

# Oceans of Potential

11-12 September 2012

Plymouth Hoe, Plymouth

[www.oceansofpotential.org](http://www.oceansofpotential.org)

# Conference Handbook

& Book of Abstracts



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# Oceans of Potential

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# Oceans of Potential

## Handbook Contents

### Contents

#### Welcome Message

Welcome to the participants of the Oceans of Potential Conference	1
Steering Committee	2

#### Conference Venue

Conference Venue, Marquee, Plymouth Hoe	3
Welcome to Plymouth, United Kingdom	4
Plymouth Map	5

#### Conference Programme

Programme of Events	6
Speaker Biographies (in programme order)	11

#### Book of Abstracts

26th Annual Plymouth Marine Science Lecture	30
Flash Presentations	31
Poster Presentations	33

#### Sponsors

Planet Ocean	55
AstraZeneca	57
Plymouth Marine Science Education Foundation	60
Plymouth Marine Laboratory	61
Marine Biological Association	63
IMarEST	65
Valeport	67
PISCES	69
SAHFOS	71

# Oceans of Potential

## Welcome message

### Welcome to the participants of the Oceans of Potential conference

It is a privilege to welcome you all to the Oceans of Potential Conference here in Plymouth on behalf of the conference co-ordinator Plymouth Marine Laboratory and the conference partners: the Marine Biological Association of the UK, the Sir Alister Hardy Foundation for Ocean Science, Plymouth University Marine Institute, the National Marine Aquarium and the Diving Diseases Research Centre.

Significant effort has gone into the planning and preparation for what promises to be an exciting number of presentations, debates and posters. We bring together stakeholders from a broad range of disciplines placing marine science at the heart of an exciting vision for developing smarter approaches to managing our resources and maximizing the potential of the natural environment to provide for society's needs. We are very grateful to the Steering Committee, and our thanks are also due to the sponsors and exhibitors of the conference.

In addition to the conference sessions, we are looking forward to hosting a panel of experts brought together for a public debate on the serious issues that face fisheries, and their place in the marine environment. Chaired by the popular BBC TV presenter and marine biologist, Monty Halls, the discussion promises to be a lively event with key stakeholders coming together for a frank exchange of opinions and hopefully to reach conclusions that can help formulate the policies to shape our fisheries for decades to come.

The conference will also host the Plymouth Marine Science Education Foundation Medal Lecture, an annual honorary award for researchers who have made major contributions to their field during their career and now pass on their experiences to a new generation of marine scientists and students. This year the honorary speaker is Professor Jan Pentreath, a marine scientist by background and a former Chief Scientist at the UK Environment Agency, presenting on the conference opening night on "Unstable atoms in the oceans: clocks, tracers and DNA".



The Oceans of Potential Conference is an integral part of the first Plymouth Marine City Festival, a citywide celebration of Plymouth's relationship with the sea. All conference participants are very welcome and encouraged to attend the wider events in the city. More information will be available at the conference registration desk.

Thank you for taking part in this conference, which I hope you will enjoy and will provide you with new inspiration, contacts and knowledge for sustaining the world's largest ecosystem whilst making the most of the many benefits the sea provides.

Kind regards,



Professor Stephen de Mora  
Chief Executive, Plymouth Marine Laboratory

## Steering Committee

Chair: Professor Stephen de Mora, Chief Executive, Plymouth Marine Laboratory

Co-ordinator: Thecla Keizer, Head of Marketing, Plymouth Marine Laboratory

Dr Gary Smerdon, Research Director, Dividing Diseases Research Centre

Dr Matt Frost, Deputy Director Policy and Knowledge Exchange, Marine Biological Association of the UK

Dr Jon Parr, Infrastructure & Operations Manager, Marine Biological Association of the UK

Professor Martin Attrill, Director, Marine Institute at Plymouth University

Paul Cox, Head of Science and Learning, National Marine Aquarium

David Johns, Process Manager, Sir Alister Hardy Foundation for Ocean Science

Gill Tanner, Head of Administration, Sir Alister Hardy Foundation for Ocean Science

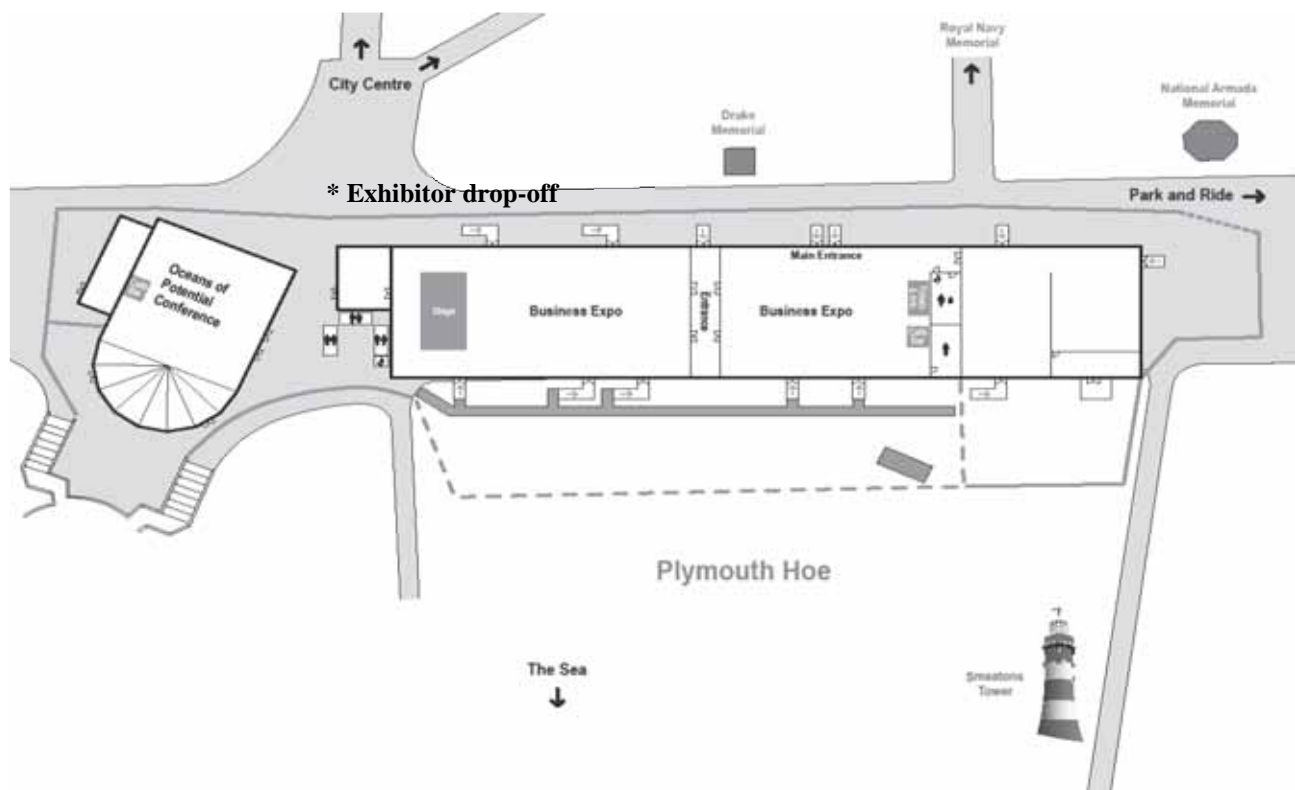
# Oceans of Potential

Registration

## Conference venue, marquee, Plymouth Hoe

The conference will take place in a large marquee on Plymouth Hoe overlooking one of the world's greatest and most beautiful natural harbours, Plymouth Sound. Upon registration, you will receive a Conference Handbook and name badge. You will need to wear the badge during the conference as this will give you access to the venue.

You are invited to join the icebreaker reception taking place in the Conference Marquee from 18:30 Monday 10<sup>th</sup> September, during which you will also have the opportunity to register. The reception will be followed by the Plymouth Marine Sciences Education Foundation Medal Lecture at 19:30 for which the honorary speaker this year is Professor Jan Pentreath, former Chief Scientific Advisor to the Environment Agency. The conference itself will start Tuesday 11<sup>th</sup> September at 09:15, with registration open from 08:30. The Oceans of Potential conference is an integral part of the first Plymouth Marine City Festival, a citywide celebration of Plymouth's relationship with the sea. All conference participants are very welcome and encouraged to attend the wider events in the city. More information will be available at the conference registration desk upon arrival.



# Oceans of Potential

Conference venue

## Welcome to Plymouth, United Kingdom

The largest city in Devon, Plymouth overlooks one of the world's greatest and most beautiful natural harbours, Plymouth Sound. Plymouth's past and present is connected with the sea and its shores have seen the departure of some of history's greatest adventurers including the sailing of the Mayflower and founding of the New World, Sir Francis Drake's defeat of the Spanish Armada, and Captain Cook's search round unmapped territories.

An open plateau, Plymouth Hoe is an excellent spot for a picnic or spotting ships in Plymouth Sound. Historically renowned for Sir Francis Drake's patronage and a game of bowls, Plymouth Hoe is also home to some favorite tourist attractions including Smeaton's Tower, a lighthouse and work of engineering genius.

Situated in Sutton Harbour, the Barbican has a charming ambience resplendent with old architecture and a historic site in its own right. It was from here Captain Cook's adventures started and thousands of convicts were shipped off to Australia. The Pilgrim Father's spent their last night here in 1620 in Island House, before setting sail on their North American Quest. You can visit the Mayflower Steps or the Plymouth Mayflower for more info on Plymouth's nautical heritage, take a rest in the charming Elizabethan Garden or visit the Elizabethan House. Studded with cafés, restaurants and bars, the Barbican also vibrates at night. Just across from the barbican is one of Plymouth's premier attractions, the National Marine Aquarium, the largest and most spectacular of its kind in Britain.

Plymouth City Centre is a modern, pedestrianized area with a wide range of shops, cafes, restaurants and is also home to one of the UK's BBC Big Screens which has become a focal point for the city's open air entertainment since it was installed in 2008.

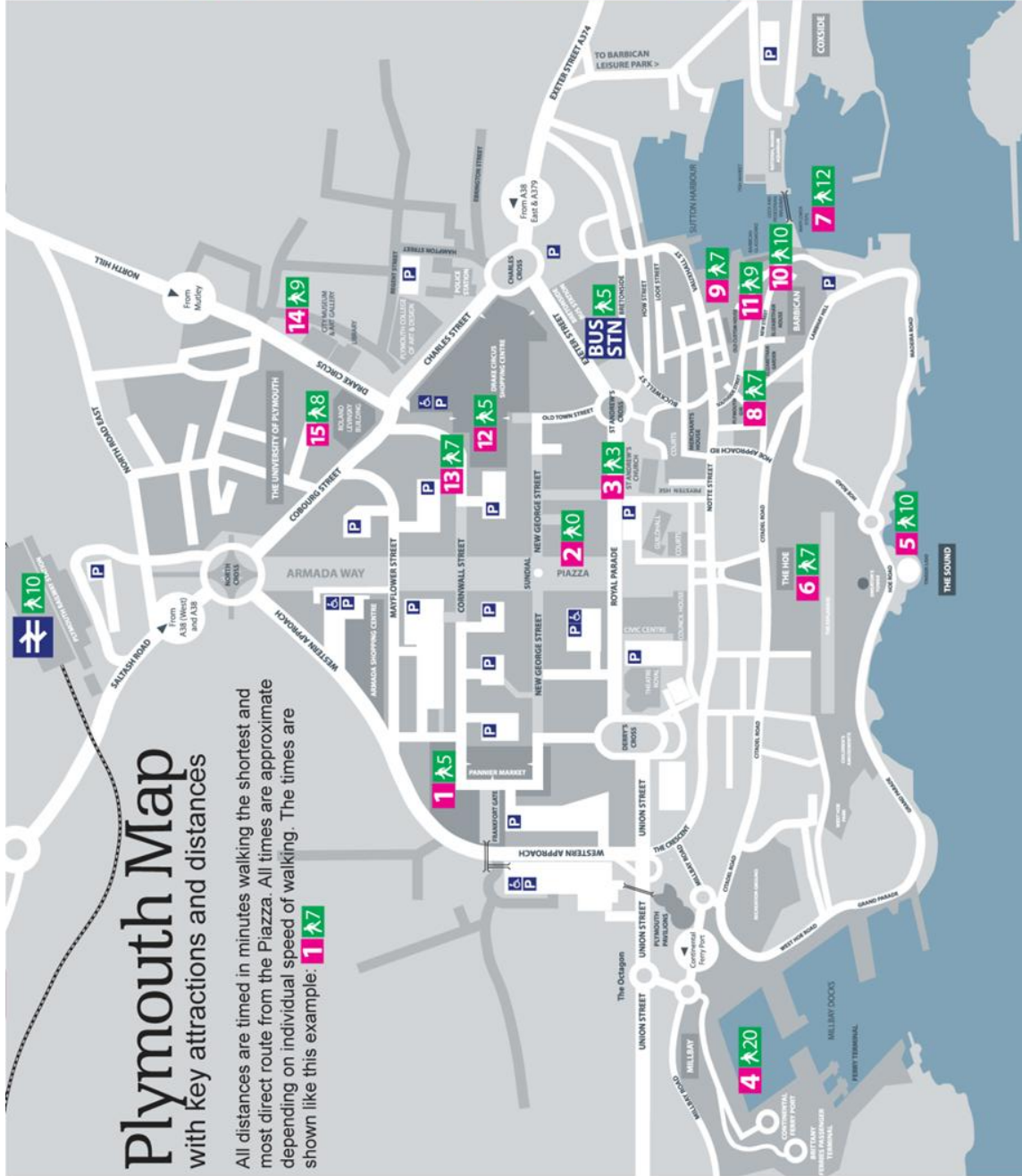
Drake Circus is Plymouth's very own covered shopping centre and home to a wide range of well-known high street and independent stores and restaurants.



