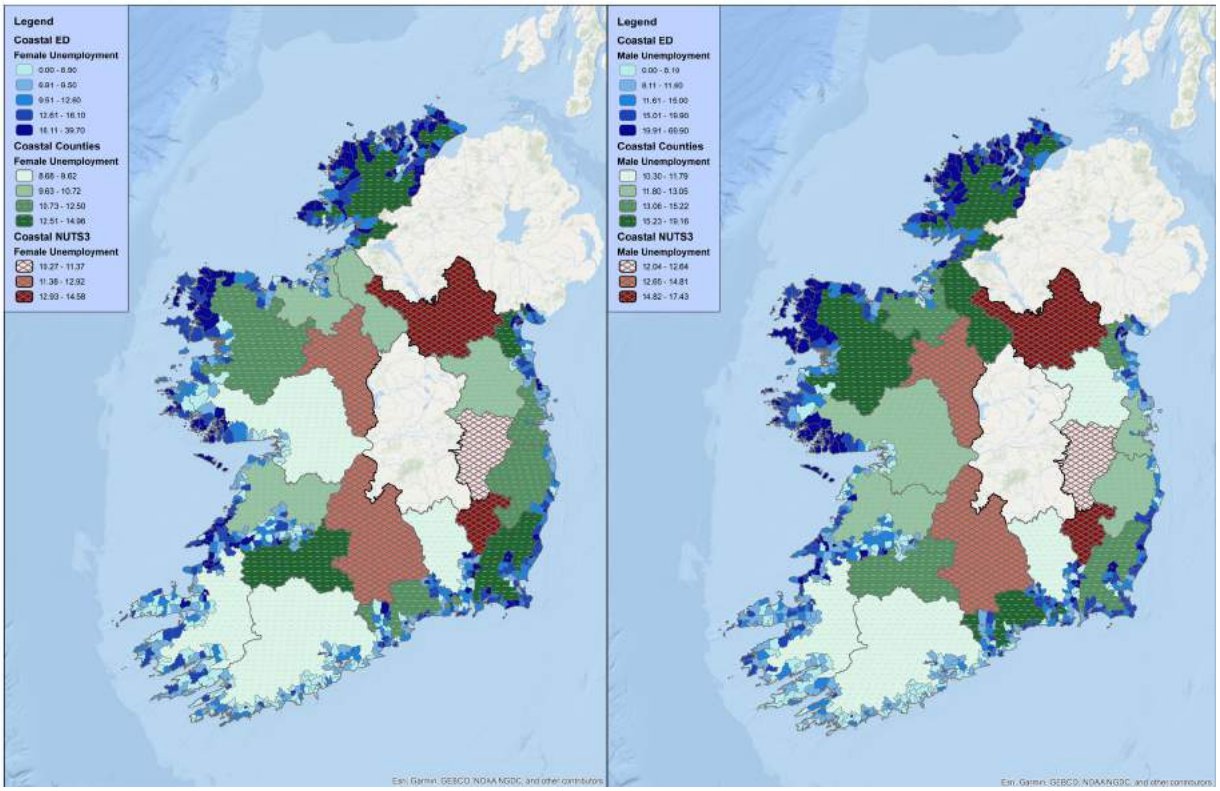


Figure 54. Male and Female Unemployment Rates at the Coastal ED, County, and NUTS3 spatial scales, maps courtesy of Ryan Burger, Cullen Masters Student, SEMRU, NUI Galway, 'Ireland's Ocean Economy Report', 2019

An analysis of the market for coastal and marine based tourism and leisure in Ireland

As part of the Marine Institute funded project 'Valuing and Understanding the Dynamics of Ireland's Ocean Economy', SEMRU at NUI Galway carried out in 2018 a survey of foreign visitors to Ireland. The survey aimed to examine what proportion of the visitor's holiday was spent in coastal areas and what proportion was spent in undertaking marine related activities. The contribution of the 'coast' and 'marine' to total overseas tourism expenditure was estimated based on interviews with over 600 overseas visitors. The spatial distribution of where overseas tourists are undertaking their different marine related activities was also investigated.

Key international tourist markets for Ireland, including the UK, North America, Germany, France and Italy were represented in the sample. In the study, the most popular marine related activities amongst the sample were walking/running along the coast/beach/cliffs, coastal sightseeing, beach or seaside trips and island trips. The most popular water-based activities were sea swimming, sea angling and recreational boating of different types.

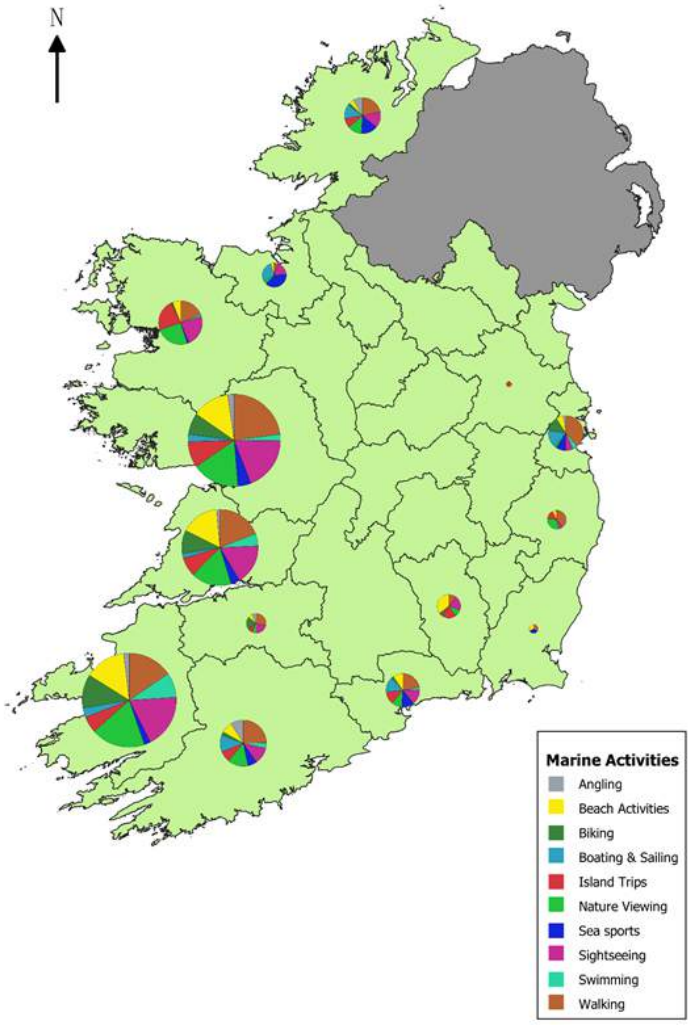


Figure 55. Overseas tourist marine activity by coastal county. Results of SEMRU visitor survey 2018. Source Ireland's Ocean Economy, NUI Galway, 2019

From an expenditure perspective, the contributions of international tourists were observed as very significant to the counties located on the west coast of Ireland in particular. Total coastal spending for overseas holiday makers was estimated to be €1.8 billion which represents approximately 40% of the total spend of tourists visiting Ireland. Moreover, approximately one third of the coastal related spending was on marine related activity. The study found that tourists who are active in marine and water-based activities tend to spend more per trip than overseas tourists in general.

SEMRU have also been conducting a national survey of coastal and marine specific leisure activities and expenditure by domestic residents in order to estimate the total value of marine related activities to all users in Ireland. This work is ongoing and aims to update previous research carried out by the Marine Institute in 2003 that also published the results of a national survey of marine leisure activities.

Action 25

Support existing and new test-beds/facilities for demonstration and commercialisation purposes that promote Ireland as a test-bed for renewable energy technologies and ICT (SmartOcean) focusing on the development of innovative technologies that support real-time information gathering (e.g. for security, surveillance, environmental monitoring).

Atlantic Marine Energy Test Site (AMETS)

In 2018, Sustainable Energy Authority of Ireland (SEAI) commissioned a review of the AMETS site to ascertain if the site remained viable for testing for wave technology given that no technology has reached sufficient readiness level to test there. The review found that the conditions for which the site were chosen were still relevant for full scale TRL 9 testing of wave technologies, however, it confirmed that there was still no technology able to test to this scale within a feasible timescale (i.e. within the next 2-3 years). TRL (Technology readiness level) 9 is defined as the actual system is proven in an operational environment.

The review recommended that SEAI consider extending the use of the site to allow for testing of other emerging technologies including floating offshore wind. SEAI applied, as part of a consortium, to Interreg NWE for funding for a project called AFLOWT to explore options to install a floating wind device at AMETS. The project was awarded in October 2018 and will commence in early 2019.

Galway Bay Marine and Renewable Energy Test Site

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. The lease also 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 in compliance with site specific conditions, the test site was commissioned in July 2018 with four new cardinal marks deployed at the test site. These marks delineate the test site for mariners, marking out the full area of the site which will be used for testing a variety of marine devices and equipment.

Within the 550 metre x 670 metre test site there are three berths for scaled ocean energy devices, as well as an area set aside for the underwater observatory. The SmartBay instrumented buoy and the waverider buoy were deployed also; these form part of a suite of the permanent equipment available for use by technology developers who are accessing the site.

Promoting the Galway Bay Marine and Renewable Energy Test Site

Over the 2018 period, the Marine Institute worked closely with Sustainable Energy Authority of Ireland (SEAI), IDA Ireland, Enterprise Ireland, and SmartBay Ireland to promote Ireland's world-class expertise, small and medium-sized enterprises (SMEs) and multinational clusters and networks, R&D capabilities and infrastructure, to global marine and maritime companies.

Highlights for 2018 include:

- The Marine Institute, SEAI and SmartBay Ireland hosted a Marine Acoustic Workshop and networking event in February 2018 in Galway. The workshop focused on the SEAI funded Acoustic Project ongoing in Galway Bay since 2011. The workshop also highlighted developments and milestones in marine acoustics in Ireland over the last decade and facilitated the interaction and networking of a variety of stakeholders including acoustic experts from academia, industry and government. Demonstrations of technology developed for Galway Bay, as well as acoustic research carried out under SmartBay Ireland's National Infrastructure Access Programme, also featured.

- SmartBay Ireland continue to work closely with SEAI and the Marine Institute to maintain a live pipeline of developers who wish to access the SmartBay Marine and Renewable Energy Test Site in Galway Bay to test and verify technologies. Developers are supported through applications to various national and transnational access programmes (National Infrastructure Access Programme, Interreg, and OCEANERA-NET Cofund) to secure funding to the test site. In 2018, 13 projects secured funding to utilise the test site; four through the EU Horizon 2020 Jerico-Next Project (Joint European Research Infrastructure for Coastal Observatories), six with the EU Interreg funded FORESEA Project (Funding Ocean Renewable Energy through Strategic European Action), and three via the EU OCEANERA-NET joint funding programme.

- SmartBay Ireland attended the WaTERS (Wave and Tidal Energy Research Sites) Workshop in 2018. WaTERS is a global network of open-water test sites which aims to identify common challenges and collaborative opportunities for test centres, enabling knowledge-sharing and avoiding needless duplication of effort and resources. The meeting was designed to connect the expertise from a number of knowledge hubs and wider industrial organisations to support the development of multidisciplinary knowledge within the ocean energy sector.

- Irish Test Facilities were also promoted in 2018 at the Asia Wave Energy Technology Conference and the World Ocean Council Sustainable Ocean Summit (SOS) to connect with potential users from the Asian market.

Galway Bay Underwater Observatory

The underwater observatory is located within the confines of Galway Bay and the SmartBay Marine and Renewable Energy Test Site, 1.5 km offshore in water depths of approximately 21 metres. The facility includes a fibre optic data and power cable allowing 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 May 2018 and was redeployed in July 2018, coinciding with the commissioning of the test site.

The observatory facility is a regional node of EMSO (European Multidisciplinary Seafloor and water column Observatory). Further details on EMSO are available under International and North/South Cooperation.

National Infrastructure Access Programme (NIAP) 2018

In December 2018, the Marine Institute launched an open call for applications under the SmartBay National Infrastructure Access Programme. The fund enables both higher education institutions, industry and other relevant organisations to access the SmartBay Test Site. Applications are invited for projects that require funding to access the facility or its data feeds to carry out scientific research and/or technology development requiring the test, demonstration and validation of novel sensors, equipment, materials, coatings and data products within the marine environment.

Grant aid in the region of €150,000, is expected to fund five to eight awards to research teams through a national competitive process.

Leveraging EU Funds

SmartBay Ireland have successfully leveraged a number of EU funding programmes aimed at providing access to the Galway Bay Test Site.

The €2.5 million Blue-GIFT (Blue Growth and Innovation Fast Tracked) has been funded by Interreg Atlantic Area Programme. Utilising test sites across Europe, the project aims to implement a coordinated ocean energy technology demonstration programme that encourages longer term demonstration and technology de-risking across the Atlantic Arc regions.

The Ocean DEMO Project, funded through Interreg North-West Europe, was also awarded in 2018. The project provides funding to developers of marine renewable technologies to test their products or services in real sea environments. Ocean DEMO specifically targets multi-machine ocean energy installations. This will allow developers to move closer to market by demonstrating arrays and array enabling technologies. Ocean DEMO will release a first call for applications in 2019 and devices will be installed from 2020 to 2022.

The SmartBay Test Site is also included in the ResouceCode OCEANERA-NET project which brings together an international consortium of businesses and test sites supported by established academic partners that seek to increase the competitiveness of wave and tidal energy across Europe. The project is co-funded by the Sustainable Energy Authority of Ireland.

SPHORCIS, an OCEANERA-NET project led by Spanish company SmallE Tec, secured in excess of €111,000 to further develop their small wave energy converter Forcis. The company intends to access the SmartBay Test Site for validation of the prototype.

Figure 56. ILV Granuaile deploying the cardinal marks at the SmartBay Test Site. Photo courtesy of SmartBay Ireland (Aerial footage www.kevlsmith.com)

Capacity, Education, Training & Awareness

A skilled and experienced workforce that adapts to changing requirements and new opportunities is essential for developing indigenous Irish industry, attracting foreign direct investment and providing efficient public services

- Harnessing Our Ocean Wealth

Photo courtesy of Andrew Downes, Xposure

Capacity, Education, Training & Awareness

Action 26

Plan for the appropriate human resources to be in place to efficiently and effectively meet the current demands and capture the future opportunities in relation to our ocean wealth.

Action 27

Maintain and build capacity (people) to meet the needs of the maritime sector; e.g. through tailored education and training programmes and research capacity building.

Promoting Maritime Careers

The Irish Maritime Development Office (IMDO) works with stakeholders in the maritime industry to promote careers in the sector. Through the Irish Seafarers Education Assistance Scheme, the IMDO, working with the shipping industry, funded 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 provided on board training for Irish cadets, over 80 of whom graduated from the NMCI in 2018.

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

More generally, the IMDO uses its market presence and website to promote maritime related career opportunities and to showcase the success that Irish seafarers have had in this global industry.

National Maritime College of Ireland

The National Maritime College of Ireland (NMCI) continues to educate and train high quality professionals for the global maritime industry. In 2018, NMCI graduated 133 new professionals and 394 students were enrolled across the College's four flagship dual academic-professional qualification programmes; Nautical Science, Marine Engineering, Marine Electrotechnology, and Supply Chain and Transport Management. NMCI offers 11 academic and/or professional programmes targeting maritime, supply chain and Irish Defence Forces professionals. Successful graduates from these courses achieve academic awards ranging from level 6 to level 9 and/or the award of professional qualifications under the STCW convention. NMCI also provides a diverse range of complementary maritime and offshore education, training and consultancy services both in Ireland and overseas. In 2018, NMCI delivered courses to 1,910 maritime professionals from all over the world, generating revenues of €1.5 million. Toward the end of 2018, NMCI secured the first of its Global Wind Organisation approvals enabling it to train professionals for the offshore wind industry and adding to its existing list of approvals that includes OPITO, the Irish Maritime Administration, the Maritime Coastguard Agency of Great Britain and Northern Ireland, the Irish Water Safety Council and Irish Sailing.

The College's maritime research and innovation unit, the Halpin Centre for Research and Innovation was involved in 10 international research and innovation projects spanning the areas of Learning Development, Maritime Safety, Security and Defence Operations (with the Irish Naval Service), Blue Growth and Maritime Mechatronic Engineering, and Design and Innovation. During 2018, NMCI also successfully transitioned from the ISO9001:2008 quality management system to its successor ISO9001:2015.

Addressing Skills Gaps in the Seafood Industry

Through its Skills Development Strategy 2018-2020, Bord Iascaigh Mhara (BIM) is addressing the skills gaps to ensure the catching, aquaculture, processing and seafood retail sectors will have a pool of talented, professional and ambitious individuals to draw from. While BIM currently offers a variety of training courses, there is scope to broaden the skills and training portfolio for the marine industry. In recognition of this, BIM has identified a wide range of additional skills to attract new entrants, upskill those already working in the industry, develop graduates of the sector and support industry executives and future leaders.

In May 2018, BIM and Cork Education and Training Board (CETB) agreed a memorandum of understanding to develop a comprehensive skills and training programme for the seafood industry. The partnership with CETB is a natural fit complementing BIM's National Fisheries College in Castletownbere and its Seafood Innovation Hub in Clonakilty, with CETB's experience in further education and training supporting a range of BIM's new skills and training programmes.

Existing programmes are offered through a calendar of events, provided around Ireland through the National Fisheries Colleges of Ireland in Castletownbere, Co. Cork and Greencastle, Co. Donegal; two mobile coastal training units; and on-site at client's premises as required.

International events, reference visits and learning opportunities are also part of the programme – a BIM facilitated visit to Singapore took place as part of BIM's '*Horizon*' Leadership Programme in 2018 (see below).

In an effort to attract young talent into this area and to facilitate those gearing up to enter into the sector, 'point of entry' courses are being designed and implemented at present and these will compete effectively for both secondary school leavers and recent college graduates. New traineeships, cadetships and apprenticeships are also being carefully constructed to offer relevant, industry-based, structured training and providing an appropriate third-level qualification, designed to ensure equivalence in the wider, post-school training environment of modern Ireland. Career progression will be clearly mapped out in order to allow those operating within the industry to achieve their true potential.

Also in 2018, BIM has developed a Skills Communication Strategy, with the aim of creating enhanced, targeted and appropriate promotion of the skills offering, essential in a changing environment, with greater career options available.

Seafood Sector Management and Leadership Development Programmes

In line with BIM's Strategy 2018-2020, two new programmes aimed at management and leadership development in the seafood sector were introduced in 2018, namely Horizon and Propel.