# Plymouth Map

with key attractions and distances

All distances are timed in minutes walking the shortest and most direct route from the Piazza. All times are approximate depending on individual speed of walking. The times are shown like this example: **1 ↗ 7**



**1** Independent Quarter



**2** The Piazza



**3** Royal Parade



**4** Millbay



**5** The Sound



**6** The Hoe



**7** Mayflower Steps



**8** Plymouth Gin



**9** Al Fresco dining



**10** Historic Barbican



**11** Modern Barbican



**15** Roland Levinsky Building



**14** City Museum and Art Gallery



**13** Cornwall Street



**12** Drake Circus





# Oceans of Potential

## Programme of events

### Monday 10<sup>th</sup> September, Conference Marquee, Plymouth Hoe

18:30 **Registration and icebreaker reception**

19:30 **26<sup>th</sup> Annual Plymouth Marine Science Education Foundation – Medal Lecture:  
Unstable Atoms in the oceans: clocks, tracers and DNA**

**Honorary speaker:** Professor Jan Pentreath, former Chief Scientist of the UK Environment Agency and currently a Plymouth Marine Laboratory Fellow and Trustee of the Sir Alister Hardy Foundation for Ocean Science

### Tuesday 11<sup>th</sup> September, Conference Marquee, Plymouth Hoe

#### Session 1: Possibilities and visions for the ocean through innovations in science and technology

**Chair: Professor Stephen de Mora, Chief Executive, Plymouth Marine Laboratory**

08:30 **Registration**

09:15 **Welcome**

Professor Stephen de Mora, Chief Executive, Plymouth Marine Laboratory

09:20 **Keynote: Potential of the ocean and challenges of sustainability**

Dr Wendy Watson-Wright, Assistant Director-General, UNESCO and Executive Secretary Intergovernmental Oceanographic Commission (IOC)

09:45 **Keynote: European perspective**

Professor Jacqueline McGlade, Executive Director, European Environment Agency

10:10 **Keynote: A new marine economy and the role of marine science**

Professor Duncan Wingham, NERC Chief Executive and previous Chair of the NERC Science & Innovation Strategy Board

10:35 **Open discussion** (Speakers and Session Chair as panel)

10:50 **Coffee break** – stall & poster exhibition, networking



# Oceans of Potential

## Programme of events

### Session 2: Bioprospecting

**Chair: Professor Nicholas Owens, Director, Sir Alister Hardy Foundation for Ocean Science**

**11:10 Session Keynote: Marine bioprospecting - a role for bioresource centers in the 21st century**

Dr Willie Wilson, Director, National Center for Marine Algae and Microbiota, Bigelow Laboratory for Ocean Sciences, USA

**11:35 Interconnections between the environment and human health – opportunities and challenges**

Professor Lora Fleming, Director, European Centre for Environment and Human Health

**11:50 Sustainable chemicals from cyanobacteria and microalgae**

Dr Carole Llewellyn, Plymouth Marine Laboratory

**12:05 Unilever's perspective on developing new supply chains and innovation within the consumer goods and speciality chemicals industry**

Dr Gianfranco Unali, Open Innovation Manager at Unilever

**12:20 Open discussion (Speakers and Session Chair as panel)**

**12:35 Lunch break – stall & poster exhibition, networking**

### Session 3: Multiple uses of the marine environment (Marine Biological Association special session)

**Chair: Professor Colin Brownlee, Director and Secretary, Marine Biological Association of the UK**

**13:35 Session Keynote: Challenges and future trends**

Susan Avery, President and Director Woods Hole Oceanographic Institution

**14:00 Marine Protected Areas and climate change**

Professor John Pinnegar, Programme Director, Cefas' Marine Climate Change Centre (MC3)

**14:15 Maximising resource potential on the seabed**

Dr Lindsay Jane Seiderer, Managing Director, Marine Ecological Surveys Limited

**14:30 The legal framework for multiple use**

Daniel Owen, Barrister and specialist in the law that regulates how we use the seas and oceans, Fenner's Chambers

**14:45 The UK regulators' perspective**

Dr Melanie Austen, Chief Scientific Advisor, Marine Management Organisation

**15:00 Open discussion (Speakers and Session Chair as panel)**

**15:15 Coffee break – stall & poster exhibition, networking**



# Oceans of Potential

## Programme of events

### Session 4: Fisheries and aquaculture

**Chair: Professor Martin Attrill, Director, Marine Institute at Plymouth University**

- 15:35 **Session Keynote: Predicting the impacts and socio-economic consequences of climate change on global marine ecosystems and fisheries**  
Professor Manuel Barange, Chair of the ICES Scientific Committee and Director of Science, Plymouth Marine Laboratory
- 16:00 **Towards an ecosystem approach to fisheries in Europe: a perspective on existing progress and future directions**  
Professor Simon Jennings, Chief Science Advisor at the Centre for Environment, Fisheries and Aquaculture Science (Cefas), Lowestoft
- 16:15 **Global food and aquaculture futures**  
Professor James Muir, University of Stirling
- 16:30 **Fisheries – future trends in the increasing food and nutrition needs, an industry perspective**  
Mike Park, Chief Executive of the Scottish White Fish Producers' Association (SWFPA)
- 16:45 **Open discussion (Speakers and Session Chair as panel)**

### Expert panel debate on 'Sustainable fisheries in a changing world' followed by a reception

- 17:30 - 21:00 - This debate will be chaired by Monty Halls, a marine biologist best known as a writer, broadcaster and BBC presenter. His recent BBC series "The Fisherman's Apprentice" followed him working for eight months as a lobster fisherman in Cornwall.

Panel members include:

- **Charles Clover**, Journalist and author, producer of the 'End of the Line' film and chairman of Blue Marine Foundation
- **Sheryll Murray MP**, Member of Parliament for South East Cornwall and past representative of the Fishing Industry
- **Mike Park**, Chief Executive of the Scottish White Fish Producers' Association (SWFPA) and Board Member of Seafish
- **Professor Manuel Barange**, Chair of the International Council for the Exploration of the Sea (ICES) Scientific Committee and Director of Science at Plymouth Marine Laboratory
- **Samuel Stone**, Marine Conservation Society Fisheries Officer



# Oceans of Potential

## Programme of events

**Wednesday 12<sup>th</sup> September, Conference Marquee, Plymouth Hoe**

### Session 5: Blue carbon and sustainable energy

**Chair: Dr Gary Smerdon, Research Director, Diving Diseases Research Centre**

- 09:15 **Session Keynote: The environmental impact of marine renewable energy**  
Professor Martin Attrill, Director, Marine Institute at Plymouth University
- 09:40 **Blue carbon**  
Dr Stephen Crooks, Climate Change Director, ESA PWA
- 09:55 **Blue carbon and carbon capture and storage**  
Jonas Helseth, Deputy Director, Bellona Europe
- 10:10 **Australia's national programme on blue carbon, integration and future trends**  
Dr Nick Hardman-Mountford, Senior Marine Scientist, Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia
- 10:25 **Open discussion (Speakers and Session Chair as panel)**
- 10:40 **Coffee break** – stall & poster exhibition, networking

### Session 6: Science fiction to science fact

**Chair: Professor Stephen de Mora, Chief Executive, Plymouth Marine Laboratory**

- 11:00 **Carbon capture and carbon storage – fiction or fact?**  
Professor Stuart Haszeldine OBE FRSE C.Geol, University of Edinburgh
- 11:15 **Geo-engineering – taking control of our planet's climate?**  
Tim Kruger, James Martin Fellow, Oxford Geoengineering Programme, Oxford University
- 11:30 **Innovative offshore greenhouse constructions providing multiple layers of farming**  
Claude Monique Mampaey, Director, Deep Arctic Water BV
- 11:45 **Technology development and *in situ* monitoring**  
Dr Tim Smyth, Head of Science "Cycling the sunlit ocean", Plymouth Marine Laboratory



# Oceans of Potential

## Programme of events

- 12:00 **Flash presentation: Will the next generation of marine scientists be able to deliver sustainable oceans?**  
Dr Hannah Flint, Technical Development Manager, IMarEST
- 12:05 **Flash presentation: The use of bio-plastic to reduce the impact of marine litter (in particular fishing gear) in the marine environment**  
Eleonora Panella
- 12:10 **Flash presentation: Implementing the ecosystem approach through the EU Marine Strategy Framework Directive: the PISCES guide**  
Toby Roxburgh, PISCES Policy Liaison Officer, WWF-UK
- 12:15 **Session Keynote: Commercialising opportunities – best practice and future trends**  
Iain Gray, Chief Executive of the UK Technology Strategy Board (TSB)
- 12:40 **Open discussion (Speakers and Session Chair as panel)**
- 12:55 Conference closing by Professor Stephen de Mora
- 13:00 **Science-industry networking lunch (by registration only) at the Business Expo on the Hoe, followed by a Question and Answer session involving Lord Green, Minister of State for Trade and Investment**
- 14:00 *The Marine Biological Association Annual General Meeting (AGM), at the Citadel Hill Laboratory right next to the conference venue. A full agenda has been sent to MBA members. Tea, coffee and cakes will be served. For details please contact: [membership@mba.ac.uk](mailto:membership@mba.ac.uk).*

## Speaker Biographies (in programme order)

### Plymouth Marine Science Education Foundation Medal Lecture

#### **Prof. R J Pentreath, BSc, PhD, DSc, FSB, FSRP, C Biol., C Rad.P.**

Jan is a Professor Emeritus of The University of Reading. A Chartered Biologist and a Chartered Radiological Protection Professional, he has been elected Fellow of the Institute of Biology and a Fellow of the Society of Radiological Protection. Jan gained his PhD at the University of Auckland, New Zealand (1968), and his DSc, for his research on radioactivity in the marine environment, from the University of London (1980). He has received Honorary DSc degrees from the Universities of Hertfordshire, West of England, and Plymouth.

Before joining the University of Reading Jan had been the Environment Agency's Chief Scientist and Director of Environmental Strategy. Prior to that he had been the National Rivers Authority's Chief Scientist, Director of Water Quality, and Head of Pollution Control. He had come to the National Rivers Authority from having been Head of MAFF's Aquatic Environment Protection Division, and Deputy Director of Fisheries Research, when he was also Chairman of the UK's interdepartmental Marine Pollution Monitoring Management Group. Prior to that he had been Head of Research at the MAFF Fisheries Radiobiological Laboratory, having been a research scientist there since 1969, studying radioactivity in the marine environment.

Jan has served on a large number of IAEA and NEA committees throughout his career, and been involved in a large range of issues relating to radioactivity in the environment and its consequences for the general public and protection issues in a broader sense. Jan has been one of the three independent scientists appointed at any one time by the Secretary of State to the UK's Joint Nature Conservation Committee. As an Honorary Professor at the University of East Anglia, he was Chairman of the Advisory Board of the Center for Social and Economic Research on the Global Environment. He has been a Visiting Professor to the Imperial College of Science, Technology and Medicine, University of London, and a Council Member of several bodies including the Natural Environment Research Council, the UK Marine Biological Association, and the Association for Schools Science Engineering and Technology. He served for many years as one of the independent members of the United Kingdom Atomic Energy Authority's Board Assurance Committee on Safety, Health and the Environment, and is currently a non-executive director of Research Sites Restoration Ltd. Back in his native Cornwall, he is President of the Cornwall Wildlife Trust and President of the Cornwall Sustainable Building Trust.

In addition to being a member and trustee of the International Commission on Radiological Protection, and Chairman of its Standing Committee on the Effects of Radiation on the Environment, he is also a trustee of the Sir Alister Hardy Foundation for Ocean Science, and an Honorary Research Fellow at the Plymouth Marine Laboratory.



**Chair: Professor Stephen de Mora**, Chief Executive,  
Plymouth Marine Laboratory,

Professor Stephen de Mora is the Chief Executive of both Plymouth Marine Laboratory and PML Applications Ltd, as well as an Honorary Visiting Professor in Biosciences at the University of Exeter. Educated in chemistry and oceanography, he obtained a BSc from the University College of Swansea and a PhD from the University of British Columbia, Vancouver.

He has taught chemistry, environmental science, and oceanography at universities in the United Kingdom (University of Lancaster), New Zealand (University of Auckland) and Canada (Université de Québec a Rimouski).

After a 20-year career in academia, he joined the International Atomic Energy Agency (IAEA) Marine Environment Laboratory in Monaco. Through the IAEA, he worked with several Regional Seas Programmes and Global Environment Facility (GEF) projects around the world.

Stephen was presented with a Distinguished Service Award in the year that the IAEA was a co-recipient of the Nobel Prize in 2005. Before returning to the UK to take up the position at PML in 2008, he had established an environmental consultancy based in Canada working for various UN bodies and the World Bank on assignment mostly in Eastern Europe, Western Asia and Central Africa. He assisted UNEP formulate a Caspian Action Plan under the auspices of the Tehran Convention.

His areas of research expertise include environmental analytical chemistry, marine pollution monitoring & assessment, chemical oceanography, biogeochemistry, and polar science. Stephen has undertaken research missions at sea, and in both the Arctic region and Antarctica

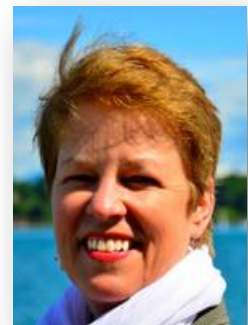


**Keynote: Dr Wendy Watson-Wright**, Executive Secretary and  
Assistant Director General Intergovernmental Oceanographic  
Commission (IOC) of UNESCO

Wendy Watson-Wright has been Assistant Director General and Executive Secretary of the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (IOC-UNESCO) since January, 2010.

Headquartered in Paris, IOC-UNESCO promotes international cooperation and coordinates programmes in marine research, services, observation systems, hazard mitigation and capacity development in order to better manage the nature and resources of the oceans and coastal areas. Within the UN system, the IOC is the focal point for ocean observations, science, services and data exchange, and is considered the competent international organization for marine science under the United Nations Convention on the Law of the Sea (UNCLOS).

From 2001 to 2009, she was Assistant Deputy Minister (ADM), Science, in Fisheries and Oceans Canada (DFO) where she was responsible for providing the leadership, and policy and scientific direction for all science activities in the 15 institutes across the department, including oceanography, hydrography, data management, and fisheries, aquaculture, habitat, climate and aquatic ecosystem science.



Other positions she has held within the Canadian federal public service include research scientist (shellfish toxins) with the Inspection Services branch of DFO in Halifax, Nova Scotia; Director of the DFO St. Andrews Biological Station in New Brunswick, Director General of DFO Audit and Evaluation (Ottawa, Ontario), and Director General of Strategic Policy and later Associate ADM of the Population and Public Health Branch of Health Canada.

She has been a member of several boards including the Canadian Foundation for Climate and Atmospheric Science, ArcticNet and Ocean Networks Canada, and was a Canadian commissioner on the Great Lakes Fishery Commission.

A Killam scholar, Dr. Watson-Wright holds a Ph.D. in Physiology from Dalhousie University in Halifax, Nova Scotia, Canada.

### **Keynote: Professor Jacqueline McGlade**, Executive Director, European Environment Agency

Professor Jacqueline McGlade became Executive Director of the European Environment Agency in Copenhagen in 2003. The EEA is a vital source of information for the European Commission, the European Parliament EU Member States and other EEA member countries in developing and implementing environment and climate policies, and in providing the knowledge base to help Europe make informed decisions about improving the environment and integrating environmental considerations into economic policies so as to develop along a sustainable low-carbon and resource efficient path.



Professor McGlade is currently on leave from her post as Professor in Environmental Informatics in the Department of Mathematics at University College London. Prior to this, she was Director of the Centre for Coastal and Marine Sciences of the UK Natural Environment Research Council, Professor of Biological Sciences at the University of Warwick, Director of Theoretical Ecology at the Forschungszentrum Jülich and Senior Scientist at the Bedford Institute of Oceanography in the Federal Government of Canada.

Her research is focused on the governance of resources and environmental informatics with particular reference to ecosystems, marine resources and climate change. She has more than 100 peer-reviewed papers and more than 200 articles, books and legal submissions and has produced and presented a number of TV and radio series and programmes plus three feature films. She has been awarded international prizes and honours from Czech Republic, Germany, Italy, Monaco, Romania, Sweden, UK and the USA.

Professor McGlade has held a number of key advisory roles and chairs at national level, including Trustee of the Natural History Museum and Board Member of the Environment Agency, at European level, including the European Bank for Reconstruction and Development, and at international levels including for the United Nations and the Consultative Group on International Agriculture Research. She has also run her own company specialising in the area of software development and intelligence systems.



## **Keynote: Professor Duncan Wingham**, Chief Executive, Natural Environment Research Council

Duncan received a BSc from the University of Leeds in 1979, and a PhD from the University of Bath in 1984, both in physics. He joined University College London in 1986, where he held lecturing posts at the Mullard Space Science Laboratory and the Department of Electronic and Electrical Engineering.

He was appointed as a Chair in the Department of Space and Climate Physics in 1996, and was Head of the Department of Earth Sciences at UCL from 2005 to 2010.

He was founder and Director of the NERC Centre for Polar Observation and Modelling (CPOM) from 2000 to 2005 which, among other things, discovered the widespread mass loss from the West Antarctic Ice Sheet and its origin in accelerated ocean melting.

He was Chairman of the Science and Innovation Board of NERC and, since 2000, the Lead Investigator of the ESA CryoSat and CryoSat-2 satellite missions.

Duncan became Chief Executive of the Natural Environment Research Council on 1st January 2012.



### Session 2: Bioprospecting

## **Chair: Professor Nicholas JP Owens BSc PhD CBIol FSB FRGS**, Director, Sir Alister Hardy Foundation for Ocean Science (SAHFOS)

Professor Owens is the Director of the Sir Alister Hardy Foundation for Ocean Science (SAHFOS) based in Plymouth and Professor of Ocean Science at the University of Plymouth. He is also a non-executive director of the Centre for Environment, Fisheries and Aquaculture Science, an executive agency of Defra

Professor Owens trained as a marine biologist and received a BSc from the University of Liverpool and a PhD from the University of Dundee. He first worked at the Plymouth Marine Laboratory where he carried out fundamental research primarily in the field of marine plankton and the links with the cycling of nitrogen and carbon. During this time he spent over three years at sea in research ships, large and small, in seas and oceans relatively near to home - the North Sea, Irish Sea and Western Approaches – to further afield including the Indian Ocean and Antarctic Ocean. In all Professor Owens has published over 100 research articles and papers in the learned literature.

In 1993, Professor Owens was appointed Professor of Marine Science at the University of Newcastle before returning to the Plymouth Marine Laboratory, in 2000, as its Director. In 2007 Professor Owens became the Director of the British Antarctic Survey during which time he visited all parts of the White Continent as well as the High Arctic. In August of this year Professor Owens became the Director of SAHFOS, an organisation which has been monitoring the health of the oceans for over 80 years through research on the plankton: through this move Professor Owens has returned to his first professional love – the plankton.

Professor Owens is married and with his wife has four sons. He lives in the North Pennines.



**Keynote: Dr Willie Wilson**, Director Provasoli-Guillard National Center for Marine Algae and Microbiota, Bigelow Laboratory for Ocean Sciences

Willie Wilson is director of the Provasoli-Guillard National Center for Marine Algae and Microbiota (NCMA). Building on the Center's 30 years of experience in the algae business, Willie's vision is to make NCMA a one-stop service facility for researchers working with marine and freshwater algae, bacteria, and viruses. Willie's academic training was at University of Wales, Bangor and University of Warwick (UK), where he received his B.S., M.Sc., and Ph.D. degrees in Marine Biology/Biochemistry, Cyanobacteria Genetics, and Algal Viruses, respectively.



He served on the senior management team at Plymouth Marine Laboratory, and now has a dual role as NCMA Director and a Senior Research Scientist at Bigelow Laboratory for Ocean Sciences in mid-coast Maine, USA. He recently managed NCMA's relocation to modern, secure, and spacious algal growth facilities in Bigelow Laboratory's new Ocean Science and Education campus.

The NCMA is a non-profit organisation that serves as a central repository to receive, maintain and distribute living cultures of algae. Spanning a broad diversity and holding approximately 3700 strains it represent the world's largest biorepository dedicated to marine algae. The core activity of the NCMA is to supply between 3000 – 4000 cultures each year to scientists, educators, biomedical researchers, and businesses worldwide. It provides a wide range of additional services including sales of growth medium, sales of nucleic acids, algal culturing techniques courses, private collections, algal characterisation, screening services, scale up and biomass production, participation in sponsored research projects and a wide range of research services tailored to individual commercial objectives. Arguably the NCMA's biggest strength is just to be there to provide unbiased and unconditional advice on how to grow algae.

**Professor Lora Fleming**, Professor in both the Miller School of Medicine and the Rosenstiel School of Marine and Atmospheric Sciences of the University of Miami

Professor Fleming is a board certified occupational and environmental health physician and epidemiologist with over 2 decades of experience and expertise in environment and occupational exposures and human health. As a Professor in both the Miller School of Medicine and the Rosenstiel School of Marine and Atmospheric Sciences of the University of Miami, she has mentored many undergraduate and graduate students in occupational and environmental health research and training. She is currently a Professor, Director of the European Centre of Environment and Human Health ([www.ecehh.org](http://www.ecehh.org)), and Chair of Oceans, Epidemiology and Human Health at the University of Exeter Medical School (Truro, Cornwall, UK).



As a physician and epidemiologist, Professor Fleming works in the areas of the Oceans and Human Health, and of Healthy/Sustainable Workplaces. With various interdisciplinary colleagues, she has performed research in the human health exposures and effects of harmful algal bloom toxins ([www.mote.org/niehsredtidestudy/](http://www.mote.org/niehsredtidestudy/)) and microbial pollution ([www.rsmas.miami.edu/groups/ohh](http://www.rsmas.miami.edu/groups/ohh)), and health disparities in the workplace ([www.umiamiorg.com](http://www.umiamiorg.com)); she has also created outreach and educational materials concerning the human health effects of marine and freshwater natural toxins and occupational health issues.

Prof Fleming is a Member of the European Science Foundation Marine Board Oceans and Human Health White Paper Group, the Scottish Association for Marine Science (SAMS) Board, the US National Institute of Environmental Health Sciences (NIEHS) Scientific Advisory Board (SAB) to the NIEHS Gulf Oil Study, and the University of Exeter Environmental Sustainability Institute (ESI) Stakeholder and Management Groups.

## **Dr Carole Llewellyn, Senior Scientist, Plymouth Marine Laboratory**

Dr Carole Llewellyn's interests lie in applying knowledge on marine ecosystem function and microbial chemical/biological interactions to biotechnological challenges. Originally Carole's work focussed on understanding the role of phytoplankton in the ocean in terms of carbon cycling, impacts of climate change and health of the environment.



Carole's expertise has evolved around algal physiology and production of environmentally important molecules. One example is the induction of protective compounds such as carotenoids and UV-protecting mycosporine-like amino acids in response to stress factors including high light, UV, nutrients and infection. Another example is in the production of algal toxins. Such molecules not only provide useful information on the ecology of the environment but they can also help guide industry on the development of novel chemicals.

Carole has led on several algal biotechnology projects working with industrial partners to drive forward on the applications of microalgae in industry particularly for the personal care industry. Carole's more recent focus has been on the increasing availability of microalgal and cyanobacterial sequenced genomes and the rapid development of 'omics' technologies including metabolomics. She is interested in using these technologies to better understand metabolic pathways in microalgae and to work towards developing a systems biology based approach for microalgae to help understand the impact of environmental change and to work towards developing a sustainable chemicals industry.

## **Gianfranco Unali**

Open Innovation Manager at Unilever

Gianfranco Unali has been at Unilever R&D for the last 12 years where he has held a number of research positions. His research interests lie in the area of sustainability, in particular the formulation of sustainable consumer products from home care, to personal care to foods; he has led a number of successful innovation projects in this area. As an Open Innovation manager Gianfranco's has a strong interest in exploring partnerships with other companies which might lead to faster routes to market.



**Chair: Professor Colin Brownlee**, Director and Secretary, Marine Biological Association of the UK

Professor Brownlee coordinates the MBA Research Programme. His research addresses biological processes that underlie major global biogeochemical cycles and the effects of changes in ocean chemistry on the life therein.

Professor Brownlee has worked at the Marine Biological Association since 1983. His research covers intracellular regulation, cell signaling and membrane transport in a range of plant, algal and phytoplankton species. Processes studied include calcification mechanisms in coccolithophores, control of early development in brown algae and signaling in diatoms.



**Keynote: Dr Susan Avery**, President and Director of the Woods Hole Oceanographic Institution

Susan Avery became the ninth President and Director of the Woods Hole Oceanographic Institution in February 2008 and is the first female leader of the institution.

Avery has used her unique position as an atmospheric scientist in charge of a world-renowned oceanographic research institution to underscore the importance of the interactions between the ocean, atmosphere, terrestrial, and human systems in efforts to understand Earth as a whole.

Her previous jobs include interim Vice Chancellor for Research and Dean of the Graduate School at the University of Colorado Boulder, as well as Provost and Executive Vice Chancellor for Academic Affairs. From 1994-2004, she served as director of the Cooperative Institute for Research in Environmental Sciences.

Dr. Avery earned her Ph.D. in atmospheric science from the University of Illinois in 1978 and her research interests include studies of atmospheric circulation and precipitation, the development of new radar techniques and instruments for observing the atmosphere, and the role of climate science in decision support.



**Dr John K Pinnegar**, Programme Director for Marine Climate Change, Centre for Environment, Fisheries & Aquaculture Science

John Pinnegar is Programme Director for Marine Climate Change at Cefas, the UK government fisheries lab in Lowestoft, United Kingdom. His research interests include the impact of climate change on marine animal populations, marine food-webs and ecosystem modelling.

He has published widely on trophic interactions and the relative importance of fishing and climatic factors in determining fish stock status. He has an interest in future scenarios and public perception of maritime climate issues.



He plays an active role in many EU and national research programmes, and regularly provides advice to the UK government and industry. He is an honorary lecturer at the University of East Anglia on fisheries and conservation. He was awarded the Fisheries Society of the British Isles 'FSBI Medal' in July 2009, in recognition of younger scientists who are deemed to have made exceptional advances in the study of fish biology and/or fisheries.