Horizon – Leadership Development Programme

BIM's Horizon Programme is a leadership development programme designed to deliver advanced business and leadership training to the seafood sector.

Targeted at future industry leaders – those who have vision, are passionate about the industry and demonstrate strong leadership skills and entrepreneurial spirit – this supported leadership training aims to:

- Build business acumen to provide the seafood sector with the tools to build scale and profit;
- Increase business and industry professionalism and sophistication to support the sector in achieving its full potential; and
- Create a platform for industry-wide conversations to share information, create stronger connections and support complex problem solving.

BIM is delivering the programme in partnership with the International Institute for Management Development (IMD), a top-ranked business school with campuses in Switzerland and Singapore.

The first programme launched in September 2018 with nine participants from the catching, aquaculture and seafood process sectors. The programme commenced with a two day workshop in October that included a case study on a multi-national seafood company, a discussion on industry issues and an introduction to leadership skills and personal development. In November 2018, BIM facilitated participation in the IMD Orchestrated Winning Performance programme in Singapore. This programme focused on upskilling with discussions centred on company growth. The visit also provided participants with an opportunity to network with 120 business professionals from 25 countries.

Throughout the four stage programme participants are involved in a coaching and mentoring process. This mentoring offers participants an opportunity to develop their personal skills, understand their own leadership styles and use learnings to grow their organisations.

The final workshop in the initial programme will take place over two days in April 2019 providing case studies on leadership, driving growth and sustainability with guest speakers to address the group.

Propel – Management Development Programme

BIM's Propel Programme is a management development programme which will provide a platform to develop and support industry management. The programme was launched in August 2018 with 14 companies representing all areas of the seafood sector participating.

Figure 57. Stages in the four-step PROPEL Programme

The Propel Programme is targeted at senior management within the seafood industry and aims to give them the tools to create and maintain stable, sustainable and profitable businesses.Each participant on the programme benefits from a Business Diagnostic Session with BIM and its strategic partner Grant Thornton. The diagnostic session will provide an in-depth analysis of challenges unique to each individual business focusing on six core areas:

1. Finance Transformation
2. Operational Excellence
3. Strategic Support
4. Innovation
5. Sustainable Development
6. Skills Development

Following the diagnostic review each participant will receive a bespoke report detailing areas where they can enhance their performance across four main areas:

1. People
2. Processes
3. Systems
4. Environment

In addition, the programme will run a number of group workshops to facilitate peer learning around key challenges facing the industry.

The programme is advancing with companies at the implementation stage at the end of 2018. This first programme will be completed by April 2019. BIM will commence the next Propel programme in June 2019 with significant expressions of interest received in advance.

Figure 58. Pictured at the launch of the Propel programme during the first of four promotional workshops around the country in May and June 2018 are industry representatives and BIM personnel with Padraig Ryan and Brendan Foster, Grant Thornton and Jim O'Toole, CEO BIM. Photo courtesy of BIM

National Fisheries Colleges of Ireland

In 2018 BIM provided 1,609 training places to seafood industry workers through the BIM National Fisheries Colleges of Ireland (NFCI), Greencastle, Co. Donegal and Castletownbere, Co. Cork and at 10 fisheries locations via the BIM Coastal Training Units. This represented 928 individuals completing one or more course.

BIM's nationwide safety programme, focusing on small fishing vessels less than 15 metres, delivered 378 Basic Safety Training Cards to skippers and crew. In addition, 253 Personal Flotation Devices with personal locator beacons were provided to industry. Undertaking this training helped the industry to meet requirements for the Department of Transport, Tourism and Sport Code of Practice that sets safety standards and protection for all persons on board vessels.

BIM Seafood Industry Training, 2018:

- Department of Transport, Tourism and Sport (DTTAS) Certificates – 169
- Safety at Sea – 1,258
- Global Maritime Distress and Safety System (GMDSS) Radio Communications – 89
- Quality and Qualifications Ireland (QQI) Certificates and Skills Training – 93

A purpose-built commercial diving decompression chamber and support facilities were commissioned in NFCI Castletownbere to provide Commercial Diver Training. These provide facilities for two QQI Level 6 Awards on the National Framework of Qualifications for Commercial SCUBA Diving Operations and Surface Supplied Diving Operations (Inshore). The first courses were run in October and November 2018 respectively. BIM's Surface Supplied Diving (Inshore) course trains divers to work with an air supply from the surface that allows the diver to spend more time and to carry out more difficult tasks underwater. Given these advantages many roles on a fish farm are best performed with the use of surface supplied diving equipment. In addition to the aquaculture industry, qualified divers can find work with most marine civil engineering projects and with experience and additional training divers can operate in the offshore diving industry.

Higher Diploma in Aquabusiness

The first students of BIM's Higher Diploma Business in Aquabusiness graduated in November 2018 having completed a year of part-time study. In all, eight students from across the seafood sectors including finfish, shellfish and seaweed were awarded this Level 8 QQI qualification. BIM's Aquabusiness course was developed as part of its new training strategy and aims to meet industry needs by providing higher skills training in aquaculture. The course is run in conjunction with the Institute of Technology Carlow, Wexford Campus and with support from the Irish Farmers Association (IFA) Aquaculture and industry stakeholders.

Upskilling Processors

BIM's new training programme for Fishmongers commenced in 2018. The seven day programme is run over a three month period and is aimed at new entrants working in independent fishmongers and on fresh fish counters in supermarkets. Participants were trained in technical fish filleting skills and quality assessment techniques as well as seafood nutrition, culinary skills and food safety.

Four seafood Hazard Analysis and Critical Control Point (HACCP) workshops were delivered regionally by BIM's food safety team. These practical workshops gave participants an overview of food hygiene legislation and an opportunity to develop a food safety management system based on HACCP principles tailored for their own business. Fifty-five participants representing the processing, retail and aquaculture sectors attended the workshops.

BIM delivered two fish quality assessment training courses in 2018 during which participants were trained in fish quality assessment techniques using the Torry and Quality Index Method (QIM) assessment schemes. These schemes are recognised globally as the most effective means of objectively assessing fish quality and determining remaining shelf-life. This programme is run in collaboration with Seafish (UK).

BIM also delivered a wide range of short training programmes and workshops to the industry, including fish handling and filleting, food safety induction and seafood labelling in the period under review.

Increasing the Visibility of Women in Ireland's Seafood Industry

BIM launched a promotional campaign to profile the important role women play in Ireland's seafood sector in the lead up to International Women's Day 2018 on 8 March.

The Irish seafood sector contributes over one billion to Ireland's GDP each year. However, women's participation in the industry remains low. Just over one in ten (11.7%) employees in fishing, forestry and agriculture sectors in Ireland is female. This is significantly lower than the EU average of 36.9%.

BIM recognises its role in supporting and encouraging greater female participation in industry to capitalise on the talents of women in the wider sector. In addition to training and mentorship, BIM is also working with women across the catching, aquaculture, processing and retail industries to develop a network to share information and ideas that will further progress and elevate their role.

BIM's promotional campaign tells the stories of talented women in a variety of roles through a series of podcasts. The aim of the campaign is to increase the visibility of women in the sector and celebrate their contribution to this valuable industry.

BIM has worked closely with the catching sector in particular. Many women in this specific sector work behind the scenes managing the accounts for fishing businesses or as the key communicators and fishing representatives in their fishing communities.

In addition, BIM has formed partnerships with International Women's Groups to gain insights into how they have developed effective networks, including the Women in Seafood Australasia (WISA). Building on this partnership, a delegation from WISA headed by Leonie Noble, WISA President, visited Ireland during 2017 to meet with women from the Irish seafood sector and BIM.

In early 2018, Jayne Gallagher, WISA director, facilitated a capacity building workshop to further develop the Women in Seafood network and to launch BIM's promotional campaign. Speaking at the event Jayne Gallagher offered:

"It has reinforced to me that even though we are worlds apart in our circumstances and our experiences, we all want our stories to be heard, we are passionate about our industry and we want to have an impact. Working together we can help ensure a viable future for the seafood industry. Ensuring women are recognised and supported in their roles, takes courage and determination and the fledgling network here needs nurturing from its members and its stakeholders to maximise its impact and potential for the wider seafood industry".

Irelands Women in Fisheries Network made a return visit to attend the annual WISA conference in Australia in October 2018. This visit was part funded by BIM under the European Maritime and Fisheries Fund (EMFF) and Australia's Fisheries Research and Development Corporation. Both groups discussed commonalities and differences in terms of the UN Sustainable Development Goals (USG) with a focus on SDG 5, Gender Equality, and SDG 14, Life Below Water. These goals provide a common language to global citizens on the benefits of diversity in leadership, objectives for sustaining coastal and island families, and protecting the marine environment.This international networking is ongoing through social media, amongst other channels, with future knowledge exchange visits in planning.

Figure 59. Pictured at the inaugural WISA conference in October 2018 in Australia were the delegation from Ireland's Women in Fisheries Network, BIM representatives and Women in Seafood Australasia. Photo courtesy of BIM

Action 29

Embed knowledge of our ocean wealth into the primary and secondary curricula;

- Explore the potential to rollout existing pilot programmes (e.g. Explorers' Programme and Follow the fleet) across the primary school network; and
- Consider options for the inclusion of marine studies in the secondary school curriculum.

Explorers Education Programme – Teachers and Students Engage with Marine Subjects Joining the Wave in Ditching Plastics

The Marine Institute's Explorers Education Programme, now running for over 13 years, continued to deliver its marine themed modules to schools around the coast of Ireland reaching up to 13,000 students in 2018. The Explorers outreach team provided an important platform for teaching marine themes in the classroom and further helped to support and reconnect teachers and their students with the marine environment. One of the strengths of the Explorers Programme is that there is a strong focus on engagement and ensuring the learning experiences are shared amongst the children, school and local communities.

2018 saw the Explorers teams highlight the impact of plastics in our oceans through science and art projects. The team also introduced the theme of marine biodiversity in the class and completed over 200 seashore safaris. The Explorers team attended over 18 events at the EU, national and local level including the European Science Educators Association event (EMSEA), SeaFest 2018, the National Ploughing Championships, and the Galway and Mayo Science and Technology Festivals. The Explorers also attended FÉILTE 2018, the Teaching Council's annual Festival of Education in Learning and Teaching Excellence, held at Mary Immaculate College in Limerick. This event highlighted some of the work teachers have been doing to include marine concepts in their cross-curricular teaching.

The Explorers team worked with over 500 teachers in schools as well as through teachers training workshops supported by the ATECI (Association of Teacher Education Centres Ireland) 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 over 200 pre-service teachers at Dublin City University highlighting how marine themes can be easily incorporated in the national curriculum.

The Explorers Education Programme reaches Donegal, Sligo, Mayo, Galway, Clare, Kerry, Cork, Waterford, Wicklow and Dublin and the teams include Leave No Trace, Galway Atlantaquaria, Loop Head Summer Hedge School, Sea Synergy, Lifetime Lab, Oceanic Surf School and Marine Education Centre, and Marine Dimensions. The programme also provides over 100 free lesson plans (via www.explorers.ie) which support the national curriculum. As part of the Explorers Education Programme class visits in 2018, up to 5,000 children in 5th and 6th class took part in two ocean literacy questionnaires. Student knowledge based on this questionnaire showed a strong increase in the children's knowledge, interest and engagement levels after participating in the programme.

'The Life of Plastics – from Cradle to Grave'

Bord Iascaigh Mhara (BIM) developed the fifth in a series of science lessons on marine topics for the 14th Edition of 'Science and Technology in Action' in 2018.

The lesson entitled 'The Life of Plastics – from Cradle to Grave' explains the recycling challenges and opportunities of plastics used by the seafood sector and remedies to alleviate the problem around the Irish coast.

The Science and Technology in Action programme is designed to support the teaching of science and related subjects in second level schools. As a participant, BIM is developing a set of seafood industry-led lessons for second level students with five lessons published to date:

1. Managing our Marine Resources
2. Sustainability in Irish Fisheries
3. Fish Farming and Aquaculture
4. Marine Litter
5. The Life of Plastics – from Cradle to Grave

Barriers and Solutions to Teaching Primary and Secondary Students about the Ocean in Ireland

Two areas of research highlighting the barriers and solutions to teaching students about the ocean in Ireland were completed in 2018.

Research, carried out by NUI Galway, examined the barriers and solutions to teaching primary school children about the ocean in Ireland. Participants in the study included parents of children (aged 6-12 years), educators, media, publishers and state bodies. Following extensive consultation, barriers were voted and ranked. Findings demonstrated the importance of state bodies being active in engaging and shaping social change. However, there was also an indication of a lack of an integrated effort, particularly at the interface of the marine and education sectors, collectively addressing this issue of teaching children about the ocean. A total of 124 solutions were created by the participants, which addressed the categories relating to barriers identified. Proposals included how to build on the capacity of an ocean literacy network in Ireland and the EU; the need for marine stakeholders to collaborate with education decision makers to support the inclusion of marine themes on the curriculum; and establishing teachers and children's values and behaviour towards the ocean.

NUI Galway also conducted a study looking at barriers to teaching 12-19 year olds about the ocean. 'Irish Ocean Conversations', research carried out as part of the EU SeaChange project, generated 128 individual barriers with 60 potential solutions. Sea Change was an EU Horizon 2020 funded project (2015-2018) that aimed to establish a fundamental 'sea change' in the way European citizens view their relationship with the sea, by empowering them, as ocean-literate citizens, to take direct and sustainable action towards a healthy ocean and seas, healthy communities, and ultimately a healthy planet. Full results of the study are available on www.seachangeproject.eu

Irish Ocean Literacy Network Members bring the Ocean into the Secondary School Curriculum in 2018

2018 was an exciting year for IOLN members working with secondary schools around Ireland, introducing the ocean to both teachers and students.

Galway Atlantaquaria formed one of the partners in a Sustainability Workshop for the JCT (Junior Cycle Teachers) STEAM group, which offered continuous professional development for junior cycle teachers. The workshop linked to the new Junior Cycle Science Curriculum. It looked at the connection between biodiversity and food production, examining elements of the cod fishery, quotas, aquaculture and marine protected areas, and how they link to human food supply. A range of workshops on seashore ecology and marine litter were also dellivered to secondary schools on the shores of Galway Bay.

Figure 60. Teachers taking part in the JCT Sustainability Workshop at Galway Atlantaquaria. Photos courtesy of Galway Atlantaquaria

Redrose Developments Ltd formed one of six partners in an Erasmus 'Feed the World 2050' project. As part of the project, Transition Year (TY) students from Our Lady's Secondary School, Belmullet considered how seaweed can be used as a protein source for the future. Exchange work with students in France and the Netherlands has assisted the group in sharing knowledge. Events in the local community have helped raise awareness of the projects and its aims.

Figure 61. Students studying seaweed aquaculture, following the format of the QQI Level 5 award; this involved independent research and peer-to-peer learning. Photos courtesy of Ann Ruddy, Redrose Developments

Leave No Trace Ireland also worked with secondary schools in Co. Mayo on a range of marine related projects, two of which went on to enter the Young Environmentalist Awards 2018. The first looked at recycling textiles destined for landfill, creating products which linked to a marine species. The 'Dugong Drawstring Bag' project won the Eco-Innovation National Award and was featured in local media. The second project, entitled 'Unwrapped' looked at the issue of unnecessary packaging.

Figure 62. Students attending the Young Environmentalist Awards 2018. Photos courtesy of Leave no Trace Ireland

In Kerry, Sea Synergy are working with their local secondary school Colaiste na Sceilge co-creating a Sustainable Development Goal 14: Life Below Water module for TY students as part of an EPA funded project called CoDesRes. Since the opening of Sea Synergy in 2014, the Sea Synergy team have introduced the wonders of Ireland's marine life to over 1,500 youths from all over the world through outdoor workshops and in class presentations on marine life or marine careers. Sea Synergy also brings on board work experience students every year helping them understand what marine careers are available and the benefits of working in a rural coastal community.

Funded by Local Agenda 21 Environmental Partnership Fund, Galway Atlantaquaria and the Irish Whale and Dolphin Group worked together with a number of secondary schools in Co. Galway, on a project entitled 'Dolphins in the Bay'. This project highlighted the issue of marine litter and the ramifications it can have on marine mammal food webs and marine ecosystems. Students' knowledge, interest and actions based around the ocean and responsible waste disposal were evaluated pre- and post-engagement. Results showed an increase in all three areas over the course of the workshops.

Figure 63. Students taking part in 'Dolphins in the Bay' in 2018 in Co. Galway. Photo courtesy of Galway Atlantaquaria

Dingle Oceanworld Aquarium shared their enthusiasm for the oceans with secondary students on the rocky shores of Dingle with the famous 'Fungi' as a backdrop. They delivered both junior and leaving certificate packages based around seashore ecology and adaptations of life on the shore.

SEA LIFE Aquarium Bray has worked for the past 10 years, utilising the TY work experience programme to inspire students to look at the marine sciences. The Aquarium in Bray has recently developed a programme geared to facilitating a greater number of students to learn about the life support systems required to deliver optimal marine animal welfare in an accessible and engaging manner.

Marine Dimensions, who are also based on the east coast, are a community driven enterprise which is dedicated to marine environmental education, research and conservation. Dr Sarah Varian and her team have run a range of marine courses for teens through their ocean school programme, and provide work experience and internships to give young people a feel for working in the marine sector.

Other initiatives include INFOMAR showcasing content on seabed mapping and geographical skills on the Scoilnet (the official education portal of the Department of Education and Skills). Twenty secondary schools nationally also completed the new Global Citizenship Marine Environment Green Flag with An Taisce' Green-Schools Programme. The redevelopment of the junior cycle curriculums provides a wealth of opportunities to engage secondary schools with ocean topics.

Further information on the the Irish Ocean Literacy Network is available under Action 30 and on www.irishoceanliteracy.ie

Science of the Sea through Sailing – ISA and Explorers Pilot

In 2018, Irish Sailing's Cara na Mara programme ran a 'science of the sea through sailing' pilot with primary schools. Supported by the Marine Institute and the Explorers Education Programme, the pilot enabled nine schools and 230 children to learn about sailing and marine science through a series of fun activities at the seashore and on the water.

Four Irish Sailing clubs – Galway City Sailing Club, Howth Yacht Club, Rathmullan Sailing Club and Foynes Yacht Club – were involved with the pilot which offered various fun learning experiences while sailing.