### **Dr Lindsay Jane Seiderer, Managing Director of Marine Ecological Surveys Limited**

Dr Lindsay Jane (Muffy) Seiderer, Managing Director of Marine Ecological Surveys Limited (part of the Gardline Group of Companies) carried out research at the University of Cape Town, including studies on kelp beds and their interactions with key consumer species such as bivalves, ascidians, lobsters and fish. The study of marine bacterial trophic interactions was initiated at the University of Cape Town and she set up and ran the marine microbiological unit within the Zoology Department in order to capitalise on this new field of research.



She has a distinguished series of over 30 research papers, including many on marine microbiology. Subsequent research has centred on analysis of the impact of industrial wastes discharges, sand and gravel extraction and other activities on seabed resources. She was appointed a Director of Marine Ecological Surveys Limited in 1990 and has actively participated in senior advisory work since then. She has contributed to many publications on environmental impact studies as well as technical reports to clients on ecological surveillance worldwide.

Dr Seiderer has recently diversified into the preparation of interactive multi-disciplinary electronic reports. She leads the consultation unit within MESL dealing with all aspects of stakeholder participation.

### **Daniel Owen, Fenner's Chambers**

Daniel Owen is a barrister at Fenner's Chambers, located in Cambridge, England. For the past 11 years, he has had a specialist practice in marine public law. His practice covers the international, European Union and United Kingdom law that governs the use of the world's seas and oceans.

Over the years, Daniel has advised clients on the legal aspects of many sea uses, including, amongst others, bioprospecting, cable laying, fisheries, marine scientific research, mineral exploration and exploitation, natural gas storage, nature conservation, renewable energy generation and shipping. His clients include companies, environmental non-governmental organisations and public bodies.

Daniel is co-author (with Robin Churchill) of 'The EC Common Fisheries Policy' (Oxford University Press, 2010, 640pp). He undertakes some teaching at the postgraduate level, providing approximately eight lectures annually to students studying International Law of the Sea on the LLM Programme at University College London.

Prior to training as a barrister, Daniel obtained a first-class bachelors degree in zoology from Oxford University and then worked for seven years in marine-related fields, first for the International Tanker Owners Pollution Federation (ITOPF), travelling worldwide to attend marine oil spills, and then for the Royal Society for the Protection of Birds (RSPB), as a marine policy officer. His Bar training included a five-month stint as a 'stagiaire' (trainee) in the legal unit of DG Fisheries (now DG Mare) in the European Commission in Brussels. In 1999, he also spent one month on board a commercial fishing vessel in the Southern Ocean, working as a CCAMLR scientific observer.

## **Dr Melanie Austen**, Chief Scientific Advisor to the Marine Management Organisation

Dr Melanie Austen is Chief Scientific Advisor to the UK's Marine Management Organisation (MMO) providing independent, objective advice and challenge to the MMO Board about the quality, objectivity and coherence of evidence and scientific analysis on which the MMO bases its strategy and decisions. She combines her role at the MMO with her appointment as Head of Science at Plymouth Marine Laboratory (PML) for its 'Sea and Society' area of science and its broad spectrum of interdisciplinary research projects from the socio-economics of marine ecosystems and their services through to environment and human health, and marine biodiversity.

She is a marine ecologist with key interests in marine ecosystem services, environmental economics and benthic ecology. She leads EU and UK funded interdisciplinary research that integrates marine biodiversity, ecosystem functioning, ecosystem modelling, marine ecosystem services, and environmental economics to support management for sustainable ecosystems and currently she coordinates the VECTORS EU project ([www.marine-vectors.eu](http://www.marine-vectors.eu)).



### Session 4: Fisheries and aquaculture

## **Chair: Professor Martin Attrill**, Director of the Marine Institute at Plymouth University

Prof. Martin Attrill is a marine ecologist whose primary research interest is focused on the mechanisms behind long-term change and large-scale spatial patterns in marine assemblages and populations. He has been working with long-term data from marine fish and invertebrate populations within a range of habitats such as the Thames Estuary, Brazilian coral reefs and the open Atlantic Ocean, including investigating the role of climate variation on fish, corals and plankton.

He has published over 100 papers in the prime literature, primarily on fish and benthic systems such as seagrass, and has also current projects investigating the roles of Marine Protected Areas, such as the new Defra designation in Lyme Bay, UK. He is a biodiversity impacts coordinator for the Wave Hub project through PRIMaRE, extending his interest in human impacts to large scale offshore renewable developments and how we can effectively and suitably monitor their interaction with the environment; he has published several reviews on the subject. Since May 2009, Prof Attrill has been Director of the Marine Institute at Plymouth University, a multidisciplinary organisation comprising over 180 academic staff working in marine and maritime areas, 250+ researchers and PhD students and 2600 students enrolled on marine and maritime courses.



**Keynote: Professor Manuel Barange**, Director of Science  
Plymouth Marine Laboratory and Chair of the Scientific Committee of  
the International Council for the Exploration of the Sea (ICES)



Professor Manuel Barange is the Director of Science at PML and Chair of the Scientific Committee of the International Council for the Exploration of the Sea (ICES. [www.ices.dk](http://www.ices.dk)). Until 2010 he was Director of the International Project Office of the IOC-SCOR-IGBP core project GLOBEC (Global Ocean Ecosystem Dynamics). Manuel's expertise includes physical/biological interactions, climate and anthropogenic impacts on marine ecosystems, fish ecology, behavior and trophodynamics, and fisheries assessment and management. Manuel was awarded the 2010 UNESCO-IOC Roger Revelle Medal for his accomplishments and contributions to ocean science.

In recent years he has increasingly focused his research on the assessment of climate change and globalisation impacts on marine ecosystems and their services, and on the interactions between natural and social sciences in fisheries, ecosystems and climate change. He was the PI of the recently completed NERC QUEST\_Fish project ([www.quest-fish.org.uk](http://www.quest-fish.org.uk)), PML PI of the multi-agency DEFRA ESPA Deltas project (<http://www.espa.ac.uk/projects/ne-j002755-1>), and a WP leader for the EuroBASIN project ([www.euro-basin.eu](http://www.euro-basin.eu)), among others. He also co-leads the ICES-PICES Strategic Initiative on Impact of Climate Change in Marine Ecosystems. Manuel has over 80 peer-reviewed publications and has edited books on "Climate Change and the Economics of the World's Fisheries" (Elgar Publishers) and "Marine Ecosystems and Global Change" (Oxford University Press).

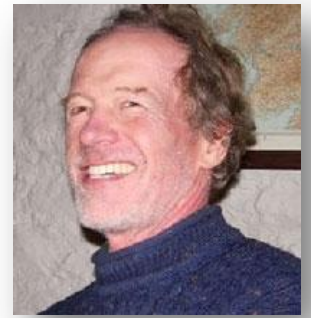
**Professor Simon Jennings**, Chief Science Advisor at Cefas



Professor Simon Jennings is a Chief Science Advisor at the Centre for Environment, Fisheries and Aquaculture Science (Cefas), Lowestoft. Through Cefas, he advises national and international bodies on marine environmental management, with a focus on issues relating to biodiversity and fishery-environment interactions. He is a former Chair of the International Council for the Exploration of the Sea, Advisory Committee on Ecosystems. Simon is also active as a research scientist, and works with colleagues to understand the structure and function of marine systems, to assess human and environmental impacts on populations, communities and ecosystems and to develop and apply tools to support marine environmental and fisheries management. This research is not strongly tied to specific approaches, scales or systems and spans the continuum from fundamental to applied. Research outputs have led to new methods of marine monitoring, assessment and management. Simon also holds a Chair of Environmental Sciences at the University of East Anglia, where he works for one day each week to develop and facilitate research collaborations between the University of East Anglia and Cefas; a contribution to the strategic alliance signed by these institutions in 2008.

## **Professor James Fraser Muir, University of Stirling**

International development and research advisor and evaluator. Professor Emeritus, University of Stirling, UK. Recent member of the UK Foresight Lead Expert Group on the Global Future of Food and Farming, Prof Muir's background is in environmental engineering and economics, with specific expertise in the aquatic/fisheries sector, including resilient production systems, energy and resources, trade, market, investment and development policy; climate change mitigation and adaptation, research and education planning and management. With experience across the academic, commercial and public sectors, as former staff member of FAO and Fisheries Adviser to DFID, and as an adviser to CGIAR and a range of other development bodies, Prof. Muir has an extensive international record in strategic sectoral planning, research management, programme design, management and evaluation, in more than 40 countries worldwide. He has authored and edited more than 200 papers, technical reports, presentations, monographs and books.



## **Mike Park, Chief Executive of the Scottish White Fish Producers Association**

Mike Park entered the fisheries sector at the age of 18, and after a career spanning 30 years, of which 25 were as skipper and company owner, he has recently concentrated his energies towards shore based activities. Mike is currently Executive Chairman of the Scottish White Fish Producers Association, the largest 'fisheries' trade association in the Europe representing 240 individual vessels and 1400 fishermen with a collective turnover approaching €200 million. His other industry commitments include: Member of the Board of the Sea Fish Industry Authority, a ministerial appointment; Member of the Board, Banff and Buchan College of further education; Chairman of Box Pool Solutions Ltd and Vice Chairman of the North Sea Region Advisory Council. Mike also chairs the Scottish Fisheries Sustainability Accreditation Group, the driving force behind certification of the main Scottish Demersal stocks. He is a member of various other industry/government initiatives including Conservation Credits, the group instrumental in changing the face of fisheries in Scotland. Mike is a recent winner of the coveted, 'Scottish Green List' and was the winner of the WWF International Sustainability award in 2011. In his spare time Mike is studying towards a degree in European Affairs through the Open University.





## Panel Debate: 'Sustainable Fisheries in a Changing World'

A high-level panel debate on 'Sustainable fisheries in a changing world' followed by a reception. This debate will be chaired by Monty Halls, a marine biologist best known as a writer, broadcaster and BBC presenter. His recent BBC series "The Fisherman's Apprentice" followed him working for eight months as a lobster fisherman in Cornwall.

**Chair: Monty Halls**, Writer, explorer, television presenter and public speaker

Monty Halls is a writer, explorer, television presenter and public speaker. A former Royal Marines officer who worked for Nelson Mandela on the peace process in South Africa, he left the services in 1996 to pursue a career in leading expeditions. Having achieved a First Class Honors degree in marine biology from Plymouth University, over the next decade he circumnavigated the globe four times on various projects, leading multi-national teams in some of the most demanding environments on earth. In 2002 he was awarded the Bish Medal by the Scientific Exploration Society for his services to exploration.



His television career began when he won Channel Four's Superhuman competition in 2004. Since then he has presented series and documentaries for the BBC, Channel Five, The Discover Channel, The National Geographic Channel and the History Channel. The three Great Escape Series for BBC2 saw Monty and his bonkers dog Reuben live on the west coast of Scotland (2008), the Outer Hebrides (2009) and the west coast of Ireland (2010). After Ireland, Monty went out to Australia to film "The Great Barrier Reef" for the BBC's Natural History Unit. Monty spent much of 2011 living and working as a fisherman, and tells the story of the threats facing the livelihood of the small fleet fishing industry in the UK, resulting in his landmark series The Fisherman's Apprentice where he joined the community at Cadgwith, Cornwall to live and work as a fisherman, to find out what is really involved in getting seafood onto our plates.

## Charles Clover

Chairman of the Blue Marine Foundation

Charles Clover is chairman of the Blue Marine Foundation; a UK based marine conservation charity. He also writes a weekly column on environmental matters for the Sunday Times. He was the author of the book, *The End of the Line* (2004), and was a director of the company that made the award-winning film of the same name (2009). He was the co-author, with the Prince of Wales, of *Highgrove: Portrait of an Estate*, an evaluation of organic farming (1993). Charles was the co-founder, in 2009, of Fish2Fork, an online news site and guide to sustainable fish restaurants, which has strong links to Blue.



## Sheryll Murray MP

Member of Parliament for South East Cornwall

Sheryll is the Member of Parliament (MP) for South East Cornwall, she was born in the village of Millbrook, South East Cornwall. She still lives in the village and before becoming an MP worked for the NHS at a local surgery. Before becoming involved in local Government, Sheryll experienced National and European Governance when she was a representative of the Fishing Industry. She was widowed when she lost her fisherman husband Neil to the sea in March 2011. Sheryll represented Rame on Cornwall County Council and represented her village on Caradon District Council until it was abolished in April 2009. She was the Leader of the Conservative Group from 2003 to 2007.



## Samuel Stone, Fisheries Officer, Marine Conservation Society

Relatively new to the UK, Samuel has a marine science background specialising in benthic ecology, fisheries research and gear technology from Australia. He is currently Fisheries Officer for the Marine Conservation Society UK where he works with the entire seafood supply chain to promote the adoption of sustainable choices and practices.

Prior to this, Samuel has filled numerous posts in the fisheries and NGO sectors including research work with the Centre for Coastal Management, Lismore; two years as a Commonwealth Fisheries Observer; and three years as Senior Project Officer for the UN World Environment Day award winning Moreton Bay Seafood Industry Association, Queensland. This role was of particular relevance to the theme of debate, 'Sustainable Fisheries in a Changing World', because the fisheries represented were the most productive in Queensland, yet were operating in an internationally recognised marine park that was also on the door-step of the fastest growing metropolitan area in the country. Among other projects in this role, Samuel worked on a highly public marine park review and was responsible for the roll-out of a national - and potentially world - first multi-fishery Environmental Management System (EMS) as a means of managing fisheries in a multi-use environment.

Samuel was co-author of the 'Regional Impact Assessment for the Moreton Bay Marine Park' (Williams et al) and was co-investigator for several projects rolled-out in this period.

Samuel has also authored a 'Climate Change Reference Guide for the Australian Seafood Industry' and represented the Queensland seafood industry at various conferences including the first ever conference on fishing vessel energy efficiency, E-Fishing, in Vigo, Spain 2010; and at the International Turtle Symposium in Brisbane 2009.



**Professor Manuel Barange**, Director of Science Plymouth Marine Laboratory and Chair of the Scientific Committee of the International Council for the Exploration of the Sea (ICES)

Professor Manuel Barange is the Director of Science at PML and Chair of the Scientific Committee of the International Council for the Exploration of the Sea (ICES. [www.ices.dk](http://www.ices.dk)). Manuel has over 80 peer-reviewed publications and has edited books on "Climate Change and the Economics of the World's Fisheries" (Elgar Publishers) and "Marine Ecosystems and Global Change" (Oxford University Press).

For further biography details please see Session 4.



**Mike Park**, Chief Executive, Scottish White Fish Producers Association

Mike Park entered the fisheries sector at the age of 18, and after a career spanning 30 years, of which 25 were as skipper and company owner, he has recently concentrated his energies towards shore based activities. Mike is currently Executive Chairman of the Scottish White Fish Producers Association, the largest 'fisheries' trade association in the Europe representing 240 individual vessels and 1400 fishermen with a collective turnover approaching €200 million.

For further biography details please see Session 4.



### Session 5: Blue carbon and sustainable energy

**Chair: Dr Gary Smerdon**, Research Director, Diving Diseases Research Centre

Gary completed his first degree (BSc (Hons) Biological Sciences) and PhD (yeast biotechnology) at the University of Exeter in Devon. In 1991 he moved to the Plymouth Marine Laboratory where he spent 13 years as a molecular biologist developing research into oceanography and coastal shelf science. He learnt to dive at Fort Bovisand in 1996 and in 2003 he was appointed as Research Director at the Diving Diseases Research Centre where he now coordinates and develops DDRC Research.

Research at the Centre ranges from clinical trials to investigations of cellular responses to hyperbaric oxygen, in parallel with diving research involving psychology and general health studies. The goal is to fully understand the impact and uses of altered pressure and altered gas environments, and to maximise their therapeutic potential for improving health.



**Keynote: Professor Martin Attrill, Director of the Marine Institute at Plymouth University**

Prof. Martin Attrill is a marine ecologist whose primary research interest is focused on the mechanisms behind long-term change and large-scale spatial patterns in marine assemblages and populations. Since May 2009, Prof Attrill has been Director of the Marine Institute at Plymouth University, a multidisciplinary organisation comprising over 180 academic staff working in marine and maritime areas, 250+ researchers and PhD students and 2600 students enrolled on marine and maritime courses.

For further biography details please see Session 4.



**Dr Stephen Crooks, Climate Change Director at ESA PWA**

Dr. Crooks is a Senior Wetland Scientist/Geomorphologist. He joined ESA PWA in 2004 after 12 years working on the science and policy of wetlands restoration at leading institutions in Europe. He has devoted his career to capacity building and decision support to meet the challenges of climate change through ecosystem restoration and wise management of wetlands.

Dr. Crooks directs activity across the company related to integration of wetland management into climate change planning and capacity building. At the technical level, he leads wetland restoration feasibility assessments and design, geomorphic assessments of landscape response to sea level rise, development of a wetlands restoration offset protocol and climate change adaptation planning. Dr Crooks has contributed to numerous committees, interdisciplinary research groups and programs. He is co-author of over 50 peer-review papers, book chapters and reports on wetland restoration, geomorphic response of coastal systems to sea level rise, sustainable management of wetland resources and carbon sequestration.



**Jonas Helseth, Deputy Director at Bellona Europa, Brussels**

Jonas Helseth is Deputy Director at Bellona Europa in Brussels, the EU policy office of the Bellona Foundation. He joined Bellona Europa in 2010 after having worked for two years with transport, energy and environmental policies at the Mission of Norway to the EU.

Helseth is currently, among other things, working for Bellona's CCS team, which has produced a number of CCS roadmaps for EU member states in recent years. He leads the organisation's work on biofuels, Bio-CCS and CCS in other industries (than the power sector), and will be taking over as Director for Bellona Europa from 1st September 2012.



**Dr Nick Hardman-Mountford**, Senior Marine Scientist at the Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Dr Nick Hardman-Mountford is a biological oceanographer with more than 15 years research experience in the application of satellite remote sensing and in situ observations in oceanography and marine ecology. In February this year he joined CSIRO Marine and Atmospheric Research in Western Australia as Senior Marine Researcher (Principal Scientist). Previously he has held the positions of Senior Scientist at the Plymouth Marine Laboratory, Ocean Carbon Cycle theme leader in the National Centre for Earth Observation (NCEO) and Acting Director of the Centre for observation of Air-Sea Interactions and Fluxes (CASIX).



His recent research has focused on ocean carbon cycle processes, including assessment of regional air-sea CO<sub>2</sub> fluxes and satellite determination of ocean provinces, phytoplankton community structure, primary production and model validation. He has also led the development and operational implementation of autonomous pCO<sub>2</sub> instrumentation for ship-borne air-sea CO<sub>2</sub> flux monitoring on the UK research vessel fleet. Other accomplishments include co-founding the Marine Environmental Change Network (MECN), a UK network of long-term time series observations, and ChloroGIN, a global network of satellite and in situ chlorophyll measurements (GOOS/GEO pilot project). He has experience as principle investigator or co-investigator on >25 UK and international research grants as well as in commercial consultancy. Since 2000, he has published >40 papers and book chapters, one book with Elsevier, >40 commissioned reports and various articles and has held membership of several professional organisations, steering committees and international working groups. He is currently Australian representative on the International Ocean Colour Coordination Group and a contributor to the coastal working group of the UNESCO Surface Ocean CO<sub>2</sub> Atlas.

**Session 6: Science fiction to science fact**

**Chair: Professor Stephen de Mora**, Chief Executive, Plymouth Marine Laboratory,

Professor Stephen de Mora is the Chief Executive of both Plymouth Marine Laboratory and PML Applications Ltd, as well as an Honorary Visiting Professor in Biosciences at the University of Exeter. Educated in chemistry and oceanography, he obtained a BSc from the University College of Swansea and a PhD from the University of British Columbia, Vancouver.

For further biography details please see Session 1.



**Keynote: Iain Gray**, Chief Executive of the Technology Strategy Board, will present the Closing Keynote and his details can be found towards the end of these biographies.

## **Professor Stuart Haszeldine OBE FRSE C.Geol, University of Edinburgh**

Professor Stuart Haszeldine OBE is professor of carbon capture and storage at the School of GeoSciences, University of Edinburgh and his current research examines geological storage of CO<sub>2</sub>, in the context of climate change and changing energy use. Stuart has over 25 years experience working with subsurface information from basin-scale to field-scale in hydrocarbon extraction and in waste disposal. A geologist by initial training, Stuart has worked on coal, oil and gas deposits, with a wide interest in fossil fuels, radioactive waste disposal and environmental impact.



Stuart was awarded the Scottish Science Prize in 1999, and elected Fellow of the Royal Society of Edinburgh in 2003. Since 2005, he has created the UK's largest University group examining CO<sub>2</sub> storage geology, with a particular focus on natural analogues and seepage processes through overburden.

Stuart was a technical advisor to the House of Commons Science and Technology Committee on CCS in 2006 and in 2007-10 a member of the independent ACCAT committee advising UK Government (DECC) on Carbon Abatement Technologies. He is currently an adviser to the DECC Chief Scientist. Stuart has provided numerous comments on Carbon Capture and Storage to the print radio and TV media, and is an invited speaker on CCS at public and technical conferences. He was appointed OBE in 2012 for services to climate change technologies.

## **Tim Kruger, Director of the Oxford Geoengineering Programme**

Tim runs the Oxford Geoengineering Programme, an initiative of the Oxford Martin School at the University of Oxford, which aims to assess the social, ethical, environmental and technical issues associated with all proposed geoengineering techniques. The aim is to determine which, if any, of the proposed techniques could be used to mitigate the effects of climate change and ocean acidification without creating countervailing side-effects.



He has investigated in detail one potential geoengineering technique, that of adding alkaline materials to the ocean as a way of enhancing its capacity to act as a carbon sink and to counteract the effects of ocean acidification. He is also interested in how proper governance can ensure that any research in this field is undertaken in a responsible way and is one of the authors of the Oxford Principles - a set of draft guidelines for the conduct of geoengineering research.

## **Claude Monique Mampaey, Director, Deep Arctic Water BV**

To cope with the increasing demands for food and food safety standards, and our limited availability of fertile soil, we need to look for new solutions to cope with the expanding challenges. One option is to shift some of our food production to open water.

Deep Arctic Water BV is developing offshore greenhouse structures, which facilitate the production of high quality vegetables, fish, meat and energy according to the principle of cradle-to-cradle. We have the technical design in-house and have found the required partners in the supply chain to help with the realization.



## **Dr Tim Smyth**, Acting Head of Science, Plymouth Marine Laboratory

Dr Tim Smyth is currently acting as a Head of Science at PML, and leads the scientific effort of the Western Channel Observatory. Tim has recently led the extension of the work of the Observatory into the international domain through two EC Interreg projects: Marinexus which involves cross channel collaboration with the Roscoff Observatory and MeDON, which is developing a cabled observatory in collaboration with IFREMER.

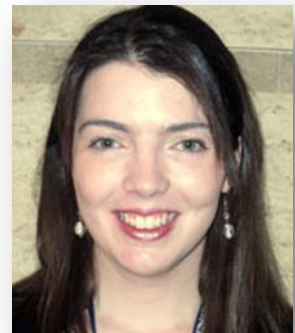


Tim's interests include the determination of inherent optical properties and primary production using satellite ocean colour data, *in situ* optics, aerosol and meteorological measurements. He also has extensive sea-going experience, primarily through the UK SOLAS programme taking in-water and atmospheric optical measurements, has been involved with the Natural Environment Research Council (NERC) CASIX centre of excellence and is a principal investigator with the National Centre for Earth Observation. Tim worked for NEODAAS for over 10 years and is currently a member of the National Centre for Ocean Forecasting executive, promoting collaborations between PML, the Met Office and NERC institutes.

He has over fifty peer-reviewed ISI papers in the literature and is a member of the NERC peer-review college.

## **Dr Hannah Flint**, Institute of Marine Engineering, Science and Technology

Dr Hannah Flint is completing her fourth year working for the Institute of Marine Engineering, Science and Technology (IMarEST) and is currently seconded to the Institute's Australia New Zealand and South Pacific (ANZSPAC) Division in the role of Divisional Manager.



Hannah's academic background has been in the Marine Science sector culminating in the completion of her PhD in 2007 based on ecological patterns in chemosynthetic environments, jointly supported by the University of Southampton and the Natural History Museum. After a year working in oceanographic equipment sales, Hannah took up the role of Membership Development Manager for IMarEST. This position required her to work amongst the membership and their branch committees and also to meet key players across industry, government and academia thus developing a knowledge of "life as a Marine Professional" across all three disciplines that IMarEST represent.

Prior to taking on her current secondment in July, Hannah was working as part of IMarEST's Technical Team and in collaboration with the Institute's Science and Technology Advisory Group (STAG) to further develop the Institute's relevance to the Marine Science community and thus enhance its ability to support and represent its Marine Science Members at an international level. Hannah herself holds membership and registration with IMarEST as a Chartered Scientist (CSci) and Chartered Marine Scientist (CMarSci).

Hannah believes that this internationally recognised external calibration (signifying a known level of academic achievement, experience gained competencies and adherence to a professional code of conduct) has the potential to further empower Marine Scientists internationally with the overall effect of enhancing the credibility of Marine Science as a recognised profession. The consultation Hannah will introduce at Ocean of Potential is stage one of this initiative. IMarEST, working with its STAG members (which include representatives from industry, academia and other Marine Science Societies) aims to provide a structured career pathway combined with sources of relevant technical and professional development which will support and enable the upcoming generation of Marine Scientists.

## Eleonora Panella

Eleonora Panella, is Italian and holds a bachelor degree in Biology and a postgraduate degree in Biodiversity and marine biology. She is currently studying for a postgraduate master on environmental policy and economics. She has been working in Brussels, in the European Parliament in the fisheries Committee and then at WWF EPO as European Marine Programme assistant.

She joined the European Maritime Safety Agency (EMSA) in Lisbon at the end of 2009, as Project Officer for Environmental Protection Marine Environment, she currently follows, among other things, the Ballast Water and alien species issue at EMSA, dealing with the EC, IMO and Members States.



## Toby Roxburgh, PISCES Policy Liaison Officer

Toby is a specialist in marine policy, planning and management with 15 years of experience. He currently works at WWF-UK, as Policy Liaison Officer for the PISCES project, where he is leading the development of a guide to implementation of the ecosystem approach in the Celtic Sea. He has particular expertise in developing and applying tools/approaches to help enhance decision-making, particularly through integration of socio-economic and environmental information.