Transition Year Students Dive into Marine Science at the Marine Institute

In 2018, 22 transition year (TY) students from counties Dublin, Meath, Mayo, Galway, Clare and Leitrim spent a week in the Marine Institute headquarters in Oranmore, Galway. The students learned about career opportunities in marine chemistry, fisheries science, marine ecosystems and sustainability, protecting the ocean environment, engineering, technology, food safety, maritime development, oceanography, climate change, data management, marine IT applications development, and science communications. The Institute's TY Training Week has shown an increased demand annually, with the week over-subscribed and places fully booked well in advance.

Students Engage with SEA-SEIS Project

Blogger and writer Daniel Farrell from CoastMonkey.ie joined scientists from the Dublin Institute for Advanced Studies (DIAS) to follow the scientists' activities during a 21 day expedition and report on the deployment of the seismometers via the RV *Celtic Explorer*'s blog Scientist@Sea.

Sponsored by DIAS and the Marine Institute, CoastMonkey provided a unique insight into life on board a research vessel through Daniel's personal blog, film clips and photography. The SEA-SEIS project team engaged with primary and secondary schools while they were at sea through seismometer naming competitions, drawing competitions, as well as composing a rap song. The Marine Institute also provided additional support through the Explorers Education Programme where students followed the expedition, created their own seismometers and got a VIP tour of the RV *Celtic Explorer*. A range of teachers' resources and videos were also made available: https://sea-seis.ie/

Figure 64. Dr. Sergei Lebedev from the Dublin Institute of Advanced Studies and Daniel Farrell from coastmonkey.ie on board the RV Celtic Explorer. Photo courtesy of Coast Monkey

Action 30

Develop outreach programmes that create an awareness of our ocean wealth

SeaFest 2018 Continues to Draw Record Crowds in 2018

SeaFest 2018 attracted over 103,400 visitors to Galway Harbour during the three day event from 29 June to 1 July 2018. At a local level in Galway, it is estimated that SeaFest 2018 generated €6.5 million in direct income for the city's tourism industry. Accommodation, restaurants and other businesses across Galway benefited from the crowds that descended on Galway Harbour over the weekend.

Galway Harbour was transformed for the three day festival with non-stop activities and entertainment for all ages throughout. The public enjoyed performances from world-champion flyboarders in the harbour. Free sailing and kayaking was on offer and Irish Sailing also offered sessions for disabled or impaired children and adults.

Doug Allan, underwater cameraman, presented seven talks over the weekend in the custom built 'Atlantic Theatre', sharing his experiences from filming at some of the wildest and most remote places on the planet. RTÉ documentary '*Ireland's Deep Atlantic*', which shares some of the secrets from the Irish waters, was also screened, as was the Academy Award-nominated Irish animation '*Song of the Sea*'.

Figure 65. Photos from SeaFest 2018. Photos couresty of the Marine Institute

Open tours took place on a number of vessels docked in the harbour, including one of the newest vessels in the Irish Naval Service, LÉ *William Butler Yeats*, the Commissioners of Irish Lights vessel *Granuaile*, the Marine Institute's research vessel *Celtic Explorer*, and pelagic trawler *Girl Stephanie*. Children were entertained in the dedicated Kids Zone with art and craft workshops, touch tank displays and a number of games and interactive activities teaching about marine litter. Galway City Museum's exhibition 'Sea Science – The Wild Atlantic' was open over the weekend with a resident scientist performing hands-on experiments. To celebrate Galway as the European Region of Gastronomy 2018, a range of cookery demonstrations were on offer at the 'Gastronomy Showcase Van'.

A commemoration event was held by the State on the evening of 29 June in Galway Harbour – Life and the Sea – A civic and military service to remember all those who have lost their lives at sea and recognising the heroism of the men and women of Ireland's rescue services.

Key partners that contributed to SeaFest 2018 included: BIM, Bord Bia, Commissioners of Irish Lights, Department of Defence, Galway City Council, Galway County Council, Port of Galway, Irish Coast Guard, Irish Sailing, Marine Institute, and the RNLI. Festival volunteers also played an important role throughout the festival.

Galway businesses, in conjunction with Galway City Council's European Green Leaf programme, supported SeaFest 2018 by adopting actions to reduce single-use plastics for the festival weekend and beyond.

Local, national and international media coverage of the festival also reached record levels. SeaFest 2018 received a 110% increase in media compared to 2017. SeaFest also received a national award during 2018. It was awarded the accolade of 'Best Cultural Event' at the 2018 Event Industry Awards. It was described by judges as 'a great celebration of Ireland's maritime heritage that serves an important cultural purpose.' SeaFest was nominated alongside some of Ireland's most outstanding events and festivals.

Promoting the Irish Seafood Sector at SeaFest 2018

BIM's presence at SeaFest 2018 aimed to make more people aware of what happens in our waters and of how Irish seafood is sustainably produced. BIM took the opportunity to showcase the great efforts the men and women in the industry are taking to protect Ireland's marine environment and to develop the industry as a global leader in sustainably sourced seafood.

The MFV *Girl Stephanie*, the 45-metre pelagic trawler, was moored at Galway docks throughout the three day National Maritime Festival. Young skipper Tomás Conneely and his crew of six were on hand to welcome visitors on board his family owned fishing vessel. This marks Tomás' first season as skipper of this large fishing vessel that is used to catch fish including herring, mackerel and blue whiting. The pelagic fishing season typically runs from October until April each year and *Girl Stephanie* is just one of 23 such vessels in Ireland.

Bord Iascaigh Mhara's Taste the Atlantic ambassador, Joan Mulloy sailed to the SeaFest event in her Figaro yacht which was lifted out of the water and also open to visitors to tour. Joan Mulloy is the first Irish female to compete in the famous Solitaire du Figaro yacht race in France.

Other highlights at SeaFest included an immersive virtual reality experience where visitors had the opportunity to plunge to the oceans' depths and learn about fish that are caught and farmed around the coast in Ireland. BIM's exhibits concerned the growing global issue of marine litter, and some of the initiatives, including Fishing for Litter, that the fishing sector and local community groups in Ireland are participating in. The weekend's entertainment also included the BIM/Bord Bia Seafood Experience, which featured dynamic exhibits of live fish and shellfish species, live cookery shows with some of Ireland's top chefs, and a series of demonstrations on how best to shop for and prepare Irish seafood.

Figure 66. Skipper Tomás Conneely on board the MFV 'Girl Stephanie' at SeaFest in Galway Harbour

Aquaculture Remote Classroom Unveiled at Our Ocean Wealth Summit

Minister for Agriculture, Food and the Marine, Michael Creed TD officially launched the Aquaculture Remote Classroom (ARC) at the Our Ocean Wealth Summit in Galway in June 2018.

Using Virtual Reality (VR) headsets, attendees were able to plunge to the depths' of the ocean to experience and learn about the environment in which salmon and mussels are farmed in Ireland.

Students will be able to actively learn about how fish is produced and farmed when the new Aquaculture Remote Classroom (ARC) begins visiting national schools throughout Ireland from September 2018 onwards.

ARC is being funded by the European Commission and forms part of the wider Farmed in the EU campaign, a European Commission led initiative to promote aquaculture in Europe.

Figure 67. L-R Felix Leinemann, Head of Unit for the Blue Economy Sectors, Aquaculture and Maritime Spatial Planning at the European Commission, Jim O'Toole, CEO BIM, Michael Creed TD, Minister for Agriculture, Food and the Marine, and Kieran Calnan, Chairman BIM at the launch of the Aquaculture Remote Classroom at SeaFest 2018 in Galway. Photo courtesy of BIM

Figure 68. Sadhbh Hendrick and Deanna Dooley enjoying the ARC headsets as SeaFest 2019 comes to a close in Galway. Photo courtesy of BIM

Figure 69. An Taisce Green Schools marine factsheet. Source: Department of Housing, Planning and Local Government

Irish Coast Guard

The Irish Coast Guard (IRCG) places great importance on prevention as an important strategy in reducing loss of life at sea and its most recent campaign focused on a safety message, emphasising the importance of retaining the ability to stay afloat, coupled with a capacity to raise the alarm utilising the theme 'Stay Afloat – Stay in Contact'. This safety message was promoted at school visits, safety demonstrations, etc. Volunteer Coast Guard units conducted water safety campaigns by visiting primary schools in their areas in the lead-up to summer school holidays and by attendance at festivals and other events. In addition, Coast Guard Volunteer Boat Units completed compliance monitoring patrols around the coast, encouraging water users to wear a personal floatation device as well as provision of safety advice.

The IRCG also conducted search and rescue demonstrations around the coast and, each year, focuses on a high-profile exercise to promote safety on the water. In June 2018, a multi-agency exercise (IRCG, Dublin Fire Brigade, and Irish Lights) was held off Galway Bay. The purpose was to exercise the insertion of a Dublin Fire Brigade Marine Emergency Response Team (MERT) into an offshore vessel that had declared an emergency. IRCG participation included:

- Dedicated desk at the Marine Rescue Sub-Centre (MRSC) Valentia
- Exercise coordinator on board the Irish Lights vessel *Granuaile*
- Shannon and Dublin based helicopters
- Exercise controller at Shannon

The exercise was extremely successful and all key tasks and timings were achieved.

Figure 70. Multi-agency search and rescue exercise held in Galway Bay in June 2018. Photos courtesy of the Irish Coast Guard

The Irish Ocean Literacy Network

The Irish Ocean Literacy Network (IOLN) creates, maintains and develops an informal network of ocean literacy champions to facilitate the collaboration, sharing and coordination of marine outreach and ocean literacy projects across the island of Ireland. The activities of the group support the three key goals of Harnessing Our Ocean Wealth and also support the UK's Marine Policy Statement in Northern Ireland.

In 2018, the network actively worked towards the vision of achieving an ocean literate society across the island of Ireland. An ocean literate person is described as *understanding the importance of the ocean to humankind, can communicate about the ocean in a meaningful way, and make informed and responsible decisions regarding the ocean and its resources*.

With over 40 members, the network's meetings provide an opportunity for members to network with other individuals and organisations; create and share solutions relating to issues concerning marine litter and the dilemmas of plastic, the ocean and human health; and plan ocean campaigns and marine events. Over the last year, the network has developed its online presence (irishoceanliteracy.ie) and social media platforms on both Facebook and Twitter.

The IOLN were also well represented in 2018 at the annual European Science Educators Association event EMSEA2018, where speakers from Ireland showcased the importance of the Irish maritime community on an international stage. A number of speakers from Ireland, representing marine outreach and higher education institutions, also spoke of the importance of marine education being included on the national curriculum from primary school through to third-level. The IOLN secretariat, funded by the Marine Institute, was awarded to Galway Atlantaquaria in 2018.

Looking towards the Ocean Decade in 2020, the IOLN members aspire to: facilitate collaboration, sharing and coordination of marine outreach and ocean literacy projects; support and grow the network; and provide a platform for engagement with all relevant stakeholders.

Sea Synergy - Marine Awareness and Activity Centre, Waterville, Co. Kerry

In 2018, Sea Synergy engaged with 45 schools and over 1,400 students in the Explorers Education Programme. Some of the schools were so impressed and empowered by the programme that they demonstrated their ocean literacy to their communities in their St Patricks Day Parade floats raising awareness of the ocean and the issues of plastic pollution. Through the many water and nature based activities that the activity centre offers, such as seashore safaris, teacher training, ocean talks, stand up paddle boarding, snorkelling, kayaking and sea camps, in 2018 Sea Synergy introduced over 2,000 people of all ages and nationalities to their ocean conservation concepts.

In February 2018, founder of Sea Synergy, Lucy Hunt, presented at a 'Gaming for the Oceans' event in San Francisco with renowned marine biologist Sylvia Earle. In June 2018, HRH Prince Charles and Duchess Camilla were hosted by Sea Synergy at Derrynane beach to discuss issues of plastic pollution and the education programmes they use to help raise awareness and empower people. Lucy worked with the 2017-18 Volvo Ocean Race managing the sustainability education programme that has been used in over 41 countries and engaged over 100,000 people. Sea Synergy was featured on a Volvo Sky Atlantic short film on sustainability in the home called 'Tide of Change'. Working with nationally funded research groups in coastal communities in projects like CoDesRes Iveragh and SS Net Reuse, Sea Synergy has been able to raise ocean literacy at a local level also.

Sea Synergy has represented Irish ocean literacy at local, national and international level to a very high standard throughout 2018, engaging with approximately 105,000 people of all ages and increasing ocean literacy.

Figure 71. June 2018, Sea Synergy showcase the work they do in Marine Explorers and the Volvo Ocean Race education programme with HRH Prince Charles and Duchess Camilla on Derrynane beach, Kerry highlighting importance of marine education and environmental awareness at a local, national and global level. HRH Prince Charles' parting words to Sea Synergy team: 'You are doing a wonderful job - keep up the good work!'

Ireland's Deep Atlantic Filmmaker Makes a Major Splash

Underwater filmmaker Ken O'Sullivan's two-part documentary 'Ireland's Deep Atlantic' aired on RTÉ in 2018, making a significant mark on raising awareness about Ireland's marine resource with its viewers, reaching a 34% television audience share. Engagement also reached compelling levels through social media, where many noted the filming as a spectacular documentary. Scenes from this footage will become part of the Irish Junior cycle curriculum where students will learn about Ireland's Atlantic Ocean in 2019.

As part of the 'Our Wild Island' series, the documentary saw Ken O'Sullivan embark on a number of voyages in the open North Atlantic Ocean in search of large whales, sharks and cold-water coral reefs. The series was filmed on board the RV *Celtic Explorer* and documented coral reefs 3,000 metres down to the seabed using the remotely operated vehicle *Holland 1*.

Following its airing, O'Sullivan also took the series on a roadshow speaking to the public about his adventures at sea including SeaFest 2018. This included highlighting conservation issues such as marine plastics and sonic pollution; decline in North Atlantic blue fin tuna; the importance of marine research; the value of eco-tourism to coastal communities; the impact of consumption and consumer habits on the marine environment; the notion of sustainable consumer behaviour; and also whale migration in the North Atlantic.

Showcasing the Marine at the Largest Science and Technology Festivals in Ireland

Galway Science and Technology Festival celebrated its 21st anniversary in 2018 where it continues to be the largest one day science event in Europe showcasing the value of STEM in education, reaching over 22,000 visitors and carrying out 200 events in schools throughout the week.

With support from the Galway Explorers Education Programme, the Marine Institute and INFOMAR scientists, the shark-themed stand provided children and their families with an insight into the life of a marine scientist, what seabed mapping involves and how this led to the discovery of the rare shark nursery off the west coast of Ireland. The children also got to see baby sharks and rays as well as hear many fun facts about the shark species around the world. The stand built on the work carried out under the SeaRover survey, a collaboration jointly funded by the Irish Government and the European Maritime and Fisheries Fund, supported by Geological Survey Ireland, Marine Institute, National Parks and Wildlife Service, and NUI Galway.

At the Mayo Science and Technology Festival on the Galway-Mayo Institute of Technology (GMIT) campus, also in November, the Marine Institute hosted an interactive stand, where scientists from the Institute's Newport Research Facility showcased research from one of the world's longest running fish trapping facilities that monitors all movements of fish to and from freshwater.

AerialSparks Making Sounds in 2018

AerialSparks is a four year artistic project exploring the ocean wilderness, marine science and radio communication. Created by visual artist Louise Manifold, the project involves artists, writers and composers that are creating stand-alone art works for radio, that explore radio's relationships with the ocean.

2018 was a very successful year for the project, with the first two artists having taken part in surveys on board the RV *Celtic Explorer*. Irish visual artist Carol-Anne Connolly spent over two weeks in the Mid-Atlantic on a survey focused on the Control of Cold Water Corals, led by University College Cork's School of Biological, Earth and Environmental Sciences (BEES). German sound artist and composer David Stalling joined a three week ocean-bottom seismic and acoustic-sensor survey in the North Atlantic Ocean as part of the SEA-SEIS project (Structure, Evolution and Seismicity of the Irish offshore) earlier in 2018. Curator Louise Manifold also joined the survey on radio wave propagation on the RV *Celtic Voyager*, led by a PhD researcher at University of Limerick's Centre for Robotics and Intelligent Systems, studying the effects of the evaporation duct around Ireland, primarily off Wicklow Head.

The AerialSparks art project has received significant national attention, becoming one of the foremost projects in the European Capital of Culture programme in Galway 2020. Activities in 2018 have paved the way for the next four artists in the project, who will all take up residency on surveys in 2019.

'Sea Science – The Wild Atlantic'

'Sea Science – The Wild Atlantic' is an interactive exhibit that focuses on the wonders of the marine world. The Sea Science gallery is the result of a collaboration between the Galway City Museum, the Ryan Institute in NUI Galway and the Marine Institute. It is Ireland's first marine science gallery and aims to strengthen the engagement of the public with our oceans and show the values and opportunities they provide.

New additions to the gallery in 2018 included a cinematic experience that allows visitors to take the plunge with the Marine Institute's ROV *Holland 1*. Irish deep sea corals and sponges that featured in a search for new medicines have also been placed on display. The Marine Institute have also funded a graduate intern position to work on the gallery through the Professor Mike Williams Memorial Bursary. The graduate intern organises marine themed tours and workshops for the visiting public.

Visual and audio information is provided in both Irish and English. The topics covered range from Irish marine flora and fauna, acoustic seabed mapping, plankton and deep sea exploration. All this information is conveyed to visitors in a fun and engaging way, using a combination of digital interactive touchscreens, hands-on exhibits and high definition footage.

In 2018, over 200,000 people visited Galway City Museum. A recent survey report showed that visitors found 'Sea Science – The Wild Atlantic' gallery to be an 'amazing', 'fantastic' and 'really educational' experience.

Sustainable Seafood Garden Overall Winner at Bloom

Bord Iascaigh Mhara's garden, which told the story of how Irish seafood is being sustainably produced to help protect fish stocks, protect the marine environment and develop and sustain fisheries dependent coastal communities in Ireland, was announced as the overall winner of Bloom 2018.

The garden was designed by Clogherhead native Andrew Christopher Dunne, who took inspiration from his experience of growing up in the local fishing village in Co. Louth. The marine garden included plants and trees found along Ireland's coastal areas, including wild flowers, ferns and grasses.

The centrepiece of the garden included a large water feature with shimmering fish sculptures and an 'upcycled' fishing boat. On board the boat former winners of the BIM Young Fishmonger of the Year Award, George and Anne Stephens and Scott Smullen from Dunnes Stores in Cornelscourt, Dublin, were among the fishmongers demonstrating ways to prepare sustainably sourced Irish seafood. TV chef and author, Fiona Uyema also featured Japanese themed Irish seafood dishes. The garden included furniture and features made from recycled materials.