He has experience in policy development and appraisal, and the provision of advice to businesses/sea-users on development planning and sustainability. Sectoral experience includes major infrastructure projects (energy, industry, transport, utilities etc), tourism, fisheries, water resources, rural development and biodiversity conservation. He has worked widely in UK and international policy, including the UK Marine & Coastal Access Act and EU Directives (Marine Strategy Framework, Environmental Liability, Water Framework and Habitats & Birds). He has directed, managed and provided technical / advisory input to projects in over 20 countries in Europe, Africa, Caribbean, Asia, Americas and the Pacific. Toby has an MSc in Applied Marine Science from Plymouth University.



## Closing Keynote: Iain Gray, Chief Executive of the Technology Strategy Board

Iain Gray is Chief Executive of the Technology Strategy Board. Iain is a Chartered Engineer, a Fellow of the Royal Aeronautical Society, Chairman of the Business and Industry Panel of The Engineering and Technology Board (ETB), a Governor of the University of the West of England and a Board Member of SEMTA and the Energy Technologies Institute.

Iain completed his early education in Aberdeen, culminating in an Engineering Science honours degree at Aberdeen University. He also holds a Masters of Philosophy from Southampton University and has Honorary Doctorates in Engineering and Science from Bath, Bristol and Aberdeen Universities.

Iain joined British Aerospace (now Airbus UK) in 1989 and over time held roles including Director of Strategy and External Affairs and Engineering Director, becoming Airbus UK's Managing Director and General Manager in January 2004. He joined the Technology Strategy Board as Chief Executive in November 2007.







# Oceans of Potential

Book of Abstracts

26<sup>th</sup> Annual Plymouth Marine Science Lecture – 1930 Monday 10<sup>th</sup> September

## **UNSTABLE ATOMS IN THE OCEANS: CLOCKS, TRACERS AND DNA**

Professor Jan Pentreath

Our understanding of chemical behaviour in the oceans is largely based on the stability of the elements, and their ability to react with each other in an orderly way. But not all elements are completely stable, and thus all (or some fraction of) such elements decay into other elements. Some of these unstable forms are naturally occurring, but human activities have now added new ones to the oceans. This unstable property of some elements has various consequences. Their decay enables them to be used as a means of determining the rates at which different processes in the oceans occur. And the ability to

detect them at extremely low concentrations allows us to trace the behaviour and fate of materials in the oceans, and in marine organisms. But their instability also results in the deposition of energy into their surroundings. This can damage living tissue, including that of humans, and it is thus important to know what such effects are, and the risks associated with them, to a high degree of certainty. The knowledge base for humans is very good; that for other organisms, however, has yet to be fully explored.

*This is an Honorary lecture hosted by the Plymouth Marine Science Education Foundation at the Oceans of Potential Conference.*

### **Will the next generation of marine scientists be able to deliver sustainable oceans?**

Flint, H., IMarEST, E: hannah.flint@imarest.org

There are a number of elements that are integral to maintaining sustainability in a rapidly changing world. Ensuring that growth in maritime trade and society's requirement for energy and other resources from the sea are balanced by effective environmental policies is foremost. Second, is that new technologies are enhanced to explore and observe oceans and seas and to implement protection measures. However, of upmost importance, is whether the next generation of Marine Scientists are equipped to deal with the increasing challenges that will face them.

Marine Science covers a huge number of disciplines and is applied across many sectors. Furthermore, Marine Scientists come from a diverse range of backgrounds and move into a wide range of roles. What remains the same, however, is that all Marine Scientists are driven by their curiosity to explore the marine environment with the end desire to advance the field for the benefit of societal needs and to ensure sustainable use of the World's Oceans.

Between September and November 2012 the IMarEST, in association with a number of prominent Learned Societies, Industry and Governmental players, will be conducting a global consultation on Marine Science Skills and Careers with the objective of producing a guidance document for all those wishing to follow a career path in the Marine Science Profession to ensure they are best placed to face the challenges head on. This consultation is targeted at all career stages; students undertaking Marine Science undergraduate and postgraduate courses, early career Marine Scientists and at those Marine Scientists working in senior positions in academia, marine policy, research and business. The consultation will seek to identify

- Whether the correct technical skills and transferable skills are being learnt across disciplines to help the next generation address current challenges and be prepared for future challenges
- Whether transferable skills are suitably being developed throughout an individual's career
- The barriers facing those in emerging economies and developing nations from pursuing a career in Marine Science
- The opportunities available for those in senior positions to influence the next generation of Marine Scientists.

The IMarEST are delighted to launch the consultation at Oceans of Potential 2012. Copies of the consultation document will be available at the IMarEST stand and from [www.imarest.org](http://www.imarest.org).

### **The use of bio-plastic to reduce the impact of marine litter (in particular fishing gear) in the marine environment**

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The Marine Strategy Framework Directive (MSFD, Directive 2008/56/EC), requires Member States to achieve and maintain 'good environmental status' (GES) for their marine waters by 2020. The properties and quantities of marine litter that are considered not to cause harm are outlined in descriptor 10 of GES. The methodological indicators for the descriptor that will need to be applied by Member States in the implementation process are, where (defined in 2010) identified in: as the Characteristics of litter in the marine and coastal environment and Impacts of litter on marine life.

Marine litter is generated either from land-based activities or from marine-based activities. In terms of marine-based activities, the impact of fishing gear has had a particularly negative effect on the environment. This has been exacerbated by the widespread use of non-biodegradable fishing gear, primarily plastics, which are generally more persistent in the

environment than natural materials. There has been little or no coordination to date between Member States to address issues related to Abandoned, Lost or otherwise Discarded Fishing Gear (ALDFG). Without concerted and cooperative effort, the quantity of marine debris by fishing gear in the marine environment will continue to accumulate, along with the associated negative impacts.

The presentation will argue that a “Sustainable Waste Plan” for a more sustainable future of the Oceans should be developed and implemented at EU level, and will focus particularly on the role that bio-plastics can play in reducing the levels of non-biodegradable waste from certain fishing gear.

The presentation will identify the latest available solutions for the creation of bio-plastic with marine compostability characteristics. In addition, suggestions will be made on how such “Plan” could promote the introduction of fishing gear made of bio-plastic either at economic and ecological level, in conformity with the descriptors established by the MSFD.

## **Establishment of new regional-seas stakeholder forums**

Roxburgh T., PISCES – Supporting Sustainable Seas, E: troxburgh@wwf.org.uk

Managing human activities at the regional-sea level (as required by the MSFD and ecosystem approach) requires close collaboration between stakeholders, and between stakeholders and governments across national borders. However, there are no existing mechanisms to allow this exchange. Stakeholders are also under increasing pressure to participate in an ever-growing range of overlapping and closely related marine policies (e.g. marine spatial planning, MCZs, MSFD, Common Fisheries Policy and the Water Framework Directive). There is a real and growing threat of fatigue and disengagement. There is an urgent need for a more organised, strategic and transparent

approach to stakeholder participation in marine policy and management.

The PISCES project, based on a partnership of Celtic Sea industry/sea-users from across the UK, France, Ireland and Spain, proposes that part of the solution is the establishment, formal-recognition and funding of neutrally-led, multi-sector stakeholder forums at the sub-regional level. These forums would need to be adequately funded and, ideally, formally recognised through statutory measures. They could be formed as part of a hierarchy of stakeholder mechanisms, each playing their role at a specific spatial scale and complementing other governance mechanisms (e.g. regional sea conventions, fisheries Regional Advisory Councils, national/sub-national stakeholder forums etc.).

Setting these up and ensuring they operate effectively will not be easy. However, the benefits are potentially significant, both for governments and for stakeholders. They would help stakeholders by enabling them to explore interactions, conflicts and perspectives, and to share ideas and solutions to issues. They would also act as a channel for exchange between stakeholders and government, helping government by negating the need to create new engagement mechanisms, acting as a means for delegating aspects of problem-solving to stakeholders, and helping to meet policy targets more cost-effectively.

By bringing together stakeholders at the regional-sea level, such forums could play an extremely valuable role in supporting trans-national cooperation and consultation in marine planning. They could also help reduce the real and growing issue of stakeholder fatigue by providing a mechanism through which input to all relevant marine policy issues could be channelled for a given area (moving towards a “consult once, use the response many times” approach).

## Poster presentations

No	Title index	Author(s)
1	Help us shape the future of our oceans	Taseer, S.
2	Does living by the coast improve health and wellbeing?	Wheeler, B., White, M., Stahl-Timmins, W., Depledge, M.
3	Ecosystems services and mDPSEEA: Uncharted waters in oceans and human health	Fleming, LE., Morris, G., Beck, S., Hurley, F., Reis, S., Depledge, M., White, M., Cowie, H., Higgins, S., Taylor, T., Austen, A.
4	Linking oceans and human health data	Fleming, LE., Golding, B., Haines, A., Kessel, A., Cichowska, AA., Bloomfield, D., Depledge, M., Hajat, S., Sarran, C., Osborne, N., Sachon, P., Bailey, T., Sabel C.
5	Anthropogenic eutrophication and impacts in coastal waters	Lazzari, L., Wagener, A., Oliveira, C., Baeta, A., Carreira, R.
6	Long-term effects of ocean warming on the prokaryotic community: Evidence from the vibrios	Vezzulli, L., Pezzati, E., Brettar, I., Stauder, M., Reid, P.C., Colwell, R.R., Hofle, M.G., Pruzzo, C.
7	The marine environment and human health: Sea of sorrow or oceanic beloved?"	Harvey, A.
8	Ecotourism potential of the Folu coastal community, Lagos, Nigeria, Southern Gulf of Guinea	Oshisanya, KI., Adegbile, O.M.
9	European Marine Biological Resource Centre	Pade, NG.
10	A collaborative study by fisherman and scientists to understand factors influencing the sustainability of the south Devon edible crab	Pearson, E., Hart, P.
11	Implementing the ecosystem approach through the EU Marine Strategy Framework Directive: the PISCES Guide	Roxburgh T., Dodds, L., O'Mahoney, C., Sutton E., Teleki, K., Varas JL.
12	Towards COast to COast NETworks of marine protected areas (from the shore to the high and deep sea), coupled with sea-based wind energy potential (CoCoNET)	Gammon, M.
13	What do we want from our seas? Using history to inform future scenarios of coastal ecosystem service provision	Selim, S., Blanchard, J., Warren, P., Webb, T.
14	Investigating the role of biodiversity on ecosystem function, under multiple environmental stressors	Bibby, R., Widdicome, S., Findlay, H., Calosi, P., Spicer, J.I.
15	Evaluating the impacts of integrating fisheries and conservation management	Gall, S.C., Sheehan, E.V., Robbins, T., Clark, S., Attrill, M.J., Rodwell, L.D.
16	The future of European shelf fisheries in a changing climate	Simpson, SD., Johnson, M.P., Jennings, S., Rutterford, LA., Blanchard, JL., Schön, P., Sims, DW., Martin, JG.
17	Climate change and pelagic fisheries predictions in Chile (CCliPesca)	Yáñez, E., Barbieri, MA., Soto, L., Martín, GS., Muck, P., Letelier, J., Silva, C., Böhm, G.,

		Aranis, A., Rodríguez, N., Parés, A., Gutiérrez, J.C., Plaza, F., Valdés, D., Vega, R., Rubio, J., Toledo, R.
18	A <i>Haplosporidian</i> -like Infection Parasitising Juvenile (Pre-Recruit) Edible Crab ( <i>Cancer pagurus</i> L) from Pembrokeshire, UK	Thrupp, T., Lynch, S., Wootton, E.C., Vogan, C.L., Malham, S.K., Culloty, S., Rowley, A.F.
19	A Novel fungal infection in pre-recruit edible crabs, <i>Cancer Pagurus</i>	Smith, A., Hamilton, K.M., Hirschle, L., Wootton, E.C., Vogan, C.L., Eastwood D.C., Rowley, A.F.
20	Health status of European lobster ( <i>Homarus Gammarus</i> ) populations	Davies, C.E., Whitten, M., Metzler, A., Tlusty, M., Chistoserdov, AY., Rowley, A.
21	Potential for microplastics to cause harm in the marine environment	Bakir, A., Wright, S., Rowland, S.J., Galloway, T.S., Thompson, R.C.
22	Recovery of a temperate reef Marine Protected Area- Lyme Bay case study	Sheehan, E.V., Stevens, T., Gall, S., Cousens, SL., Attrill, M.J.
23	The front line: Investigating the influence of ocean fronts on marine apex predator spatial ecology	Scales, K.L., Miller, P.I., Votier, S.C., Phillips, R.A., Godley, B.J., Sims, D.W., Ingram, S.N.
24	UK-Integrated Marine Observing Network (UK-IMON)	Mills, D., Bell, M., Brown, J., Cotton, D., Crozier, W., Foden, J., Gowen, R., Frost, M., Inall, M., Moffat, C., de Mora, S., Owens, N., Raynor, R., Willmott, A.
25	DASSH - The UK Archive for Marine Species and Habitats Data	Adams, L., Griffiths, C., Lear, D., Luckraft, I., McGhee, S., Parr, J., Seeley, R.
26	The Atlantic Meridional Transect	Rees, A.
27	Ecological indicators in support of integrated ocean observing	Racault, M-F., Platt, T., Sathyendranath, S., Agirbas, E., Vicente, V.M., Bruun, J.
28	Meroplankton: Understanding the unknown	Lindeque, P., Fileman, E.
29	Subtidal surveys to investigate fine-scale distribution of <i>Sepia officinalis</i> spawning habitat within the English Channel	Bloor, I., Jackson, E.L., Attrill, M.J., Robin, J-P.
30	Presence-only modelling to investigate large-scale distribution of <i>Sepia officinalis</i> spawning grounds within the English Channel.	Bloor, I., Marshall, C., Attrill, M.J., Jackson, E.L.
31	Assessing a bioremediation strategy in a shallow coastal system affected by a fish farm culture - application of GIS and shellfish dynamic models in the Rio San Pedro, SW Spain	Silva, C., Yáñez, E., Martín-Díaz, M.L., DelValls, T.A.
32	GreenSeas analysis framework: Time series analysis giving a quantified science-fact identification approach	Bruun, J., Somerfield, P., Allen, I.
33	Modelling archaeological palaeolandscapes for offshore renewable impact assessments	Gribble, J., Leather, S., Jones, DL.
34	The use of concrete base foundations in offshore wind – The environmental considerations	Reach, I., Jones, DL., Langman, R.