Figure 72. Jim O'Toole CEO, BIM, pictured at BIM's Sustainable Seafood Garden debut

Cuan Beo – Reconnecting the Land and the Sea

Cuan Beo is an innovative coastal community group that supports individuals and organisations to understand and adopt sustainable practices associated with the aquatic resource of South Galway Bay from Oranmore to Blackhead in Co. Clare.

2018 was a very active year for community engagement for Cuan Beo. A high point in terms of public recognition was winning the Galway County Council Cathaoirleach Environment Award. Since then, results from their work have developed in a number of positive ways. The Cuan Beo Native Oyster Workshop held in Clarinbridge in 2017 initiated several actions that were implemented in 2018. These included:

- A native oyster restoration project in Galway Bay
- Cuan Beo @ Cruinniu na mBad 2018
  Cuan Beo brought a popular new dimension to Cruinniu na mBad Festival in Kinvara, Co. Galway in 2018 with a series of marine science and engineering lectures, and local chefs presenting their work in the Cuan Beo Marquee over the two days. The events attracted large crowds estimated to be in excess of 5,000. The Cuan Beo theme for the Cruinniu 2018 was 'Linking the land and the sea – A holistic approach to creating a sustainable future for Galway Bay'. The event also included presentations focused on the cultural and ecological heritage of Galway Bay.
- Cuan Beo Interactive Environmental Exhibition for Primary Schools at Clarinbridge Oyster Festival, October 2018

Community Science - Native Oyster Restoration Project in Galway Bay

Funded under the European Maritime and Fisheries Fund, local fishing communities and community members took part in a community-led science project in Galway Bay following support and guidance from the Marine Institute.

Community science, as opposed to citizen science, is where Cuan Beo trains and coordinates local fishermen/community members to conduct contract surveys for remuneration (e.g. oyster surveys). This work included the establishment of a baseline study/survey of native oyster settlement in Galway Bay, cultch experiments (placing of shell in the bay for oyster spat to attach to) and the deployment of oyster spat collectors to quantify the level of baby oysters in the water column. This work has provided an opportunity for over 20 local fishermen to get involved and also provided a new income stream.

Infrastructure

Maintaining, upgrading and providing (marine and coastal) infrastructures is critical to our national economy; energy needs and export potential; supporting coastal and rural communities; running (scientific) operational programmes; enabling research, development and innovation activities; facilitating technology transfer; the development of new products and services; and ensuring the safety and security of the maritime domain

- Harnessing Our Ocean Wealth

Photo courtesy of SmartBay Ireland

Infrastructure

Action 31

Maximise the utilisation of existing state maritime infrastructure (e.g. research vessels, coastal access points) through multi-purpose usage and sharing, in support of operational programmes, research, test and demonstration and monitoring.

Action 33

Securely store all publicly funded marine data (e.g. seabed mapping, monitoring, research and scientific data) and where appropriate make available, as easily and freely as possible, in compliance with existing standards (e.g. INSPIRE) for multi-purpose usage (e.g. for research, governance, maritime spatial planning and commercial development purposes). Leverage for value-added purposes, including links to key EU projects in this area, such as, the EMODNET initiative.

Ireland's Research Vessels – *Celtic Explorer* and *Celtic Voyager*

RV *Celtic Explorer* 2018 Activity

The RV *Celtic Explorer* began 2018 at AP Falmouth, United Kingdom, for a five year refit. The 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 major advantage for acoustic fisheries surveys.

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 (conductivity, temperature, depth) casts along a predetermined track. The second survey of 2018 was the Annual Southern Oceanographic Rockall Ocean Climate 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 (see Action 13a for details).

The Marine Institute led annual 'Blue Whiting Acoustic Survey' took place in March and involved using the newly installed fisheries sonar. A key highlight of the acoustic survey was the mapping of the SS *Athenia* ship wreck off Rockall Bank. The annual 'Anglerfish and Megrim Survey' followed this in April. The survey involved ICES (International Council for the Exploration of the Sea) approved bottom trawling in order to obtain biomass estimates for anglerfish and megrim data for setting an abundance index. Further details on this survey are available under Action 10.

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 and 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 km^2 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, which was also the first ROV *Holland 1* survey of 2018. The survey took place within the Charlie-Gibbs Fracture Zone (CGFZ), which is the longest fracture zone north of the Azores. The 2,000 km 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. Further details on the TOSCA survey are available under International and North/South Cooperation.

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 on the vessel for tours over three open days. The second leg of the WESPAS survey commenced after SeaFest; with the survey track stretching over 22 days from Galway through to Malin Head and as far north as the Outer Hebrides.

Figure 73. The Marine Institute's RV Celtic Explorer in Galway Harbour for SeaFest 2018

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, details of which are available under Action 30.

The ROV remained on board for its final expedition led by NUI Galway and 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 Seismicity of the Irish offshore' (see Action 21). 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 an 18 month period (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 on board 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. Further details are available under Action 29.

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 with CTDs and day grabs 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 University of Limerick 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* 2018 Activity

Once again 2018 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, south west and into Galway Bay took place also to acquire data required under the EU Water Framework Directive.

The next survey was trialling a new underwater TV (UWTV) camera system in Galway Bay /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 NUI Galway, UCC and the Galway-Mayo Institute of Technology. A geophysical survey, led by a team of scientists from Sligo IT took place in late February. Survey operations included vibrocoring in Liverpool Bay and Cardigan Bay.

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. Nephrops surveys continued into May as the vessel sailed from Dublin to Lorient to commence the fifth Langolf UWTV survey, led by scientists from Ifremer, in the Bay of Biscay.

Maynooth University 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 Seas.

The vessel sailed to the Porcupine Basin also in May to carry out a novel research survey on acoustic noise propagation which was led by NUI Galway. 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 of coverage 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 nephrops UWTV surveys were completed, including the Porcupine grounds. Another survey led by NUI Galway carried out a further investigation into the distribution of *Dinophysis* species in the eastern Celtic Sea.

The autumn survey season saw two 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 in 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 Maynooth University, NUI Galway 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 and inter-comparison 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 (see below).

Remotely Operated Vehicle (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.

The majority of ROV *Holland 1* survey time was spent on board the RV *Celtic Explorer* in 2018. 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 the Marine Institute, 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, and 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.

Replacement of the RV *Celtic Voyager*

An important announcement in 2018 was the Government's approval to build a replacement vessel for the RV *Celtic Voyager* and the award of the design contract in December 2018. The commencement of a build programme for a new marine research vessel was included in the Marine Institute's 2019 Budget provision to allow for the planned replacement of the 21 year old *Celtic Voyager* with a new 50 metre modern research vessel. The Institute tendered for the design of the new national research vessel in late 2018 and contracts for design were signed in January 2019. Tendering for the construction phase is anticipated in 2019, with the build process expected to complete in 2021.

The vessel will be used by the Marine Institute and other state agencies and higher education institutions to undertake fisheries research, oceanographic and environmental research, and seabed mapping and surveys. The new vessel will also have the capability to assist with maintaining and deploying weather buoys, observational infrastructure and remotely operated vehicles.

Geological Survey Ireland (GSI) Research Vessels

GSI continued to operate the inshore seabed mapping fleet, RV *Keary*, RV *Geo*, RV *Lir* and the new RV *Mallet* to support INFOMAR and other projects such as 'CHERISH' (see Action 13a). In 2018, the vessels operated out to 30 nautical miles (NM) offshore while continuing to survey as close to the shore as possible. The area surveyed was in the Celtic Sea, from Kilmore Quay to Kinsale and inshore as far as Glandore.Outside of the regular season from April to October the vessels were also utilised on other projects such the Dublin Bay monitoring programme and marine archaeology in Smerwick Harbour Co. Kerry.

All vessels are equipped with state-of-the-art multibeams, inertial navigation systems (INS) and other geophysical sensors. When not seabed mapping, the vessels conducted groundtruthing operations with underwater cameras and sediment samples.

Figure 74. GSI Inshore Fleet. Photo courtesy of the GSI, Department of Communications, Climate Action and Environment

Aquaculture Research Cluster – Meeting the Needs of Industry

In 2018, the Marine Institute continued to invest in the upgrade and linking of the aquaculture research site at Beirtreach Buí 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. Beirtreach Buí 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. The facility is being used as part of a project that aims to 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 Beirtreach Buí 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 NUI Galway, Teagasc and led by Bio-Marine Ingredients Ireland secured funding from the Government's Disruptive Technologies Innovation Fund (HYDRO-fish project) to produce products for the aquaculture industry that will disrupt current farming practices. Such product disruptions include 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 Iascaigh 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 Beirtreach Buí site, Newport research infrastructure and the Páirc na Mara project currently being developed by Údarás na Gaeltachta.

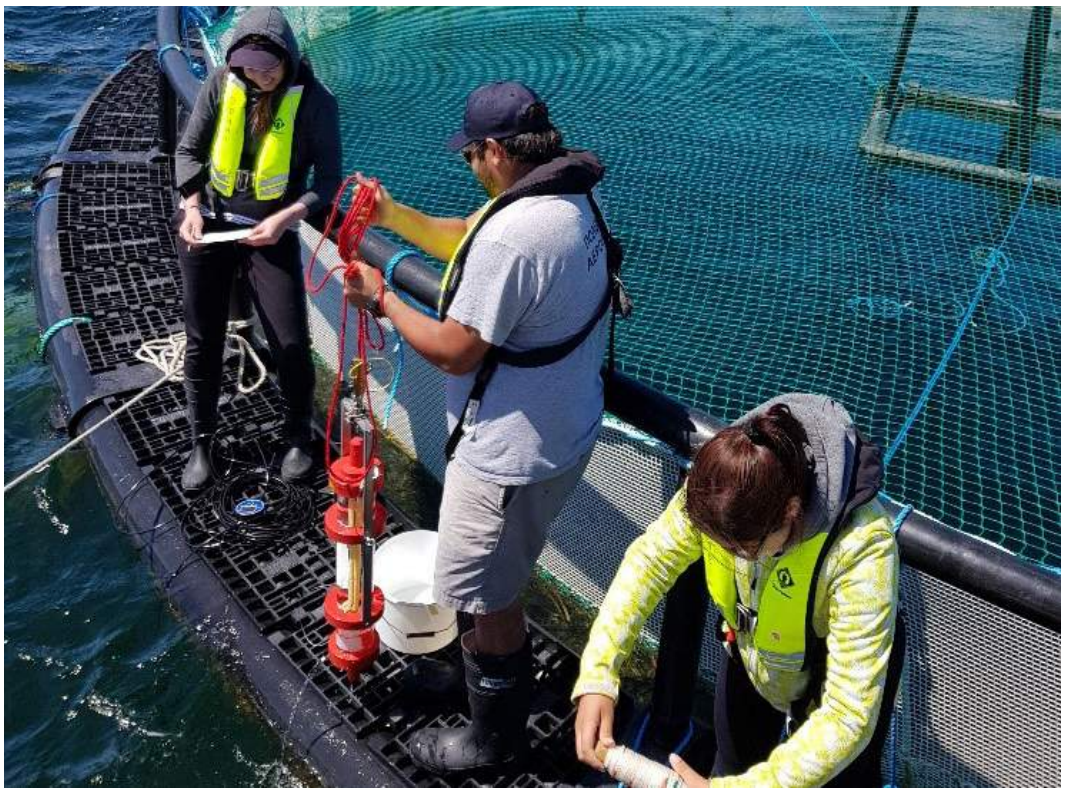


Figure 75. Photo courtesy of the Marine Institute

Lir National Ocean Test Facility

The Lir National Ocean Test Facility (NOTF) is a world-class centre for renewable energy and marine research, located in the UCC Beaufort Building in Ringaskiddy, Co. Cork. Lir is a custom designed test facility which features upgraded and expanded tanks and equipment for the testing of small scale ocean energy renewable devices. Testing infrastructure includes:

- A Deep Ocean Wave Basin (circa 1:15 scale testing)
- The Open Ocean Emulator, an ocean wave basin with a sophisticated two-sided paddle system and a two sided absorption system (circa 1:50 scale testing)
- A wave and current flume with coastal/tidal testing capabilities (circa 1:50 scale testing) and a wave demonstration flume
- Mechanical and electrical workshops
- Electrical testing infrastructure, including a smart-grid and a series of linear and rotary rigs used to test power take-off and energy storage

Lir is an essential part of Ireland's ocean energy research and testing infrastructure and provides a significant launch pad for both national and international marine renewable energy developers.

All tank and infrastructure commissioning has been completed on site and the Lir NOTF was officially opened in January 2019.

Currently, University College Cork (UCC) are managing two significant EU H2020 projects linked to the Lir infrastructure:

- The Horizon 2020 INFRARIA MaRINET2 project is providing access to ocean energy developers to test infrastructure throughout Europe. MaRINET2 has built upon the previously successful MaRINET programme. UCC are project coordinators. Facilities at NUI Galway and the University of Limerick are also included, as well as the SmartBay Galway Bay Marine and Renewable Energy Test Site.
- The Horizon 2020 INFRADEV Marinerg-i project, also led by UCC, aims to unite Europe's leading renewable energy research organisations to become the leading international distributed infrastructure. Its integrated nature and coordinated approach will accelerate the research development and deployment of offshore wind, wave, tidal and combined energy technologies and help maintain Europe as a global leader in this sector.

University of Limerick Marine Renewable Energy ROV

Researchers from University of Limerick launched a remotely operated vehicle (ROV), *Étaín*, funded with a €2 million award from the Science Foundation Ireland (SFI) Infrastructure Programme. It incorporates the OceanRINGS+ Control Environment, developed by MaREI researchers at University of Limerick, which yields precision navigation systems, target-referenced flight control, real-time imaging near heaving structures in the ocean, auto control of manipulator systems, and other advanced features. *Étaín* can operate in challenging wind, wave, and tidal conditions and will be used to inspect, repair and maintain marine renewable energy facilities.

Galway Bay Test Site and Underwater Observatory

The Galway Bay Marine and Renewable Energy Test Site and Underwater Observatory are national infrastructures where Irish and international ocean energy and marine technology researchers and developers can test and verify new technologies within real sea conditions. Developers and researchers can apply for funding to access the test site through various European Union and national support programmes.

Support packages were awarded to 13 companies in 2018 and six devices and components were deployed at the test site throughout the year.

SmallETec Wave Energy converter

Figure 76. Photo courtesy of SmartBay Ireland

SmalleTec, a Spanish company, successfully secured a support package under the OCEANERA-NET programme managed by Sustainable Energy Authority of Ireland (SEAI), and the SME instrument to trial and validate the eForcis design in SmartBay. They will perform a second trial in 2019 of beForcis, which is an improved eForcis device.

The device, which was housed in a water tight box attached to the top of a Marine Institute buoy, uses the motion of the buoy and simple electromagnetic principles to harvest energy.

The principle aim of this novel device is to use the energy generated from ocean waves as an alternative power source to address electricity supply shortages within off-grid marine devices operating in harsh marine conditions.

FORESEA Blue Ocean Monitoring

Funded under an Interreg FORESEA Support Package, Blue Ocean Monitoring deployed its acoustic enabled glider at the test site in September 2018. The glider was deployed and piloted for a 24/7 period, where it collected acoustic data for the test site to complete an acoustic landscaping of the area and compare the data collected against the fixed Passive Acoustic Monitoring (PAM) system onsite. This helped to gain a better understanding of what can be achieved with a hydrophone mounted within a mobile glider platform rather than fixed onsite installations such as data buoys and the SmartBay Observatory.

Figure 77. Photo courtesy of SmartBay Ireland

The information collected was used to create an acoustic model of the test site. This will provide valuable information to the test site operations team and to wave energy developers at the site, providing a better understanding of sound propagation from wave energy converters and useful data for environmental monitoring.

Providing Transnational Access to Unique European Coastal Observatories and Test Sites through the JERICO-NEXT Trans National Access (TNA) Programme

The EU Horizon 2020 funded JERICO-NEXT Trans National Access (TNA) programme supported three projects that accessed the Galway Bay Underwater Observatory in 2018, all of which requested a minimum of two months' access.

- Sonardyne, a leading independent global provider of underwater acoustic, inertial, optical and sonar technology, successfully secured funding under the JERICO-NEXT TNA Programme to access the SmartBay managed Observatory for their project 'ECSyrinx'. Sonardyne deployed its Doppler velocity instrument at the site, with the objective of testing and validating the performance of the device during long-term deployments in real-sea conditions. The outcome of these trials helped Sonardyne to evaluate device performance within a variety of environmental conditions and allowed for comparisons to be made against data gathered by other instruments permanently installed on the observatory, therefore validating performance.

- Project 'Advance' was a JERICO-NEXT TNA project which deployed an autonomous underwater camera designed to capture images of the seafloor and benthic species, in particular the Norwegian lobster or nephrops. The project team had representatives from ICM/CSIC (Spain) and from ISMAR/CNR (Italy). The camera was deployed in the SmartBay Observatory for two months (July-September period), and images from the observatory's camera were used to compare and complete the observations.

- The 'MicroPlastox' project is examining the distribution of microplastics in seawater in several parts of the world. Collaboration with the SmartBay Observatory related to the installation of a micro-net for sampling of plastics.

In addition to these projects, a Spanish company, Zunibal, deployed a directional wave buoy called 'Anteia', which is used to monitor waves at the Galway Bay Renewable Energy Test Site. The aim of this project is to validate the prototype technology against the permanently deployed waverider buoy infrastructure at the test site.

National Infrastructure Access Programme

The National Infrastructure Access Programme, funded by the Marine institute as part of the Marine Research Programme, supported eight projects which utilised the Galway Bay Test Site in 2018.

A Dublin City University (DCU) project 'Marine Inspired Design for Antifouling Technology' completed testing at the test site; biofouling organisms present on glass panels coated with novel transparent coatings for optical sensors was assessed. The project focused on creating novel antifouling (AF) coatings and textures inspired by the brown crab and other familiar fish species. Test panels were deployed in Galway Bay for six months.

Dundalk Institute of Technology Wave Activated Sensor Power (WASP) utilised the test site to carry out a device assessment which aims to measure sea state. This data is vital when assessing the viability of locations for wave energy farms and to assist in designing effective coastal protection measures. Calibration of the WASP took place in the Galway Bay Test Site followed by proof of concept testing.

A University of Limerick (UL) project accessed the test site to explore options for expanding the working footprint of a deep sea cabled observatory node. The research was aimed to develop leading edge technologies for routine, low cost ocean observation; targeting extension of these capabilities to remote buoyed observatories and offshore platforms.