## Help us shape the future of our oceans

E: [contact@p1marinefoundation.org.uk](mailto:contact@p1marinefoundation.org.uk)

Taseer, S.

P1 Marine Foundation (World Ocean Council; ACOPS; The Wildlife Trusts; University of Southampton and The Green Blue)

P1 Marine Foundation is a charity dedicated to the protection and improvement of the marine environment by raising awareness through education and effective partnerships.

The P1 Marine Foundation recognises that there are fundamental values that need to be incorporated to be successful in creating an environmental change.

Our approach is to form partnerships with communities, universities and industry bodies to work together to develop projects that focus on the sustainability of the marine environment.

## Does living by the coast improve health and wellbeing?

E: [mathew.white@pcmd.ac.uk](mailto:mathew.white@pcmd.ac.uk)

Wheeler, B., White, M., Stahl-Timmins, W., Depledge, M.

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It is often assumed that spending time by the coast leads to better health and wellbeing, but there is strikingly little evidence regarding specific effects or mechanisms to support such a view. We analysed small-area census data for the population of England, which indicate that good health is more prevalent the closer one lives to the coast. We also found that, consistent with similar analyses of greenspace accessibility, the positive effects of coastal proximity may be greater amongst more socio-economically deprived communities. We

hypothesise that these effects may be due to opportunities for stress reduction and increased physical activity.

## Ecosystems services and mDPSEEA: Uncharted waters in oceans and human health

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Fleming, L.E., Morris, G., Beck, S., Hurley, F., Reis, S., Depledge, M., White, M., Cowie, H., Higgins, S., Taylor, T., Austen, M.

Oceans and Human Health is a new scientific discipline, bringing together research and training in the oceanographic and biomedical sciences to address the concerns of both the public health and environmental science communities.

In public health, embracing the 'ecological approach' to policy and practice is necessary where planetary and economic considerations suffuse the already complex interactions of social, behavioural, and environmental health determinants. The conceptual model, the modified **Drivers, Pressures, State, Exposure, Effect, Actions (mDPSEEA)** has been used to frame issues in environmental health with reference to social, demographic, cultural, behavioural, and other influences. Initial work demonstrates the capacity to engage multiple stakeholders, identify crosscutting themes, identify a research agenda, and inform policy. Essentially a "process simplification," mDPSEEA offers a crude but flexible "navigation tool" in a complex system.

Environmental science faces similar pressures to integrate the natural and the physical with social, economic, infrastructural, and other anthropocentric concerns. We recognise in the concept of ecosystem services (*provisioning, regulating, supporting, and cultural services benefitting humanity*) a parallel "process simplification." Both mDPSEEA and Ecosystem

Services enable different constituencies and stakeholders to navigate complexity, identify priorities, and speak to wider policy interests, while attempting to preserve both the public health and the health of the environment.

Integrating ecosystem services with the holistic problem-framing approach represented by mDPSEEA can provide a conceptual bridge between ecological public health and more anthropocentric perspectives now taking root in environmental science; furthermore, such an integration will enhance the capacity to frame and address policy-relevant questions in the complex world of oceans and human health. We examine the utility of this approach by outlining how it might be applied to explore the public health and environmental repercussions of different events, e.g. where climate change impacts on environmental pathogens or an oil spill contaminates food and bathing water.

## **Linking oceans and human health data**

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Fleming, L.E.<sup>1</sup>, Golding, B.<sup>2</sup>, Haines, A.<sup>3</sup>, Kessel, A.<sup>4</sup>, Cichowska, A.A.<sup>4</sup>, Bloomfield, M.<sup>2</sup>, Depledge, M.<sup>1</sup>, Hajat, S.<sup>3</sup>, Sarran, C.<sup>2</sup>, Osborne, N.<sup>1</sup>, Sachon, P.<sup>2</sup>, Bailey, T.<sup>5</sup>, Sabel, C.<sup>5</sup>

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### **Background**

The new scientific discipline of Oceans and Human Health brings together research and training in the oceanographic and biomedical sciences to address the concerns of both the public health and environmental science communities.

Many challenges in oceans and human health can be linked to environmental factors, including climate change, harmful algal blooms (HABs), microbial and chemical pollution, and fisheries depletion. However, the research into these linkages remains fragmentary, suffering from the lack of common tools and databases for carrying out investigations across the many different scientific themes, business expertise and resources needed to explore these complex associations. The main aim of this new partnership is to create a central data and analysis source as an internet-based Platform which will be a vital new common resource for oceans and human health research in the UK and beyond.

### **Methods**

Existing databases, currently stored in various locations and organisations (including the UK Met Office and the Health Protection Agency), will be combined. This will enable oceanographic, climate, weather, and environment data to be linked and analysed with human health and wellbeing data. With appropriate confidentiality and ethical safeguards, the Platform will be available to UK and other researchers.

### **Results**

Themed Demonstration Projects will demonstrate the uses of the resource. These Projects have been identified because of: the availability of suitable data sets; the impact of climate, weather, and the environment on human health and wellbeing; and the potential clinical and public health relevance, especially in vulnerable populations.

### **Conclusion**

A final over-arching objective is to translate and communicate the products, presence, and value of the Platform through the Demonstration Projects, workshops, and an accessible web portal. New partner organisations, in the UK and throughout the world, will be invited to use the Platform, and to help build it further.

## Anthropogenic Eutrophication and Impacts in Coastal Waters

Lazzari, L.<sup>1</sup>, Wagener, A.<sup>1</sup>, Oliveira, C.<sup>2</sup>, Baeta, A.<sup>1</sup>, Carreira, R.<sup>1</sup>

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The Guanabara Bay in Rio de Janeiro, Brazil, is an outstanding example of anthropogenic impact in coastal systems due to various activities. In the present work the goals were to determine exchange fluxes of materials between the bay and the adjacent coastal waters and by using stable isotopes to characterize the process influencing the pool of carbon and nitrogen. For this we sampled water over 25 hours in winter and summer from three different depths at a single station strategically positioned in the bay. Measurements included CTD, nutrients, chlorophylls, DOC, POC, PON, carbon and nitrogen stable isotopes in particulate organic matter, among others. Ammonia is the most important species of dissolved nitrogen ( $8 - 46 \mu\text{mol L}^{-1}$ ) and is significantly and inversely correlated with salinity in all depths. There is a marked and tidal independent trend to lower POC, PON,  $\text{NH}_4^+$  in the bottom waters (28 m) as a result of the high organic matter turnover rates in the surface waters. DOC is in general around  $3 \text{ mg L}^{-1}$  but very elevated values (up to  $400 \text{ mg L}^{-1}$ ) were observed in certain periods.  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  varied in the range of 20.08-23.43 ‰ and 2.17-7.11‰, respectively.  $^{13}\text{C}$  depleted organic matter was found principally in the bottom or in samples with lower Chl *a* concentration, while for  $^{15}\text{N}$  the inverse was observed. For carbon this can be interpreted as resulting from degradation of algae material more than deriving from land inputs. The nitrogen isotopic signature seems to be strongly influenced by N derived from sewage in surface and mid depth waters since the  $^{15}\text{N}$  depleted material is found

associated with elevated OD and Chl *a*. C/N ratio varied from 5.3 to 7.3 and showed no correlation with N and C isotopes. The C/N range is typical for primary producers and in the lower range, of bacteria contribution (CAPES, FAPERJ).

## Long-term effects of ocean warming on the prokaryotic community: Evidence from the vibrios

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Vezzulli, L., Pezzati, E., Brettar, I., Stauder, M., Reid, P.C., Colwell, R.R., Hofle, M.G., Pruzzo, C.

Long-term effects of ocean warming on prokaryotic communities are unknown due to the lack of historical data. Vibrios are still regarded by most microbiologists as the dominant culturable bacteria in the ocean and there is good reason to believe that global warming may increase their presence. For example, an unexpected increase in the number of bather infections associated with vibrios was recently reported in Northern-Europe, raising more concern about the role of climate change on *Vibrio* occurrence in the sea. The Continuous Plankton recorder (CPR) survey is one of the longest running marine biological monitoring programs in the world, operated by SAHFOS (UK) since 1954 and it provides a long-term archive of formalin preserved plankton samples. Since plankton represent the largest environmental reservoir for *Vibrio* in the aquatic environment this offers a unique opportunity to investigate *Vibrio* occurrence in the sea over a multi-decadal time scale. The aim of this work is to assess a possible linkage between the occurrence of vibrios, including the human pathogen *V.cholerae* and environmental variables in the southern North Sea over the last half century.



## **The marine environment and human health: Sea of sorrow or oceanic beloved**

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The marine environment offers many goods and services that can benefit human health and well-being but the marine environment can also be the cause of disease, injury or death.

Little is known about how the public perceives the state of the marine environment, how these perceptions impact upon decisions to participate in marine recreation and to what extent these decisions can affect regional economies. This research aims to investigate the barriers and motivators, as well as understand how the perceptions and values of the public influence their decisions to participate in marine recreation. This study is in the early stages of development and this poster highlights the methodologies and background for the doctoral research project.

## **Ecotourism potential of the Folu coastal community, Lagos, Nigeria, southern Gulf of Guinea**

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A rural assessment of the Folu community, located on longitude N06 23.443' and latitude E004 11.767', on the barrier Lagoon coast of Nigeria was surveyed to assess the ecotourism potential of this community using observation checklist, direct observation of potential touristic activities and direct interactions with stakeholders in the community. The resulting discovery of the biological diversity of resources

ranging from several species of sea turtles to dolphins in abundance, a huge sandy beach sheltered with the palm tree *Nypha reticulata*, an enlightened populace, a resort centre La Campagne Tropicana, the open sea front and lagoon. Its relative distance from Lagos city makes this community an ideal location for an ecologically motivated tourist. Factors hindering the progress of this community and tourism development include lack of good governance the bane of Africa's problem, coastal flooding, poor sanitation and poverty, failure to recognize, acknowledge and harness the potentials by government. This community is one of those threatened by climate change and should be ingrafted in the National Adaptation plan, if this is done, it will greatly enhance this community's ecotourism development and prevent it from extinction.

## **The European Marine Biological Resource Centre (EMBRC)**

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European Marine Biological Resource Centre

The oceans represent the largest set of ecosystems on Earth and harbour exceptionally high biological diversity. This biodiversity provides a rich and diverse source of novel organisms, genes and products that underpin a very wide range of basic and strategic biological, biomedical and biotechnological research. Marine research laboratories play a key role in unlocking this potential as well as providing facilities for food security and environmental and ecosystem services research.

Europe has a good coverage of strategically located marine biological research stations at sites showing high biodiversity or ecosystem diversity. Integrating the infrastructure represented by these individual marine stations will increase the efficiency, cost-effectiveness

and visibility of national research and training facilities by facilitating access to the European-wide end-user community thereby providing large scale facilities and associated expertise currently unavailable at national levels.

The **European Marine Biological Resource Centre (EMBRC)** is a distributed research infrastructure, linking 13 marine stations in 8 countries to provide common research goals, collaboration and access to research vessels; scientific diving facilities; aquaria and culture facilities; molecular laboratories, equipment and expertise; bioimaging; bioinformatics; and conference, teaching and training facilities. EMBRC will become the leading infrastructure provider in Europe for the marine biosciences.. EMBRC end users will comprise researchers from scientific institutes, universities, governmental and NGO agencies, SMEs and industry, who wish to apply cutting-edge approaches to study marine model organisms across the biological, biomedical and environmental sciences.

A focus on standardisation of protocols, data collection and sharing of best experimental practices and culturing techniques will ensure a high standard of research, easy access to data and sharing of results. EMBRC will provide technology and knowledge transfer platforms to allow fast and seamless dissemination and translation of scientific discovery into applications and products.

## **A collaborative study by fishermen and scientists to understand factors influencing the sustainability of the south Devon edible crab**

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Fishermen and scientists from the GAP2 project have been working in collaboration over the past year to collect data detailing the spatial and temporal distribution of crab catches and discards throughout the Inshore Potting Area (IPA) off the South Devon coast. The inshore fishery for Edible Crab is mostly executed within a 470km<sup>2</sup> area around Start Point in the English Channel. The IPA was established in 1978 after the inshore trawlers and crabbers agreed on a partitioning of the inshore area to reduce trawl damage to static gear. This area is fully exploited and has been yielding steady crab catches for at least thirty years and probably longer.