UL Mobile and Marine Robotics Centre and Irish company SonarSim collaborated to install an imaging SONAR lander at the Observatory. The SONAR data is live streamed, enabling remote access to the SONAR equipment via a web portal, which also runs SONAR visualisation software for users. The remote access interface allows users to control the SONAR settings and orientation underwater, using the 360-degree pan and tilt capabilities of the frame. The primary objective of the SONAR lander is for training purposes, most systems have configurable range, gain, pulse, and filter settings, which, in combination with pan and tilt support in a known environment, provides a plethora of data interpretation exemplars for an introductory primer to underwater acoustics. Other potential uses of the equipment include: feature tracking research, scientific site monitoring, and public outreach.

Building Alliances across European Marine Research Infrastructures EurofleetPlus

Building on the achievements of the two preceding Eurofleets projects, the Marine Institute are coordinating EurofleetPlus, a €9.9 million Horizon 2020 project comprising a consortium of 42 marine institutes, higher education institutions, foundations and SMEs from 24 countries across Europe, North America and Oceania. Involving transnational activities, EurofleetPlus prioritises research on sustainable, clean and healthy oceans, linking with existing ocean observation infrastructures, as well as supporting innovative ideas working closely with industry.

The project will facilitate access to the largest advanced research vessel fleet across Europe, Greenland, USA, Canada, Bermuda and New Zealand. Enabling access to a unique fleet of 27 state-of-the-art research vessels from European and international partners, through competitive calls, researchers are able to access the entire North Atlantic, Mediterranean, Black Sea, North Sea, Baltic Sea, Pacific Southern Ocean and Ross Sea.

EurofleetPlus is also undertaking joint research activities to meet the evolving challenges of marine research, in particular, deep ocean research and exploration, data management, and virtual access. Additionally, the project facilitates 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.

Figure 78. EurofleetsPlus kick off meeting takes place at the Marine Institute. Photo Cr Andrew Downes, XPOSURE

Irish Lights Multi-Purpose Usage of Maritime Infrastructure and Marine Data

Irish Lights continues to support a range of stakeholders and customers by providing access to a range of fixed and floating infrastructure, data, technology services and expertise. Irish Lights continues to promote its assets and services as an input to the offshore energy supply chain and to support Marine Institute activities in the area of multi-purpose usage of marine data through its support of the Digital Ocean initiative, the Marine Atlas and Ocean Energy Data Portal. Data from the Irish Lights MetOcean Service is directly available via the Irish Lights website and dissemination through Twitter feeds. Various data requests are also facilitated on a case by case basis.

In 2018, progress was made across a number of different activities:

- The Irish Lights vessel *Granuaile* took part in a joint incident response exercise also involving the Irish Coast Guard and the Fire Service, simulating a fire on board a vessel at sea
- MetOcean data from Irish Lights infrastructure was provided to Bord Iascaigh Mhara, the Marine Institute, the Office of Public Works, Sustainable Energy Authority of Ireland (SEAI), and a number of offshore renewables developers
- Irish Lights is represented on the National Marine Infrastructure Providers' Forum, which had its first meeting in September 2018
- Irish Lights provided and deployed four new buoys for SmartBay to mark the Galway Bay test site
- The *Granuaile* supported the Marine Institute in carrying out a deep ocean survey off the west coast. The survey, amongst other things, identified a previously unknown shark nursery of great scientific interest
- Through a Service Level Agreement with the Irish Coast Guard, Irish Lights helipads were used at a number of stations around the coast, as well as siting equipment at lighthouse locations
- The *Granuaile* undertook some buoy contract work at Eagle Island on behalf of SEAI
- Irish Lights submitted a response to the Marine Spatial Planning consultation process, and has been sitting on various panels reviewing and consulting on the draft framework
- Supported the University of Limerick through the Science Foundation Ireland funded MaREI programme to deploy and test their new remotely operated vehicle using the Irish Lights vessel *Granuaile*
- Supported Inland Fisheries Ireland to pilot test the deployment of fish monitoring sensors on Irish Lights' buoy infrastructure to track and study fish movements in a fully marine environment with depths greater than fifty feet
- Provided vessel traffic density information to a number of customers/stakeholders interested in offshore renewable energy development
- Provided infrastructure and expertise to Maynooth University in relation to the use case, application, testing and deployment of next generation drone solutions. Details of the Maynooth University U-Flyte project are available under Action 8

- Continued to provide and maintain two Special Marks for the Atlantic Marine Energy Test Site (AMETS) off Belmullet, Co. Mayo which also collect and disseminate MetOcean data
- Maintained support to Met Éireann by hosting and transmitting visibility and MetOcean data from a number of lighthouses
- Provision and monitoring of a contract buoy at the WestWave site off the coast of Co. Clare on behalf of SEAI continued
- Worked with An Garda Síochána facilitating the siting of equipment to support the Garda Tetra network
- Supported a PhD research study into the use of the 'Evaporation Duct' phenomenon to extend communications beyond the horizon in conjunction with the University of Limerick via the SFI funded MaREI centre
- Collaborated with a Dublin City University led project to assist in the development of a coastal observation network with partners from University College Cork, Geological Survey Ireland. Maynooth University and University College Dublin
- Facilitated operators providing mobile communications from a number of lighthouse locations
- Assisted with the deployment of radar systems for port vessel traffic services
- Enabled the transfer of High Frequency (HF) radar data via our Automatic Identification Systems (AIS) network for NUI Galway from Inisheer and Loop Head Lighthouses
- Continued to provide a synthetic AIS AtoN (Aids to Navigation) service for General Electric (GE) at the Arklow wind bank and for the Northern Ireland Fishery Harbour Authority (NIFHA) at the Ardtole beacon.

During 2018, Irish Lights launched their new Strategy 2018-2023: Safe Seas – Connected Coasts. The strategy demonstrates that Irish Lights has as an explicit objective – maximising the utilisation of its infrastructure to the national benefit.

Marine Data and Ireland's Digital Ocean

The Irish Digital Ocean digital services platform is being developed further by the Marine Institute to make Ireland's marine digital assets more readily available for public services, research and innovation. In 2018, new data sources have been integrated and new ways to access information, including visualisation of predictive oceanographic model data and data from the INFOMAR seabed survey programme, enabled data reuse across new and developing programmes. A new Data Management Quality Management Framework was also developed in 2018, which will underpin the quality of marine data management in line with international standards (IOC -IODE accredited). These services will underpin future programmes in the area of marine planning, fisheries and environmental management.

Activities linked to international data projects and networks are available under International and North/South Cooperation.

Action 32

Put in place clear integrated policies and strategies for the development of new key strategic infrastructures to support job creation and economic growth (e.g. the grid and port infrastructure to support renewable energy and export potential).

Action 34

Carry out national, regional and local initiatives aimed at tapping into the potential of new and existing coastal infrastructure to develop sustainable products, services and jobs. This would encourage investment along the coast.

Action 34d

Utilising existing built and natural assets (e.g. lighthouses and offshore islands) to develop tourism products and services.

Action 34f

Supporting major national seaports in the implementation of their master plans to provide additional capacity and greater draft using their own resources.

Maintaining the Six Fishery Harbour Centres

Under statute, the Department of Agriculture Food and the Marine (DAFM) owns, manages, maintains and develops the six designated Fishery Harbour Centres (FHCs) located at Howth, Co. Dublin; Dunmore East, Co. Waterford; Castletownbere, Co. Cork; Dingle, Co. Kerry; Ros an Mhil, Co. Galway; and Killybegs, Co. Donegal.

The six FHCs are located strategically around the coast, where they play a key part in the sustainable development of the economic and social fabric of the regions in which they are located. It is estimated that 78% by volume of all the fish landed into Ireland with a value exceeding €290 million takes place at the six FHCs. The infrastructure at the FHCs is valued in excess of €600 million and given the vital role they play in servicing and supporting the fishing industry it is crucial that the ports are kept up to proper standards. In 2018, the Department was allocated €25.9 million towards the development of the FHCs and €33.7 million has been allocated in 2019 under the Fishery Harbour and Coastal Infrastructure Capital Programme for projects at the FHCs, including Cape Clear Island (also managed by DAFM). This represents an increase of €7.8 million from 2018 and underlines the importance of the contribution of the seafood sector to Ireland's economy.

Because of the aggressive marine nature of the environment in which the FHCs are located and the industrial scale and type of activity that takes place at the ports on an ongoing basis, annual maintenance of the piers, and their associated furnishings and fittings including fenders, bollards, ladders, surfaces, water mains, electrics etc., is vital. The sum allocated for FHC safety and maintenance annually is generally in the region of €2 million and in 2019 €2.48 million has been allocated for this purpose. Typical of any infrastructure, renewal, replacement and new construction work is essential in order to meet the operational, environmental and hygiene requirements at the ports.

In the past, significant infrastructure development has been implemented including a €50 million development at Killybegs FHC completed in 2004 and a €39.5 million development at Castletownbere FHC completed in 2012. The following are typical of the nature of the projects that were implemented at the FHCs over 2018 as part of the annual programme.

Killybegs Fishery Harbour Centre

Smooth Point Pier Extension

To meet the increasing demand from the fishing industry, work commenced in 2017 on the construction of 120 metres of new quay face at Smooth Point. The pier extension will accommodate vessels with a draft of up to nine metres at low water.

In 2018, Phase 1 of the project primarily included the dredging of contaminated sediment, bringing it ashore for treatment and stabilisation and subsequent disposal for beneficial reuse.

Phase 2 of the project includes the final dredging and construction of the quay wall. Works are expected to commence in mid-2019 and it is expected that construction will be completed and the new quay commissioned in 2020.

Figure 79. Smooth Point Pier Extension Phase 1 Dredging, Killybegs FHC. Photo courtesy of Department of Agriculture, Food and the Marine (DAFM)

Landing Pier Mooring Dolphin and Fendering Upgrade

In 2018, Killybegs FHC saw the commissioning of its new mooring dolphin and upgraded fenders at the Landing Pier. A mooring dolphin is a marine structure above the water level, consisting of piles driven into the seabed supporting a concrete deck, fendering and mooring bollards. The purpose was to provide additional mooring points to reduce the lateral movement of vessels using the Landing Pier. The new dolphin, together with stronger fenders on the pier, has significantly reduced damage caused by swinging vessels. This project has served to protect an important part of the older marine infrastructure in the harbour.

Figure 80. Vessels berthed alongside the completed Mooring Dolphins funded as part of the Killybegs Landing Pier Fendering Project under the Fishery Harbour Centre and Coastal Infrastructure Development Programme. Photo courtesy of DAFM

An Daingean FHC

Eastern Basin Additional Pontoons and Completion of Dredging Works

In 2018, a project comprising additional piling works and a new pontoon system costing approximately €1 million was completed in the Eastern Basin. This provides much more efficient use of the space and provides safe berthage for up to 35 of the smaller commercial vessels using Dingle FHC.

Additionally, the dredging works to the navigation channel to the port that commenced in 2017 were completed in 2018 with reinstatement of the eastern landside area at a cost of €5 million.

Figure 81. Eastern Basin Pontoons at An Daingean FHC. Photo courtesy of DAFM

Dunmore East Fishery Harbour Centre

West Wharf Remedial Works

November 2017 saw the commencement of Phase 3 of the West Wharf remedial and improvement works. This Phase of the works was completed in October 2018 at a cost of €1.5 million.

The works involved the demolition of a 96 metre length of the existing wharf deck and its replacement with a new reinforced concrete wharf structure, remedial works to the existing reinforced concrete piles and the replacement of the existing greenheart fenders with super arch fenders.

Since 2016, remedial and improvement works have been undertaken on a phased basis with a total 181 metre length of the West Wharf now repaired.

Figure 82. West Wharf, Dunmore East FHC. Photo courtesy of DAFM

Castletownbere FHC

Dinish Wharf Expansion

Harbour pier development works currently under construction at Castletownbere will provide an expansion of the existing Dinish Wharf to include an additional 216 metre length of quay, capital dredging works, two rock armoured breakwaters and associated works.

In 2018, a €23.4 million works contract was awarded to L&M Keating Ltd. The construction works commenced in October 2018 progressing steadily through to year end with site establishment, construction enabling works, capital dredging, and steel sheet piling to extend the pier. Environmental and archaeological monitoring works contracts were in place to supervise the civil works and are ongoing. The works programme was on target at year end and will continue into 2019, with a current scheduled completion date of December 2019.

Figure 83. Dinish Wharf Expansion at Castletownbere FHC, Photo courtesy of DAFM

Castletownbere Harbour Administration Building

Works commenced in January 2018 on the construction of a new Harbour Administration building at the Mainland Quay, Castletownbere, following award of a €1.3 million building contract to Ned O'Shea and Sons (Construction) Ltd in late December 2017.

The works will include demolition of the old auction hall and existing harbour offices. The new building will provide a focal point in the harbour and will contribute to the redevelopment of the harbour and town areas to coincide with proposed traffic management improvements planned for the town. The building will provide office accommodation and meeting rooms for staff in the Harbour Master's Office, the Sea Fisheries Protection Authority, and the Marine Engineering Division. The works are progressing well and are on target for completion by April 2019.

Figure 84. New Harbour Administration Building Castletownbere FHC, Photo courtesy of DAFM

Supporting Irish Ports

The Irish Maritime Development Office (IMDO) liaise with the ports on their Master Plans, opportunities to secure EU and other funding, and business development opportunities in related sectors such as marine renewable energy. The IMDO commissioned the IPORES report and the Port Capacity Study in 2018 as part of these activities (see Actions 17 and 24 for details). Research is being undertaken by the IMDO into port performance metrics, in tandem with the report on port capacity. This research is informing the Department of Transport, Tourism and Sport (DTTAS) about the future development of Irish ports and will contribute to the Department's considerations on the future of National Ports Policy. The IMDO has recently published a study dealing with the Implications of Brexit on the Use of the Landbridge. The report sheds light on the volume of traffic moving through Irish ports to access EU markets via Great Britain and is informing ports about the challenges and opportunities in preparing for Brexit. The IMDO has also been working with the ports in the development of additional technology related infrastructure and a 'Smart Ports' initiative.

The IMDO also fulfils this role by participating with ports in EU Programmes. The IMDO is currently working with Irish ports to develop an integrated project that will drive the efficiency of Irish ports concentrating on digitalisation, as well as opportunities to use technologies, such a Blockchain, to improve port performance.

The National Ports Policy categorises Dublin Port Company, the Port of Cork Company and Shannon Foynes Port Company as Ports of National Significance (Tier 1), and their continued commercial development is a key strategic objective of Government. The three ports are also recognised as 'core' ports within the new TEN-T (TransEuropeanNetwork-Transport) Regulation at a European Union level.

The Ports of National Significance (Tier 1) – Dublin, Cork and Shannon Foynes – collectively handle just over 80% of all tonnage at Irish ports in any given year. All three have ambitious development Masterplans outlining their future infrastructure development over the next 30 to 40 years.

In 2018, the Department of Transport, Tourism and Sport continued to support ports in the implementation of their Master Plans. These programmes will enhance national and international connectivity, and provide for future increases in trade and national port capacity requirements by facilitating more vessels, larger sized vessels and increased tonnage and throughput.

Dublin Port Company continues to progress its €230 million infrastructure investment – the Alexander Basin Redevelopment Project (ABR). Dublin Port considers that the implementation of this project will result in the most significant redevelopment of the port's infrastructure in over a century. The port spent circa €90 million on port infrastructure in 2018 and plans to invest a further €147 million in 2019.

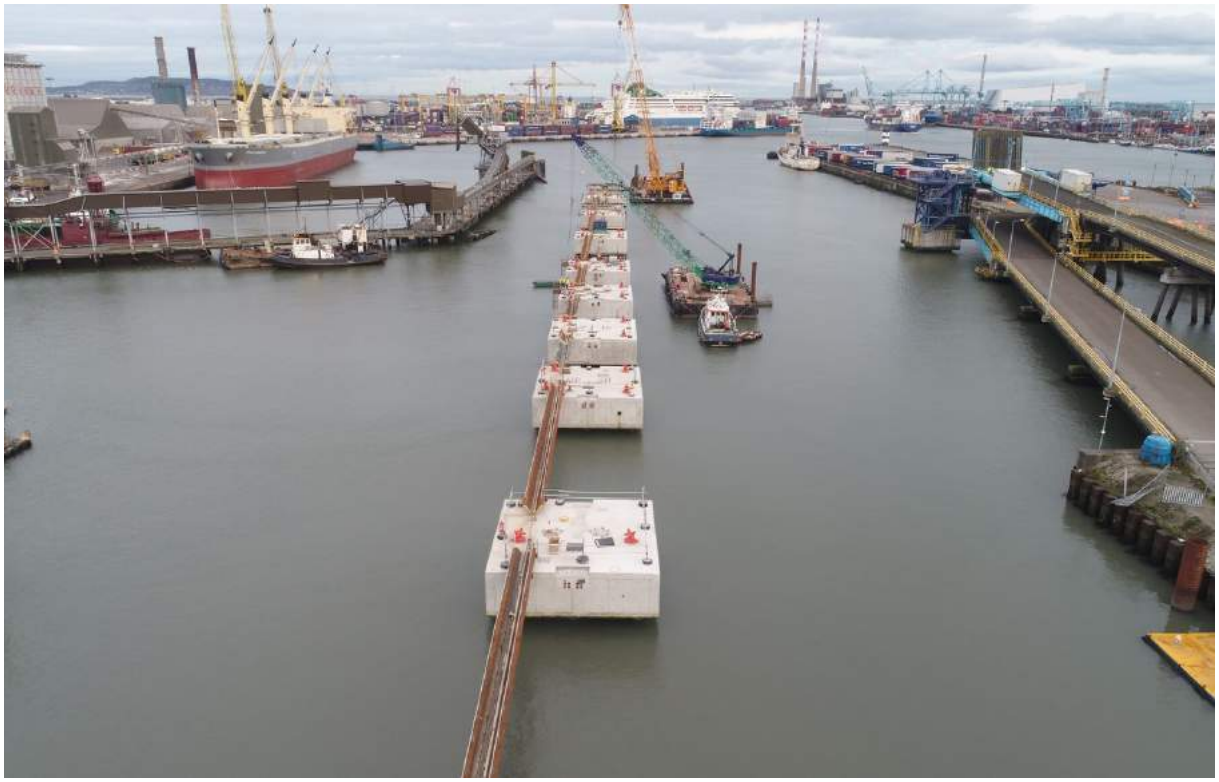


Figure 85. Dublin Port ABR, New RoRo Jetty. Photo courtesy of the Department of Transport, Tourism and Sport

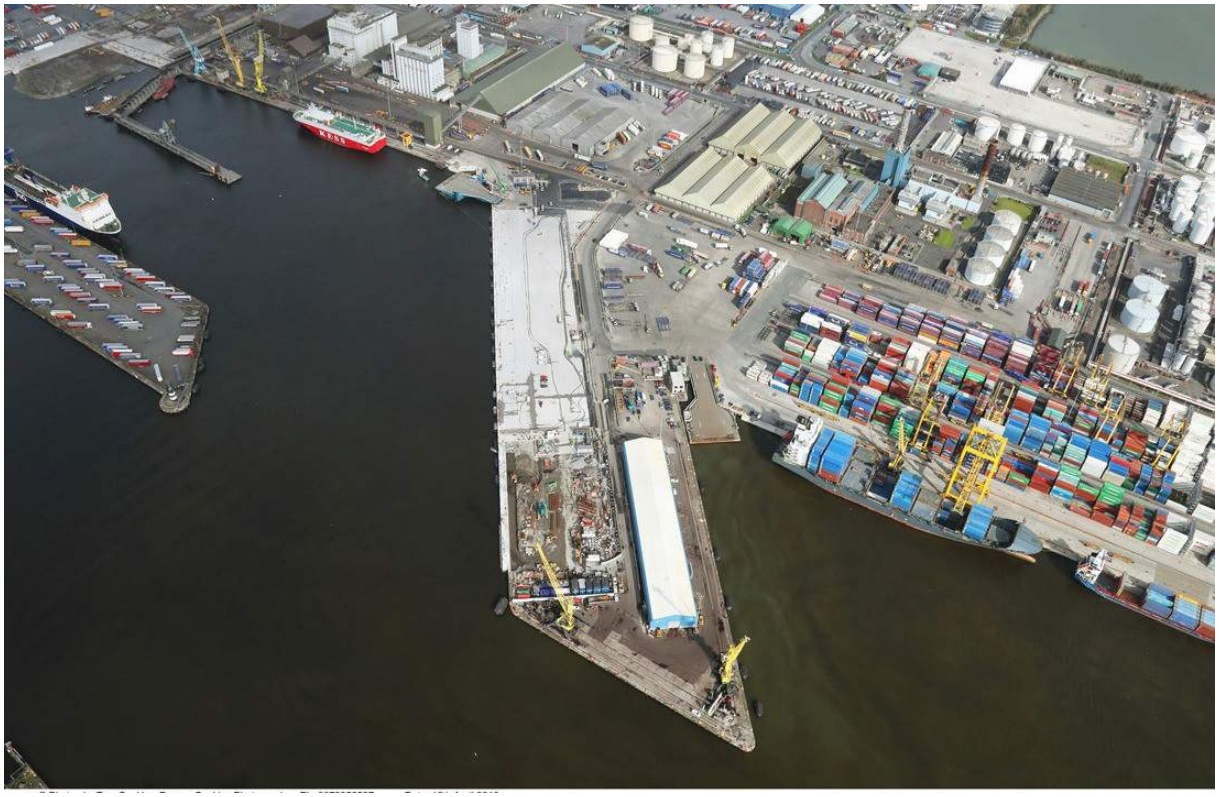


Figure 86. Dublin Port ABR Ocean Pier. Photo courtesy of the Department of Transport, Tourism and Sport

The Port of Cork Company commenced work on the Ringaskiddy project in June 2018, which will facilitate the transfer of port activities from the upper to lower harbour area around existing facilities at Ringaskiddy. This project represents an investment of €90 million in the redevelopment of Ringaskiddy. This state-of-the-art facility is the most significant single investment in marine infrastructure and superstructure in the history of the Port of Cork Company.

Figure 87. Port of Cork, Ringaskiddy redevelopment. Photo courtesy of the Department of Transport, Tourism and Sport

Figure 88. Port of Cork, Impression of finished terminal. Image courtesyof the Department of Transport, Tourism and Sport

In May 2018, Shannon Foynes Port Company announced plans for an expansion at its general cargo terminal at Foynes, adding over two-thirds the size of its existing area. Shannon Foynes will invest over €20 million in converting 83 acres on the east side of the existing port into a land bank for marine related industry, port centric logistics, and associated infrastructure. It's the latest phase of a €64 million investment programme and will be developed on a phased basis over five years.

Access to European TEN-T, Connecting Europe Facility (CEF) and European Investment Bank (EIB) financing has been vital to help progress these ambitious plans by the Tier 1 Ports. With the support of Department of Transport, Tourism and Sport and the IMDO, the port companies of Dublin, Cork and Shannon Foynes have all successfully obtained EU funding towards their current projects. In March 2018, the European Commission (DG MOVE) published its draft Connecting Europe Facility (CEF) midterm review, which confirms the extension of the North Sea Mediterranean Corridor (NSMED) to include Shannon Foynes Port Company.

The National Ports Policy stipulates that there is no Exchequer funding for Ports – all of these major development projects must be financed by the commercial port companies.

Figure 89. Shannon Foynes, Phase 1 of the Jetty expansion programme at Foynes. Photo courtesy of the Department of Transport, Tourism and Sport

Great Lighthouses of Ireland

Tourism and heritage is a key focus area of Irish Lights' strategy, Safe Seas – Connected Coasts covering the period 2018 to 2023, which includes ambitious goals around promoting our rich maritime heritage and culture.

Irish Lights has made a significant investment in developing its tourism offering to deliver 13 iconic sites around Ireland all of which are supported by a dedicated manager and guided by a strategic marketing plan out to 2020. Since the formation of the Great Lighthouses of Ireland (GLI) brand partnership in 2015, the combined effort of all partners has supported positioning the brand and each lighthouse visitor experience as a valued tourism asset for Ireland.

Over 11.2 million overseas visitors came to the island of Ireland in 2018, delivering revenue of approximately €6.1 billion. Government, tourism and local authority stakeholders recognise that this partnership, informed by visitor needs, aligned to the national development agenda and supported by a shared vision and ambition can deliver economic benefits to destinations that need it most and provide through shared content and images a compelling reason for international visitors to consider a holiday in Ireland. In 2018, GLI partners recorded a combined total of 143,580 visitor sales, and accommodation partners have reported occupancy rates of 49.4%.

To inform the future and measure the impact of effort to date, Irish Lights have commissioned an economic impact assessment, which will be completed in early 2019. The output of this report will support current lighthouse tourism operations and will be an important milestone and tool for informing future plans and potential funding programmes. The impact of Brexit on outbound travel from Britain and exchange rates remain a concern, however, 2018 data from all GLI partners indicate that visitor numbers continue to grow, and many are planning to open for longer periods in 2019.

Irish Lights continues to support the development of its tourism assets and has invested in the development of the GLI brand by taking a strategic approach to the preservation of its heritage assets and furthering tourism development around the coast by working with communities and partners to open new lighthouse sites and experiences. Investing in and developing a compelling brand identity and suite of marketing collateral (digital and print) continued in 2018. This included providing resources to design and deliver a marketing plan, social media and publicity campaigns.

Specific achievements in 2018:

- Built and strengthened strategic alliances and memberships with new organisations and partners, including Titanic Foundation, Heritage Island and Libraries Northern Ireland
- Further developed the GLI website, while supporting more promotions via social media, competitions and special offer campaigns
- Secured funding from Fáilte Ireland for developments at Fanad Lighthouse and Valentia Island Lighthouse, and received a grant from The National Lottery Heritage Fund - Northern Ireland for a digital project that will tap into the Irish Lights archive
- Were represented at key international and national business and consumer events including World Travel Market, ITB Berlin, Dublin Horseshow, Bloom and Belfast Maritime Festival
- Attracted visitors and supported publicity through competitions and events, with 'Shine a Light' on Summer; 'Great Lighthouses, Great Fun' photo competition; SeaFest 2018; and Libraries NI Big Summer Read, engaging over 55,000 adults and children

- Delivered workshops, training and mentoring for all partners

- Shared presentations on the GLI model and partnerships at national and international conferences including UNWTO (United Nations World Tourism Organization); IALA (International Association of Marine Aids to Navigation and Lighthouse Authorities); Adventure Travel summits; Wild Atlantic Way forums and more

- Great Lighthouses of Ireland partners were recognised and shortlisted for a variety of awards over 2018, including: the British Guild of Travel Writers World Tourism Award (Hook Lighthouse shortlisted); and Irish Tourism Awards 2019 (Clare Island, Loop Head and Hook on the list of nominees).

Discussions and meetings are ongoing with the team and partners, sharing development plans, and considering priority actions.

Supporting Tourism in Marine and Coastal Areas

In 2018, Fáilte Ireland engaged with four projects, focused on marine and coastal areas, which had received a Stage 1 Pass under the first call of the Grants Scheme for Large Tourism Projects in 2017 . A number of the outcomes of the grants scheme will support the upgrading and addition of facilities to support and encourage marine and water-based activities. These include the development of Heartbreak Pier, Cobh; investment in Strandhill Surfing Centre of Excellence, Co. Sligo; construction of a cable car and visitor centre at Dursey Island, Co. Cork; and the construction of a 27 metre floating pontoon 1 km from Sligo town centre.

The Grants Scheme for Large Tourism Projects, which was launched in 2016 and runs up to 2020, is highly competitive and received 115 applications as part of its first call out to the public, private and voluntary sectors. Following an evaluation process, 24 tourism projects progressed to Stage 2 of the process. The two-stage application process was put in place to allow Fáilte Ireland to engage with projects at an early stage in their development. Final decisions on Delivery Grant funding for the remaining projects will be made over the course of 2019 and 2020 as they reach readiness.

Following the completion of a Visitor Experience Development Plan (VEDP) for the Connemara Coast and Aran Islands in Co. Galway and for the Skellig Coast in Co. Kerry, Fáilte Ireland delivered a focused small grants scheme to support the development of world-class visitor experiences in these areas. The New Horizons on the Wild Atlantic Way 2018 grants scheme provided funding of between €30,000 and €200,000 to new and operating visitor attractions along the Wild Atlantic Way within the defined geographies of the Connemara Coast and Aran Islands, and the Skellig Coast.

Further details on Fáilte Ireland's preparation and implementation of Visitor Experience Development Plans in 2018 are available under Action 19.

International and North/South Cooperation

International cooperation is an essential element of integrated marine policy and planning. Close cooperation with our Atlantic neighbours and international partners can also bring about economic returns and benefits

- Harnessing Our Ocean Wealth

Photo courtesy of Christo Anestev

International and North/South Cooperation

Action 36

Influence the development and implementation of EU maritime policy, strategies and programmes (e.g. IMPEUSA, CFP, MSP, MSFD, EMODNET) to assist in the delivery of the goals of Harnessing Our Ocean Wealth. This will be achieved by:

- Maximising relevant funding opportunities (e.g. structural and cohesion funding);
- Utilising Irish representation in Brussels; and
- Highlighting our marine sector/our ocean wealth during the Irish EU Presidency (Jan – Jun 2013).

Action 37

Ensure the inclusion of marine research in all relevant Work Programmes developed under HORIZON 2020 in order to maximise EU marine research funding opportunities and support the implementation of IMP – EU and its Sea Basin Strategies.

Action 38

Continue to foster a North/South and East/West approach in developing/enabling the marine sector through existing structures and bodies.

Action 39

Establish key trade and research links in non-EU markets and countries.

Update from Ireland's Maritime Affairs Attaché – Dymphna Keogh

Throughout 2018, Ireland influenced the development and implementation of EU maritime policy, strategies and programmes and built on the existing relationships with the EU institutions such as the European Parliament, Committee of the Regions, European Economic and Social Committee and with European Commission services across a range of Directorate Generals. Key to this work is the permanent diplomatic post dedicated to maritime affairs within Ireland's Permanent Representation to the European Union in Brussels. This unique role ensures that Ireland is centrally placed to influence the development and implementation of maritime policy as well as promote and champion its national marine sector. The post is jointly supported by several Government Departments represented on the Marine Coordination Group.

Ireland participated in the Atlantic Strategy Steering Group which in 2018 saw the Spanish delegation take the chair of the Group. Originally adopted in May 2013, the Atlantic Strategy and associated Atlantic Action Plan encourages Member States to work together by sharing information, costs, results and best practices, as well as generating ideas for further areas of cooperation of maritime activities.

This includes both traditional activities, such as fisheries, aquaculture, tourism and shipping, as well as emerging ones such as offshore renewables and marine biotechnology.

In 2017, the EU Commission had contracted an independent consultant to take stock of the initiative at mid-term. This review – published in February 2018 – highlighted both the positives and negatives of the plan and on foot of its publication, stakeholder conferences were held in each of the Member States of the Atlantic Strategy Group (Ireland, France, Spain, Portugal and the United Kingdom). The Irish event took place in early October 2018 in Dublin and brought together key stakeholders (practitioners and associations), decision makers from national, regional and local levels and managing authorities of EU funds in order to provide responses to the shortcomings identified in the mid-term evaluation of the Atlantic Action Plan. The Irish workshop focused on the two issues of sustainable aquaculture, and maritime connectivity in the EU Atlantic area. The outcomes of the workshops will form the foundation for a revised Atlantic Strategy Action Plan to be produced in 2019.

Ireland played an active role in a number of conferences and seminars throughout 2018, among them the 5th Annual Atlantic Strategy Conference that took place in Vigo, Spain in October. At this event, an Irish initiative – The Cool Route project – led by the Hincks Centre for Entrepreneurship Excellence at Cork Institute of Technology and co-funded under the Interreg Northern Periphery and Arctic Programme, took the main prize at the Atlantic Project Awards 2018 in the category 'to create a socially inclusive and sustainable model of regional development'.

Ireland was also in attendance at European Maritime Day, which took place on 31 May and 1 June in Burgas, Bulgaria. Participants had the opportunity to attend stakeholder workshops and pitch presentations addressing a broad range of maritime issues such as the blue economy; marine spatial planning; maritime security, surveillance and information exchange; marine research, innovation and technologies; and sea basin cooperation and strategies.

Cork will host European Maritime Day in 2020 (Lisbon in 2019) and as such, officials from Cork City Council and the Maritime Affairs Attaché in Brussels attended the event in Burgas to assess the programme, meet with EU officials and talk to past and future hosts of the event with a view to informing their preparation for Ireland's 2020 event.

In October 2018, Ireland was represented at the international Our Ocean Conference in Bali, Indonesia by the Minister for Agriculture, Food and the Marine, Michael Creed TD This annual conference aims to identify solutions and commit to actions in order to address some of the most important challenges facing the oceans: marine protection; marine pollution; climate change impact and sustainable fisheries; the blue economy; and maritime security. Ireland was one of seven EU Member States to make commitments at this conference and overall committed €320 million to direct actions across each of the specific areas. Minister Creed took part in a panel discussion on climate change impact on the oceans, met with various international delegations and met with the Irish attendees at the Youth Summit event that ran alongside the main conference.

During 2018, Ireland contributed to the development of a new EU Maritime Security Strategy Action Plan which was agreed by the European Council in June 2018. The EU's maritime security strategy action plan was first adopted in December 2014 to help safeguard the interests of the EU and protect its member states and citizens. The revision adopted allows for a more focused reporting process to enhance awareness and better follow-up to the strategy.

Ireland continues to work closely with the EU Commission and other institutions in the areas of the blue economy, ocean energy and research and innovation, and recognises the centrality of the EU's maritime policies to the successful implementation of Harnessing Our Ocean Wealth.

European Activities Promoting Opportunities within the Irish Ports Network and Shipping

The Irish Maritime Development Office (IMDO) provides advice to the Department of Transport, Tourism and Sport (DTTAS) and industry on new European policy and funding directions. The IMDO participated in all relevant EU events including those related to the Ten-T Program, Motorways of the Sea, Connecting Europe Facility, and European Short Sea Shipping Network and is working with the Irish stakeholders to win increased levels of funding to develop the maritime industry.

Ten-T Days Event

Ministers, Members of the European Parliament and key stakeholders attended Ten-T Days in Ljubljana, Slovenia, in April 2018 to discuss how to contribute to smart, sustainable and safe mobility, relying on the trans-European transport network and investments in transport connectivity. The IMDO, along with representatives from the Irish ports and from Department of Transports, Tourism and Sport attended the conference. It was a very successful conference which came at a crucial time for the development of the EU transport system. European Commissioner for Transport, Violeta Bulc visited the Irish stand in the exhibition hall endorsing the plans to keep Ireland connected.

Figure 90. Ten-T Days Event. See International and North/South Cooperation. Photo courtesy of the Irish Maritime Development Office

Re-Development of Ten-T Corridors in Light of Brexit

Following on from the proposed realignment of the TEN-T corridors to position Ireland on both the Atlantic and North Sea-Mediterranean corridors, a seminar on 'Ireland's European Connectivity – Ports and maritime links in the Atlantic sea basin' was organised jointly by the European Coordinators for Motorways of the Sea, the Atlantic and North Sea-Mediterranean corridors, in cooperation with the IMDO. The event, held in April 2019, brought together representatives from the ports, maritime transport and logistics sectors to reflect jointly on the current and future situation of ports and maritime links in the Atlantic sea basin, in particular in view of the potential consequences that Brexit may have on that situation and to identify solutions of how to meet those challenges and leverage opportunities.

Event at Shannon Foynes

The IMDO, in conjunction with Shannon Foynes Port Company, brought key stakeholders and funding programme coordinators together in Limerick in May 2018 to address the development of Irish ports and the role that EU funding programmes can play. The event highlighted the opportunity to develop a project of scale to prepare Irish for the future and to close the gap, on a proportionate basis, that exists between the amount of funding drawn down by Ireland's maritime sector and that achieved by other transport sectors across the EU.

Atlantic Action Plan – Connectivity and Ports as Blue Economy Hubs

The European Commission organised a series of workshops on the future of the Atlantic Action Plan. The workshops were set up in cooperation with the five Atlantic Member States: France, Ireland, Portugal, Spain and the UK. The IMDO were involved in working with Ireland's Maritime Affairs Attaché and the European Commission to organise a national workshop related to 'Connectivity and Ports as Blue Economy Hubs'. The event was held in Dublin in October with the IMDO providing an opening overview of Ireland's blue economy. Follow-up actions include promoting greater links between Atlantic ports to improve connectivity in peripheral Atlantic regions.

Representing Ireland at the WaterBorne Technology Platform and other European Advisory Fora

The IMDO is the Irish representative on the Waterborne Technology Platform (TP), which has been set up as an industry-oriented Technology Platform to establish a continuous dialogue between all waterborne stakeholders, such as classification societies, shipbuilders, ship-owners, maritime equipment, manufacturers, infrastructure and service providers, universities or research institutes, and with the EU Institutions, including Member States.

The IMDO participated in the expert group meetings of the Industrial Research Advisory Groups (IRAGs), held in Brussels during 2018, that developed the 'Strategic Research Agenda for the European Waterborne Sector' for the areas of ships and shipping, ports and logistics, and blue growth.

The IMDO were also invited to participate in the Green Shipping Expert Group that will develop a research and innovation agenda as well as an implementation plan for the transformation of waterborne transport to a zero-emission mode of transport in 2050.

In addition to participating in the Waterborne TP, the IMDO are also contributing to the 'Docks the Future' project where the 'port of the Future' concept is being refined for the EU commission to lead to a 'Port of the Future Road Map for 2030'.

Expert group meetings in Porto, Portugal (October 2018) and Trieste, Italy (April 2019) addressed the multitude of existing challenges for the future of the competitiveness of the European Ports, focusing on three different domains – ports integration, ports infrastructures, and ports integration and hinterlands logistics.

Also in 2018, the Department of Transport, Tourism and Sport - Irish Maritime Administration (IMA) - contributed to the development of Greenhouse Gas policy at the International Maritime Organization and European Union; bringing in a new Statutory Instrument on ship recycling; and advancing the ratification of the International Convention on Ballast Water Management.

Further details on the 2018 activities of the IMDO are available under Actions 17 and 24.

International Ocean Discovery Program

ECORD (European Consortium for Ocean Research Drilling) is a management structure of 15 members (14 European countries and Canada) for scientific ocean drilling as part of the International Ocean Discovery Program (IODP) 'Exploring the Earth under the Sea'. The science in IODP involves a wide range of fundamental and applied issues for society, such as climate and ocean change, biodiversity and origin of life, the earth in motion including the study of earthquake processes, and the earth structure and dynamics in relation to its surface environment.

As Geological Survey Ireland is a contributing member since 2005, Irish scientists can apply to take part in IODP expeditions. This provides opportunities for high impact scientific research but also new collaborations. Scientists work globally rather than locally and are part of a larger operation serving science and fundamental understanding.

Dr Aggeliki Georgiopoulou (University College Dublin, School of Earth Sciences) and Dr David McNamara (NUI Galway, Earth and Ocean Sciences) were on board the drill ship JOIDES Resolution (Joint Oceanographic Institutions for Deep Earth Sampling) as part of the Integrated Ocean Discovery Program expedition 372. The expedition started in Freemantle, Australia and finished in Wellington, New Zealand in early January 2018.

Horizon 2020 – Maximising EU Marine Research Funding Opportunities

In conjunction with Department of Agriculture, Food and the Marine (DAFM) representatives, the Marine Institute is National Delegate to the Programme Committee for Societal Challenge 2 (SC2) of the EU Horizon 2020 (H2020) Programme. In 2018, the Institute continued to act in their role as National Contact Point for marine aspects of H2020 funding. Other representation provided by the Institute included the European Marine Board, EurOcean, the Intergovernmental Oceanographic Commission of UNESCO and the Management Board of the Joint Programming Initiative on Healthy and Productive Seas and Oceans (JPI Oceans).

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 (RIA) projects under the All Atlantic Flagship calls have Irish participants. These are NUI Galway (€101,000 for TriAtlas), University College Cork (€140,000 for iAtlantic), and Galway-Mayo Institute of Technology and Cartron Shellfish (€305,000 and €62,000 respectively for AquaVitae). One of two projects funded under the 'Sustainable harvesting of marine biological resources' call is 'Ecologically and economically sustainable mesopelagic fisheries (MEESO)' with the Marine Institute, Teagasc and BIM in the consortium.

Ireland received awards of €1.2 million across BG topics representing a 61.4% success rate for the ranked list (a two-stage process). The drawdown to Ireland comes in at 2.8% of the available budget, well in excess of the 1.2% juste retour 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 €48 million in funding has been won by Irish based researchers across all pillars and societal challenges of the framework programme. €7.9 million of this was in 2018 alone, with awards across 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.

DAFM and the Marine Institute have been monitoring the development of Horizon Europe in conjunction with sister agencies, government departments and the Department of Business, Enterprise and Innovation (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 European Commission (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 Societal Challenge (CS) 5 working group and marine research advisory group. DAFM co-organised the Bio-Based Industries (BBI) information day with UCC at the end of May 2018. BioMarine Ingredients Ireland Ltd presented a case study as a representative of an SME in the 'new' bioeconomy. The EC hosted an SC2 information day the same month, outputs of which were disseminated to interested Principle Investigators and the marine research community. A pilot training programme, funded by Intertrade Ireland and executed by Aqua TT, was undertaken in 2018 for north-south partnerships in H2020 pursuing the coordination of a number of SC2 topics. Personnel from the Marine Institute and the Agri-Food and Biosciences Institute in Northern Ireland attended.

INTERREG Northern Ireland – Ireland – Scotland Bryden PhD Programme

The EU Interreg funded Bryden PhD programme offers fully funded PhD Studentships in marine renewable energy and bio-energy in the following institutions – Queen's University Belfast, University of the Highlands and Islands, Letterkenny Institute of Technology, Ulster University, Agri-Food and Biosciences Institute, Donegal County Council and Dumfries and Galloway Council.

Using a Doctoral Training Centre model, the Bryden Centre project will recruit 34 PhD students and six Postdoctoral Research Associates; each of whom will work with industry to produce industrially relevant research with the potential for commercial exploitation and resulting economic growth within the region. Final output will include peer reviewed journal and conference publications with cross border authorship. Letterkenny IT are the Irish Partners in the project.

Implementing the Galway Statement Trans-Atlantic Research Collaboration

To complement and broadcast the many achievements of AORA, the Atlantic Ocean Research Alliance Coordination and Support Action (AORA-CSA) put a strong emphasis in 2018 on socialising and communicating the keys outputs. A dedicated communications and social media campaign was embarked on to publicise the AORA cooperation and communicate all the achievements under the Galway Statement on Atlantic Ocean Cooperation (signed in May 2013).

Two videos, a suite of animated infographics, brochures and stands were developed. These were publically launched in Brussels in May by the European Commission to mark the five year anniversary of the Galway Statement and subsequently on the North American continent in Washington D.C. at the 'Transatlantic Research Cooperation to Treasure and Protect the Atlantic Ocean' event held at the Woodrow Wilson Center in early June during Capitol Hill Oceans Week.

Throughout 2018, the material produced and the key overarching messages highlighting the importance of the Atlantic Ocean were broadcast at international meetings by the European Commission, US National Oceanic and Atmospheric Administration, and Fisheries and Oceans Canada. A successful social media campaign run by the AORA-CSA Secretariat at the Marine Institute was also delivered.

The AORA-CSA continues to provide flexible responsive supports to coordinate and organise scientific dialogues and other key engagements and outputs for the Atlantic Ocean Research Alliance.

AORA-CSA coordinated a Maritime Alliance and BlueTech Cluster Alliance Workshop together with the European Commission, Marine Resources Unit, Directorate General, Research and Innovation (DG RTD) and the US National Oceanic and Atmospheric Administration (NOAA), to promote a dialogue and solicit input from industry about key research themes for further Atlantic cooperation and address ocean challenges globally. This event was held at the Oceanology International Conference in the ExCel Exhibition and Convention Centre, London.

As part of the communications campaign the AORA-CSA participated in and exhibited at European Maritime Day 2018 in Burgas, Bulgaria, in May 2018.

A Galway at five years panel session took place at the Harnessing Our Ocean Wealth Summit in Galway in June 2018. The event marked the five year anniversary of the signing of the Galway Statement on Atlantic Ocean Cooperation in 2013.

In early December 2018, a High Level AORA Next Steps Workshop was organised in Brussels. This event looked to maximise joint efforts in 2019 for impact beyond the AORA-CSA lifetime. The direction and critical deliveries for the AORA-CSA in 2019 were discussed and agreed on.

Figure 92. Craig McLean NOAA, Máire Geoghegan Quinn (Co-Signatory of the Galway Statement for the European Union), John Bell European Commission, Wayne Moore Fisheries and Oceans Canada, Peter Heffernan Marine Institute

TOSCA Survey - Multidisciplinary Study of a Dynamic Deepwater Environment in the North Atlantic

Geological Survey Ireland (GSI), University College Dublin and the National Oceanography Centre in Southampton co-led a successful scientific voyage to the mid-Atlantic ridge in May 2018. This geological and biological study, named 'Tectonic Ocean Spreading at the Charlie-Gibbs Fracture Zone' (TOSCA) was planned over three years by the project partners. Thirteen scientists in total travelled 1,600 km west from Galway to the site, on board the RV *Celtic Explorer*. During the month at sea, marine surveying equipment including Ireland's ROV *Holland 1* was used to characterise the Charlie Gibbs fracture zone, which consists of two faults, visible on the seabed, that cross the Atlantic

from Ireland to Newfoundland. These faults are parallel and 40 km apart on both the American and European tectonic plates. They continue to separate from the centre of the Atlantic at the mid-Atlantic ridge. The faults, or fracture zones, offset the mid-Atlantic ridge by 370 km. They facilitate a unique style of tectonic plate spreading that result in submarine mountains rising up to 4 km above the abyssal plain.

The success of such a high profile scientific research expedition, to one of the most remote parts of the world, shows that Ireland has the capacity to contribute to globally important marine research. The nine research agencies involved were Geological Survey Ireland; University College Dublin; Marine Institute; National Oceanography Centre Southampton; Queens University Belfast; Memorial University Newfoundland and Marine Institute Newfoundland, Canada; National University of Athens, Greece; and Christian-Albrechts Kiel University, Germany. The expedition was supported by the National Development Plan, the Irish National Research Vessels Ship-Time Programme, the Deutsche Forschungsgemeinschaft, the INFOMAR programme and the Atlantic Ocean Research Alliance.

Figure 93. TOSCA Survey 2018. Photo courtesy of GSI, Department of Communications, Climate Action and Environment

EurofleetPlus

The Marine Institute led Horizon 2020 project EurofleetPlus proposal was successfully funded in 2018. The project facilitates access to the largest advanced research vessel fleet across Europe, Greenland, USA, Canada, Bermuda and New Zealand. The €9.9 million project includes a consortium of 42 marine institutes, universities, foundations and SMEs from 24 countries across Europe, North America and Oceania.

Establishing a strategic roadmap and sustainability plan, the EurofleetPlus project will extend and enhance the capabilities of the European research vessel infrastructure, bringing new perspectives, new ideas, and new research and innovation tracks that will be beneficial to all. the project kick off meeting took place at the Marine Institute in Galway, March 2019.

Further details on the EurofleetPlus project are available under Action 31.

Figure 94. EU H2020 EurofleetPlus Kick-off meeting held at the Marine Institute, Galway (March 2019). Photo courtesy of the Marine Institute

BIM Hosted International Speakers at Its Bradán Salmon Growing Conference in October 2018

Bord Iascaigh Mhara hosted a two day conference on the scientific developments within the salmon farming industry in Galway at the end of October. In line with an increasing global demand for seafood, aquaculture is the fastest growing animal food production sector in the world. Consequently, fish farming operations are evolving rapidly with technologies and equipment under continuous development. The Salmon Growing Conference provided BIM with an opportunity to showcase the latest innovations in Irish operators and included discussions on the growing use of 'cleaner fish' and desalination systems.

In all, 25 presentations from national and international experts covered the latest research and technological developments within the sector. Topics included fish health and welfare, structural and service equipment and organic certification.

Production volumes in Ireland are small by international standards, however, Ireland has a reputation for excellence in organic salmon production. In 2018, Irish salmon production was valued at €114.5 million and amounted to 12,000 tonnes. The Irish salmon farming industry employs circa 210 people with farms located mainly along the west coast of Ireland.

Figure 95. Attending BIM's Bradán Salmon Farming Conference are: Vera Flynn, BIM Finfish Certification; Damien O'Keefe – Irish Salmon Growers Association and Susie Mitchell Aquatic Veterinary

International Collaboration in Fisheries Control

The Sea Fisheries Protection Authority (SFPA) is a member of the Administrative board of the European Fisheries Control Agency (EFCA), which is based in Vigo, Spain. As the National Competent Authority for fisheries conservation in Ireland, SFPA also provided personnel to operate the Central Control and Inspection Centre in Vigo for the Joint Deployment Programmes that EFCA coordinates with member states and, when required, SFPA Sea Fisheries Protection Officers for member states' fisheries patrol vessels.

SFPA hosted the inaugural Fisheries Control Conference in conjunction with the Irish Naval Service at the National Maritime College of Ireland, Cork, in early October 2018. The Fisheries Control Conference 'Risk Based Approach to Inspections' was attended by the Naval Service, the Air Corps, European Control, Fisheries Agency (EFCA) and the SFPA.

The SFPA also participated in Sea Fisheries Control and Seafood Safety related meetings hosted by groups such as Directorate General of Maritime Affairs and Fisheries (DG MARE), Directorate General of Health and Food Safety (DG SANTE), European Fisheries Control Agency (EFCA), Department of Agriculture, Food and the Marine (DAFM) and Food Safety Authority of Ireland (FSAI). During 2018, the SFPA provided support to the North Western Waters Control Experts Group (NWWCEG).

Figure 96. SFPA's Head Office in Clonakilty on 12 September where the SFPA hosted a visit by the Kenyan fisheries delegation to discuss mutual cooperation under the terms of the Memorandum of Understanding (MoU). Pictured are: members of the Kenyan delegation; Susan Steele, Chair; Bernard O'Donovan, Director of Trade Compliance and Internal Audit and Adrienne Patterson, Director of Port Operations, SFPA.

Figure 97. Brian Fitzgerald, Director of IT, SFPA gives a demonstration of the ERS system to members of the Kenyan fisheries delegation at SFPA's Head Office in Clonakilty in September.

Implementing the Common Fisheries Policy (CFP) – North West Waters Regional Group of Member States

The North West Waters Regional Group of Member States (Ireland, Belgium, France, UK, Netherlands and Spain) meets regularly to agree discard plans and other fisheries measures in consultation with relevant stakeholders. A key element of the CFP was the introduction of a practical and phased discards policy or landing obligation by 1 January 2019. Since October 2014, the European Commission has adopted several discard plans, within the parameters laid down in Article 15 of the CFP, in the waters of interest to Irish fishermen in preparation for the full implementation of the landing obligation.

The North West Waters Regional Group of Member States and stakeholders met regularly throughout 2018 to discuss various implementation issues and also to agree to the inclusion of additional measures to support the phasing in of the landing obligation by the target date of the 1 January 2019. It is expected that over time the landing obligation will lead to an improvement in the state of the stocks of importance to Ireland and will result in increased fishing opportunities for the Irish fishing industry. Further details are available under Action 10.

Fish Movements in Irish Waters

The Data Collection Multiannual Programme (DCMAP) is funded under the European Maritime and Fisheries Fund (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 (see Action 10 for further details).

The Programme includes internationally coordinated research surveys. In 2018, Marine Institute staff spent a total of 535 scientist 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.

Regional coordination of the DCMAP was achieved through the Regional Coordination Group (RCG) of the North Atlantic through the work of 12 intersessional subgroups. In 2018, the Marine Institute participated in an industry funded mackerel egg survey carried out by the 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.

Throughout 2018, Marine Institute scientists continued to participate in a range of ICES (Council for the Exploration of the Sea) working groups. This included international Working Group on Eels (WGEEL); Working Group with the Aim to Develop Assessment Models and Establish Biological Reference Points for Sea Trout (Anadromous Salmo trutta) Populations (WGTRUTTA); Working Group on Data Poor Diadromous Fish (WGDAM); Working Group on the Science Requirements to Support Conservation, Restoration and Management of Diadromous Species (WGRECORDS) (by correspondence); and the Regional Coordination Group (RCG) Mediterranean and Black Sea (RCG Med and BS) meeting for Eel (Diadromous Sub-Group).

Blue Fin Tuna – Satellite Tracking their Migration Routes

The Marine Institute, working in collaboration with the International Commission for the Conservation of Atlantic Tunas (ICCAT), continued to track the movements of bluefin tuna (BFT) in 2018, with satellite tags placed on 24 fish 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 2000s, 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 Queen's 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 m. 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.

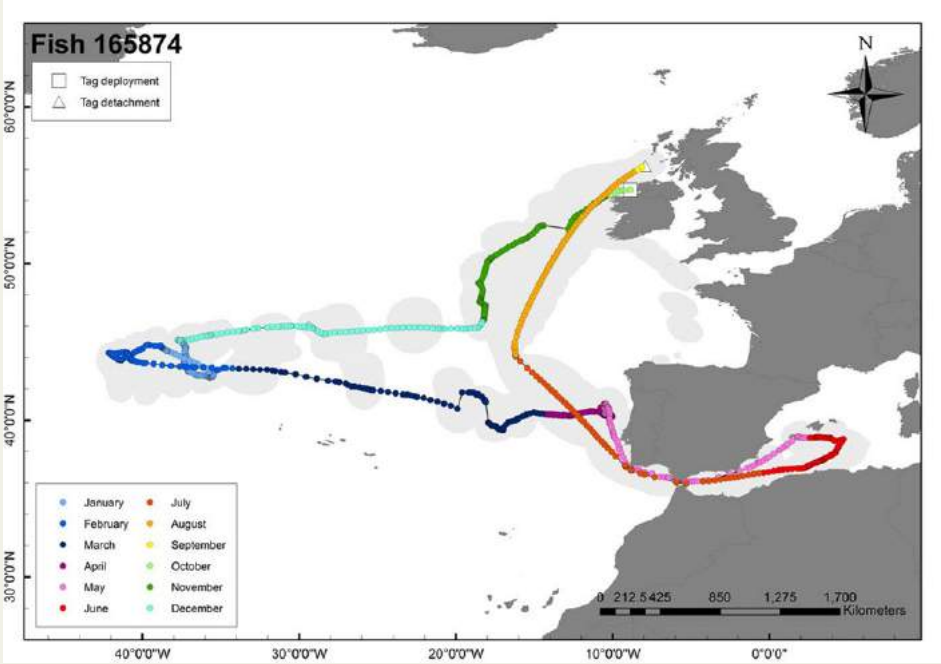


Figure 98. Map courtesy of the Marine Institute

Participating in International Science Policy Fora

Irish-based scientists continue to participate in international scientific and technical fora such as ICES (International Council for the Exploration of the Sea) and OSPAR as experts in working groups.

In March 2018, the Marine Institute hosted the Intergovernmental Oceanographic Commission (IOC) Group 1 preparatory meeting in Dublin attended by twenty international scientists and programme managers. The fifty first Executive Council meeting of the IOC was held in July where national initiatives, such as the coordination of AORA and seabed mapping programmes, were promoted and highlighted.

The Ocean Frontier Institute (OFI) held their first science meeting in St. Johns in October 2018 with high-level representation from their key international partnerships, including the Marine Institute. Subsequently, a series of Ocean Frontier International Fellowships were announced linking and promoting the OFI, the Marine Institute, Geomar, the Norwegian Institute of Marine Research (IMR), the Alfred Wegener Institute (AWI), LabXMer, Woods Hole and the Lamont-Doherty Earth Observatory. Large scale partnership projects were also discussed and are profiled for 2019.

The Marine Institute and MaREI attended the autumn plenary of the European Marine Board (EMB). Dr. Jeremy Gault of MaREI was elected to the executive committee of the EMB for a period of 2-4 years. Planning is underway for the EurOcean 2019 conference in Paris to highlight and celebrate the UN Decade of the Ocean.

Marine Institute – GEOMAR Joint Science Meeting

The Marine Institute continues to build strategically important links with international partners to foster collaborative approaches to the big marine research & innovation challenges. In 2018, the Marine Institute and the German research institute GEOMAR made substantial progress in building a bilateral research alliance with particular focus on joint research in the Atlantic Ocean.

GEOMAR Helmholtz Centre for Ocean Research, Kiel, is one of the leading marine science institutions in Europe. GEOMAR investigates the chemical, physical, biological, and geological processes in the oceans, as well as their interactions with the seafloor and the atmosphere. Research at GEOMAR is organised in four Research Divisions: Ocean Circulation and Climate Dynamics, Marine Biogeochemistry, Marine Ecology, and Dynamics of the Ocean Floor.

Following a number of meetings between the leadership of both institutes, a Joint Science Meeting was held in Kiel in early November 2018 to explore avenues of mutually beneficial cooperation between the two institutes. Science teams from both institutes engaged both before and during the meeting on five selected topics: (i) Deep Sea Technology; (ii) Digital Ocean; (iii) Seabed Mapping; (iv) Ocean Pollution; and (v) Mesopelagic Ecosystems.

The Joint Science Meeting was very successful with new avenues of collaboration and capacity build identified under each of the five thematic areas. The Marine Institute and GEOMAR are also investigating mechanisms to support and jointly fund future collaborative projects from 2019 onwards.

International Data Projects

In 2018, Ireland has connected in to a number of international data projects and networks including SeaDataCloud, EMODNET Ingestion, OpenGovIntelligence and EMODNET Chemistry and Bathymetry. The services and networks being developed by these activities allow for marine data to be integrated and accessed at a pan-European level, which is important for developing regional models and understanding. Connecting in to these projects ensures that Irish marine data is well represented at an international level and that Irish marine researchers can connect with European marine data experts to develop new capabilities.

Joint Programming Initiative on Healthy and Productive Seas and Oceans (JPI Oceans)

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 JPI (Joint Programming Initiative) calls open for submission of transnational proposals in microplastics, blue bioeconomy, marine and maritime technologies and climate research.

Ireland continues to be an active participant the EU Joint Programming Initiatives. The Joint Programming Initiative Healthy and Productive Seas and Oceans (JPI Oceans) was established in 2011 as an intergovernmental platform, open to all EU Member States and associated countries who invest in marine and maritime research. With 20 participating countries (as of 2018), JPI Oceans covers all European sea basins and provides a long-term integrated approach to marine and maritime research and technology development in Europe. Ireland is a member of JPI Oceans and is represented on the JPI Oceans Management Board (General Assembly) by the Marine Institute.

Since its establishment, JPI Oceans has published a Strategic Research and Innovation Agenda and an associated Implementation Plan. Several common programmes of transnational research have been developed, e.g. in the areas of marine microplastics, environmental impacts of deep sea mining, common calibration for marine sensors, and munitions in the sea. Through a programme of research led by Galway-Mayo Institute of Technology, Ireland is participating in a marine microplastics transnational research project supporting applied research on development of common assessment methods and mitigation measures to address microplastics pollution. The Marine Institute and the Department of Housing, Planning and Local Government have jointly committed funding of up to €600,000 towards a second call on marine microplastics, with a deadline for submissions in February 2019.

Further details on a number of specific JPI Oceans co-funding programmes, e.g. MarTERA, BiodivERsA and OCEANERA-NET, are available under Actions 25 and 27.

International Collaboration in Shellfish Safety

One particular highlight for the Marine Institute's shellfish safety team in 2018 was a sizable contribution to the bi-annual International Conference on Harmful Algae (ICHA), held in Nantes, France in October. Marine Institute scientists were involved in 10 presentations at the conference. 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 international laboratories.

In addition, international research collaborations in harmful algal blooms are ongoing with colleagues in Germany and China continued in 2019, and the Marine Institute team continues to run the international certification programme for phytoplankton identification.

The shellfish safety biotoxin team in the Marine Institute 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 laboratories around the world took part in the proficiency testing programme, an increase of approximately 50% in 10 years.

Climate and Ocean Observation

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 changing oceans and climate are essential for the State 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.

The Marine Institute continued in 2018 its involvement in an EU operational oceanographic service, the Copernicus Marine Environment Monitoring Service (CMEMS) providing validation and scientific expertise for the development of biogeochemical numerical models of the Iberia-Biscay-Ireland region.

The Marine Institute's oceanographic 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.

In 2018, the Marine Institute actively contributed 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 (see Action 13a for further details). 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 (SC). 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.

As outlined under Action 13a, Irish scientists (Marine Institute and NUI Galway) undertook the Annual South Rockall Trough Ocean Climate cruise aboard the RV *Celtic Explorer*. In 2018, the Marine Institute continued involvement in the ICES (International Council for the Exploration of the Sea) Working Group on Oceanic Hydrography (WGOH). 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 (conductivity, temperature, depth) standard sections, ocean data buoys and inshore long term monitoring stations in the North Atlantic region.

International Marine Scientific Research Activities in Irish Waters in 2018

Twenty-nine 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 five of these surveys. Of the remaining 24 surveys, 13 were UK vessels and the rest were German (3), Norwegian (2), Spanish (2), Dutch (2), French (1) 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.

Country	Vessel Name	Survey Name /Code	Discipline	No. of Days in Irish waters
UK	*Corystes*	Various	Fisheries, Ecosystems Health, Oceanography, Geology/ Geophysics	27
UK	*Cefas Endeavour*	Groundfish survey using commercially based survey standardised otter trawl.	Fisheries	8
UK	*Cefas Endeavour**	Groundfish survey using 4m beam trawls - part of internationally coordinated WGBEAM survey	Fisheries	10
UK	*Scotia **	Bottom trawl survey targeting juvenile gadoid species	Fisheries	6
UK	*Scotia*	Trawl survey to estimate the abundance and distribution for anglerfish	Fisheries	10
UK	*Scotia*	Bottom trawl survey targeting juvenile gadoid species	Fisheries	11
UK	*Scotia*	Demersal Trawl survey to assess pre-recruit year class strengths of cod, haddock whiting, Norway pout, mackerel and herring.	Fisheries	6
UK	*Prince Madog*	Bluefish Survey - assessment & management of scallop stocks and fisheries	Fisheries, Marine Biology	3
UK	*Prince Madog*	Bluefish Survey - assessment & management of scallop stocks and fisheries	Fisheries	7
UK	*James Cook **	Biogeochemistry and Ecosystems Research at the PAP Sustained Observatory	Oceanography	5
UK	*James Cook **	Habitat Mapping around Haig Fras and Whittard Canyon	Geology/Marine Biology	15

Table 5: Foreign Marine Scientific Research Activities in Irish Waters in 2018 ** Irish observers' participation*

Country	Vessel Name	Survey Name /Code	Discipline	No. of Days in Irish waters
UK	*Sparkling Sea*	Estimate the distribution, abundance and population structure of Cod, Haddock & Whiting in the Irish Sea	Fisheries	3
UK	*MSR Endeavour* *	4m Beam-trawl Groundfish survey	Fisheries	10
Germany	*Maria S Merian*	To obtain continuous time series of the variability of the North Atlantic Current	Physical Oceanography	5
Germany	*Heincke*	AZAHAB	Oceanography	12
Germany	*Walther Herwig III* *	Investigations on fish diseases and biological effects of contaminants	Fisheries, Pollution	6
Norway	*Kings Bay* *	Blue Whiting Acoustic Survey	Fisheries	6
Norway	*Fiskebas* *	Tagging and biological sampling of mackerel	Fisheries	10
Spain	*Miguel Oliver**	Blue Whiting Acoustic Survey	Fisheries	7
Spain	*Vizconde de Eza* * *	Abundance Estimations & Distribution Patterns of Demersal-Benthic Species	Fisheries	13
Netherlands	*Tridens* *	International Blue Whiting Survey	Fisheries	8
Netherlands	*Pelagia* *	The unknown role of Submarine Canyons - pathways or sinks for Organic Carbon	Oceanography, Marine Biology	7
France	*Thalassa* *	Evhoe 18 - French Bottom Trawl Surveys	Fisheries	10
Belgium	*Belgica*	GOLLUM - Seismic Tsunami investigations	Geology/ Geophysics	10

Table 5: Foreign Marine Scientific Research Activities in Irish Waters in 2018

** Irish observers' participation*

4. Focus & Expectations For 2019

Photo courtesy of Jason Clarke

Governance	Prepare sectoral climate change adaptation plans for a number of relevant sectors (including Flood Risk Management, Communications Network, Electricity and Gas Networks, Transport Infrastructure, Built and Archaeological Heritage, Biodiversity and Seafood) as part of the implementation of the National Adaptation Framework, and submit to Government for approval. Local authorities to prepare local adaptation strategies
	Increase stakeholder engagement with the Seafood Sector Climate Change Adaptation Plan – Distribute information leaflets at SFPA Breakfast events, the Skipper Expo, SeaFest and other such industry events to enhance awareness of the adaptation planning process
	Consider a number of complex matters raised by the advice from the Office of the Attorney General on the draft text of the Maritime Area and Foreshore (Amendment) Bill. Following the conclusion of this review by the Marine Legislation Steering Group Legal, options to progress the reform of marine consenting will be brought to Government
	Develop the legislation necessary to prohibit the sale and use of microbeads
	Complete a first draft of the National Marine Planning Framework along with the accompanying environmental assessments
	Launch of industry-led Strategy for the Inshore Fisheries Sector
	Begin preparations for the new European Maritime and Fisheries Fund (EMFF) Operating Programme 2021-2027
	Through further licence determinations, effectively eliminate the shellfish licensing backlog
	Explore various scenarios on the impact of Brexit on the Irish ocean economy
	Continue the implementation of the National Ports Policy in line with published commitments, including the transfers of the remaining ports of regional significance to more appropriate local authority led governance structures. It is anticipated that New Ross and Galway will transfer to the relevant Local Authorities in 2019
	Prepare ports for Brexit, examining possible options such as adjusting infrastructural plans and examining possible new trade routes to mainland Europe. Maintain the ports' engagement with relevant agencies regarding possible requirements post-Brexit and work to try to avoid undue delays. Necessary additional infrastructure has been identified and the OPW are working with the port companies to ensure that this is put in place in a timely manner
	Continue a ports capacity study which will introduce regular capacity forecasting for ports and facilitate future planning, in line with the National Ports Policy, taking cognisance of the potential effects of Brexit
	Develop a performance measurement system for the Ports of National Significance (Tier 1 and Tier 2), in line with the National Ports Policy
	Implement the recommendation actions from the OREDP Review
Maritime Safety, Security & Surveillance	Maintain and enhance the Recognised Maritime Picture and continue to maintain data sharing protocols with external stakeholders (Maritime Safety)
	Continue Civil/Military Working Group research and proposal-making in relation to a Multi-Role Vessel for the Naval Service in accordance with the White Paper on Defence 2015
	Commence work on the mid-life extension project of two P50 class Navy vessels, which will extend the life of the vessels and address obsolescence
	Replace the current fleet of two Airbus Military CN-235 maritime patrol aircraft with larger more capable aircraft

Clean Green Marine	Prepare an interim report on the implementation of the Marine Strategy Framework Directive nationally, as required by Article 18 of the Directive
	Convene an expert working group to advise the Minister for Housing Planning and Local Government on the establishment of spatial protection measures (SPMs) including marine protected areas (MPAs) as required by Article 13 of MSFD and in accordance with the Aichi target 15 relating to MPAs established under the Convention on Biological Diversity
	Draft legislation to provide the Minster for Housing, Planning and Local Government with the necessary powers to create bespoke marine protected areas not currently provided for under existing statutes
	Commence preparatory work for the implementation of Cycle II of MSFD
	Update the administrative provisions in the Dumping at Sea Act. The General Scheme of the proposed legislation to prohibit certain 'rinse down the drain' products containing intentionally added plastic microbeads, will undergo pre-legislative scrutiny in early 2019 but before any ban can be implemented, Ireland will need to seek and receive a derogation from the EU Commission from single market requirements, on environmental grounds
	Continue to work with partner states in OSPAR and the EU to address issues caused by increased human activity both on land and in our oceans which is putting significant pressure on marine ecosystems
	Develop and implement circular economy waste management measures, in particular the EU Plastics Strategy to reduce the impact of marine litter
	Launch of 'Clean Oceans Initiative' - setting a target for 100% of Irish trawlers to recover plastic waste from the oceans
	Analyse data on seabirds in the Irish Sea, collected as part of ObSERVE I, to inform decisions on requirements for additional marine SPAs. Further aerial surveys of potentially important marine seabird areas, as part of the ObSERVE II project, are at the planning stage. The Department of Communications, Climate Action and Environment has committed to work in 2019 with the National Parks and Wildlife Service of the Department of Culture, Heritage and the Gaeltacht to scope, and allocate resources to, a Phase II of the ObSERVE Programme
	Implement the third phase of the SeaRover project to explore the canyon systems of the southern continental shelf

Business Development, Marketing & Promotion	Create a series of Wild Atlantic Way looped drives that will encourage visitors to explore other parts of the region. The Shannon Estuary Drive is the first of ten routes identified. Develop the following drives in partnership with communities and local authorities: Burren Drive (due to launch in 2019); Mulroy Bay Drive (due to launch in 2019); North Cork Drive (work to commence in 2019 for launch in 2020)
	Progress a number of Irish Visitor Experience Development Plans, including: Inishowen Peninsula; Sligo Coast; Clew Bay; Loop Head Peninsula and North Kerry; and Haven Coast (Kinsale to Ballydehob, Co. Cork)
	Develop a number of Masterplans for Wild Atlantic Way Signature Discovery Points for specific locations focusing on visitor management, including: Inishowen Peninsula, Malin Head; Fanad Peninsula; and Keem Bay, Achill Island
	Target the supply of products and services to the continually expanding UK Offshore Wind Industry market, and host an event to showcase Irish SMEs' capabilities to UK Offshore Wind Industry Developers and their Tier 1 Contractors
	Build on the current capacity of circa 80 Irish companies with relevant products and services, to develop an Industry Cluster and a national capability to feed into the UK and Global Offshore Wind Industry
	Invest in the coordination of an Ireland Pavilion at a number of international seafood expos
	Host a Marine Ireland stand profiling Irish capabilities at the Ocean Business marine tech Trade Show in Southampton
	Host the Trade Show at the Our Ocean Wealth Summit in Cork and bring overseas delegations (Norwegian, Middle Eastern and UK) to meet with Irish Companies
	Continue to support the Irish Marine Industry Network (IMIN) through an agency partnership approach and further strengthen the Network by developing outreach and promotional material
	Complete a number of international Trade missions, including a visit to the UAE

Research, Knowledge, Technology & Innovation	Implement the third phase of the SeaRover project to explore the canyon systems of the southern continental shelf
	Continue the implementation of the National Marine Research & Innovation Strategy 2017-2021, holding two meetings of the National Marine Research Funders' Forum, developing a marine research funding directory and conducting a Mid-term Review of the Strategy
	Launch, under the Marine Institute's Marine Research Programme, a number of competitive calls – Cullen Fellowships, joint calls, Networking and Travel Grants, and shiptime access
	Following further investment by Science Foundation Ireland, expnasion of the MaREI Centre to include 12 partner institutions (from original six). Recruitment of additional PIs with internationally recognised expertise in science and engineering to progress MaREI's research strategy
Capacity, Education, Training & Awareness	New Geological Survey Ireland partnership in a European Space Agency funded project on coastal change
	Students learn about Ireland's Atlantic Ocean with scenes from the documentary 'Ireland's Deep Atlantic' becoming part of the Irish Junior cycle curriculum
	Expansion of the Seafood Skills and Training Scheme throughout the Seafood Sector
	Ongoing promotion and facilitate the use of Ireland's Ocean Energy Test Sites
Infrastructure	Tender for the construction phase of a new national Marine Research Vessel
	Continue to invest in a number of capital projects at Ireland's six Fishery Harbour Centres and publically owned Harbour Network as part of the EMFF Fishery Harbour Scheme
	Continue to work with ports to maximise EU funding opportunities for port development
	Dublin Port Company to continue with the implementation of the Alexandra Basin Redevelopment Project (ABR)
	The Port of Cork Company to continue construction on the Ringaskiddy project
	Phase 2 of the Shannon Foynes Port Company's Infrastructure Development Programme

International and North/ South Cooperation	Pilot actions and activities that maximise impact, dissemination and outreach for the Atlantic Ocean Research Alliance e.g. Go Atlantic Blue campaign, developing a Summer School for Atlantic Ocean Youth Ambassadors and coordinating among the Galway Statement tagged EU H2020 research projects for the decadal conference OceanObs'19 and as well as a Marine Microbiome workshop.
	Continue to engage at European level to promote Ireland's interests in keeping with the policies outlined in Harnessing Our Ocean Wealth
	Work with the Atlantic Strategy Steering Group on the revision of the Atlantic Action Plan in partnership the European Commission, France, Portugal, Spain and the UK.
	Irish participation and attendance at European Maritime Day 2019 in Lisbon on May 16-17 and Portugal's Ocean Conference, taking place concurrently
	Continue preparations for the hosting of European Maritime Day 2020
	Preparations in relation to Horizon Europe - the European Comissions ambitious €100 billion research and innovation programme that will succeed Horizon 2020
	Participate in international science policy fora, including engagement with the Ocean Frontier Institute in Canada, European Marine Board planning for the EurOcean 2019 conference in Paris celebrating the UN Decade of the Ocean
	Continue participation in transnational calls, including four JPI calls in microplastics, blue bioeconomy, marine and maritime technologies, and climate research

ouroceanwealth.ie