A preliminary account of our work will be presented including results of a recent crab tagging programme carried out by CEFAS to assist with interpreting the distribution of catches over space and time. The spatio-temporal catch data and crab immigration and emigration rates from DST tagging will then be combined with fishermen's local ecological knowledge to parameterise a Dynamic Biomass Model for the fishery exploiting the IPA.

This model will be developed to enable crab fishermen to enter early season catch data to provide a sustainable yield for the coming season, and the longer term. This will enable fisher directed stock assessments, and empower crab fishers to knowingly take a sustainable yield. Consequently, the sustainably caught crab should achieve an increased market value and secure fishermen's livelihoods for the future.

## **Implementing the Ecosystem Approach through the EU Marine Strategy Framework Directive: the PISCES Guide**

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The ecosystem approach is a way of making decisions in order to manage our activities more sustainably. It moves away from the traditional sectoral approach, towards one where all human activities are managed in an integrated way. It requires the maintenance of ecosystem services and strong participation of stakeholders. The EU Marine Strategy Framework Directive (MSFD) requires Member States to develop and implement marine strategies using the ecosystem approach, in order to improve the condition of Europe's seas.

PISCES (Partnerships involving Stakeholders in the Celtic Sea Ecosystem), a pioneering EC LIFE+ co-funded project led by WWF-UK, has developed a guide on what is required to implement the EA in the context of the MSFD. Uniquely, the guide represents the "voice" of stakeholders, having been developed through a Celtic Sea-wide partnership of marine industry / sea-user groups from the UK, Ireland, France and Spain.

The guide, due for launch in October 2012, is aimed primarily at marine stakeholders and government decision-makers. It is applicable in the Celtic Sea and other regions. The guide explores what the EA means for both the process of developing and implementing marine strategies, and the overarching governance and management requirements needed to achieve MSFD objectives. As a stakeholder-led initiative, the main focus is on improving stakeholder

participation. The guide recommends practical ways in which stakeholders can input and add value, and what stakeholders and government can do to help ensure this happens.

The guide concludes that involving stakeholders early on will help to ensure that management measures are cost-effective, equitable, affordable and supported. However, achieving this sort of input will require greater stakeholder collaboration and communication and between stakeholders and government, at national and trans-boundary levels. The guide highlights the need to establish multi-sector, regional stakeholder forums to help deliver this.

## **Towards COast to COast NETWORKS of Marine Protected Areas (from the shore to the high and deep sea), coupled with sea-based wind energy potential (CoCoNET)**

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European environmental policies include legislation on protecting species and habitats valuable for their biodiversity, as well as policies for producing energy in cleaner ways. In the marine context, the establishment of marine protected areas (MPA) and installing offshore wind farms (OWF) are important ways to achieve these goals. However, the linking of MPAs as ecologically coherent national (let alone cross-border) networks, and their interaction with proposed OWF development, has been little studied in the European seas.

CoCoNET is part of the EU 7th Research Framework Programme, involving researchers from 39 institutions in 22 countries across Europe, with a budget of €9 million over four years. CoCoNET will research the scientific basis for, and identify potential groups of

interconnected MPA's in both the Mediterranean and Black Seas, shifting from an ad hoc designation of local (single MPAs) to regional (networks of MPAs) and basin (network of networks) scales. The identification of physical and biological connections will clarify the processes that govern patterns of biodiversity distribution in offshore and deep sea areas, ascertaining whether the existing MPAs are sufficient for ecological networking. The results will suggest how to design better marine habitat protection schemes, including the necessary higher-level management measures and monitoring programmes, to maintain and ensure the effective exchange of organisms between protected areas. In addition, an enhanced wind atlas for the Mediterranean and Black Seas will identify areas where potential OFW might be established. Field experiments and modelling will assess the advantages and disadvantages of siting OFW within or near MPA networks and help to elucidate ecologically sensitive design criteria. The project will integrate the Mediterranean and Black Seas scientific and policy communities through intense collective activities and strong communication with stakeholders and the public at large.

The “Oceans of Potential” conference and this project both examine the management of the marine environment and the development of renewable energy.

### **What do we want from our seas? Using history to inform future scenarios of coastal ecosystem service provision**

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Human beings depend on the marine environment for a range of vital ecosystem services, at global (e.g. climate regulation),

regional (e.g. commercial fisheries) and local scales (e.g. coastal defence, recreation). The relationships between these different ecosystem services are not yet well defined, but both positive and negative correlations exist, such that it is impossible for any management strategy to maximise provision of all services concurrently.

At the same time, human activities have also altered the state of marine ecosystems, which in turn affects service provision. Scientists and policy makers are now looking at these issues in a more holistic way and incorporating all aspects – social, economic and ecological – in ecosystem management. However, the knowledge and understanding of marine ecosystems before exploitation goes back only a few decades. As such it is difficult to set strategies and management policies when baselines on how ‘natural’ the system is, cannot be measured or defined.

This Project will be using a historical approach to better understand different states of marine ecosystems and how they provide services on a large spatial and temporal scale. We use historical data to define past scenarios, a modelling approach to derive transition probabilities between scenarios, and social scientific methods to obtain new information on public preferences for different scenarios. Records of biological communities of the study area (North Yorkshire coastal region) is linked with existing information on their functional traits to build an understanding of how the biology of the system ultimately defines the provision of ecosystem services. Here we will present the conceptual framework, model development as well as preliminary analysis of applying ecosystem indicators to snapshots of scenarios of historic ecosystem service provision.

## **Investigating the role of biodiversity on ecosystem function, under multiple environmental stressors**

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Coupled with atmospheric increases in CO<sub>2</sub> gas, is a concomitant decrease in atmospheric oxygen levels and a slow but subsequent rise in the earth's average temperatures. These global changes, primarily driven by anthropogenic activities, are causing alterations to the oceans on an unprecedented scale. Furthermore, the penalties predicted are likely to be heightened within the coastal zone where additional, localised impacts such as nutrient enrichment, hypoxia, pollution, fishing, etc. will likely cause potent consequences that are not yet fully understood.

Coastal ecosystems have an integral role in supporting life on earth and their degradation poses serious threats to human wellbeing. One such degradation is a global loss in biodiversity (the variety of life at multiple levels) which has fuelled investigations into the functional consequences of declining diversity within communities and ecosystems. Although our understanding of the biodiversity-ecosystem-function (BEF) relationship has advanced, information about the potential changes to BEF when subjected to multiple environmental stressors is scarce. Subsequently, the overarching aim of this research is to investigate the role of biodiversity on ecosystem function when multiple environmental stressors (i.e. ocean acidification, hypoxia and temperature) are occurring.

This presentation summarises the importance of moving towards multiple stressor investigations and sets out a directional research pathway that

will form aspects of a 3 year PhD project and contribute to the knowledge gaps in global change science.

## **Evaluating the impacts of integrating fisheries and conservation management**

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Traditionally, fisheries management has focused on the economics of fisheries and management of single species, with conservation coming second to economic imperatives. More recently however, the importance of ensuring sustainability of fisheries through adopting an ecosystem approach to management has been recognized, leading to the introduction of management methods which protect both target species and their supporting ecosystems. The Marine and Coastal Access Act 2009 led to the creation of Inshore Fisheries and Conservation Authorities (IFCAs), whose role includes both fisheries and conservation management. As a consequence of Defra's new management approach, one of their current responsibilities relates to management of European Marine Sites (EMSs), including Special Areas of Conservation (SACs). These sites are protected in line with the requirements of the EU Habitats Directive, and within them, activities known to cause damage are prohibited. The new management approach requires the potential impact of commercial fisheries within EMSs to be assessed, and based on this, the implementation of local management measures as required. Locally, this management falls to the IFCAs. Plymouth University is therefore working with the Devon & Severn IFCA to develop monitoring programs suitable for evaluating the impacts of different fishing

methods on the features of EMSs. This is part of a larger project designed to evaluate the impacts of integrating fisheries and conservation management through assessment of the ecological, economic and social impacts of management measures. The South Devon Inshore Potting Agreement area provides a case study where the impact of static and mobile fishing gear can be assessed. Towed and baited video techniques will be used to quantify impacts of trawling and potting on sessile benthic species and nekton, and socio-economic research will use fisheries data, questionnaires and interviews to qualify and quantify the impacts of management techniques on commercial fisheries and wider stakeholders.

### **The future of European shelf fisheries in a changing climate**

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The European continental shelf is experiencing a period of intense warming, with a 1.3°C rise over the last 30 years and predictions for a further 2.5°C rise during the 21st Century. Evidence is mounting for effects of climate change on marine fish assemblages, but most studies cover short or intermittent time periods

and small geographical areas, with analysis generally focussing on past impacts rather than predicting future effects. First, we present the findings of a macrospatial study of the entire UK marine fish assemblage measured annually for a 30-year period by commercially-independent trawls comprising >100 million demersal fish sampled over an area > 1 million km<sup>2</sup>. We find evidence of community change in the North Sea, NW Scotland, the Channel, and the Celtic and Irish Seas. Exploring these patterns at a fine spatio-temporal resolution, we find strong relationships between measured community change and key environmental drivers, with predictable species-level responses associated with temperature and depth preferences, life-history characteristics and phylogeographic history. Second, we use Generalised Additive Models trained on data from 1980-2005 to predict future patterns of response for commercially-important North Sea demersal fish species during the predicted warmer conditions of 2070-2099. In contrast to current suggestions that populations will maintain abundance by tracking preferred temperatures polewards, by including depth in our models we predict that populations of nine of the ten-most abundant and commercially important North Sea species will decline. Four cold-water species (including Atlantic cod and haddock) decline due to excessive temperatures throughout the North Sea, while five warmer-water species (including plaice and dab) decline due to loss of suitable benthic habitat in preferred thermal niches. We suggest that fishing opportunities for current target North Sea species will decline substantially with warming during the next century, with future fisheries depending upon currently untargeted and newly arriving species.

## Climate change and pelagic fisheries predictions in Chile (CCliPesca)

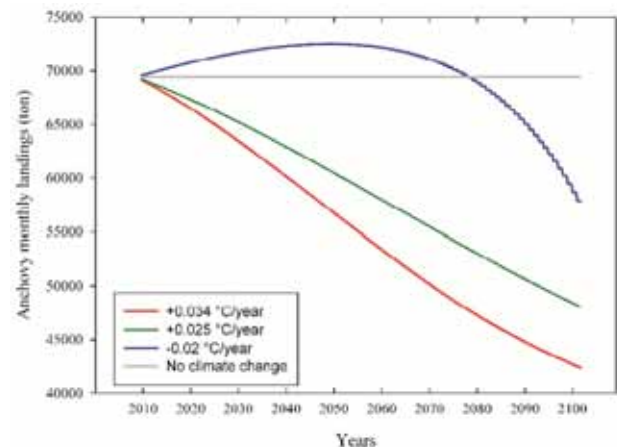
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One of the priorities adopted in national and global fisheries policies is the progressive implementation of an ecosystem approach for fisheries management (EAF) to ensure the sustainability of aquatic resources. Climate Change (CC) will affect fisheries development in the EAF context and it is important to consider such effects at regional and local scales. The conceptual approach of CClPesca project is to link historical and future scenarios of CC with their external environmental (physical) and socio-economic (fishing effort) drivers to assess the impacts on the abundance of pelagic fish (anchovy, sardine, common sardine, jack mackerel and swordfish) species in Chile. The aim of CClPesca is to develop a forecast system to explore how CC will affect the abundance of the future pelagic fisheries resources at the national, regional and local levels. The specific objectives: 1) update and consolidate historical (1950-2011) biological, fisheries and environmental databases; 2) study the effects of CC scenarios in the local environment using Ocean-Atmosphere Global Climate Model (OAGCM) and high-resolution Regional Ocean Modeling System (ROMS); 3) analyse relationships between historical abundance and physical environment. The relationships will

allow developing conceptual ecosystem models for fisheries resources; 4) develop multivariate ecosystem models using advanced techniques (e.g. artificial neural networks) to predict the abundance of pelagic resources from estimate scenarios of environment and fishing effort; 5) predict spatio-temporal changes in the abundance of pelagic fisheries by applying the ecosystem models and time CC scenarios developed in objective 2; 6) develop an Internet application that allows the access to databases and predictions. Figure 1 show a first model developed for monthly anchovy landing that considers different scenarios of CC (Yáñez et al., 2012). CClPesca is funded by FONDEF (Fund for the Promotion of Scientific and Technological Development, Chile Government) programme and will run from January 2013 to July 2015.



**Figure 1.** Monthly anchovy landing projections in northern Chile up to 2100, considering four climate change scenarios (Yáñez et al., 2012).

**Reference:** Yáñez E., M.A. Barbieri, F. Plaza and C. Silva. 2012. *Climate Change and Fisheries in Chile*. In: Behnassi M., Shelat K., Hayashi K., Syomiti M. (eds.), *Vulnerability of Agriculture, Water and Fisheries to Climate Change: Toward Sustainable Adaptation Strategies*, Springer (issue date: Sept. 2012).

**A Haplosporidian-like infection parasitising juvenile (pre-recruit) edible crab (*Cancer pagurus*) from Pembrokeshire, UK.**

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A disease survey was conducted for juvenile (pre-recruit) edible crab *Cancer pagurus* inhabiting intertidal shorelines at two sites of varying salinities in Pembrokeshire, UK. A combination of *in vivo* and *in vitro* methodologies were utilised to assess the prevalence and severity of known and novel diseases. Several different parasites and pathogens were found infecting pre-recruit crabs, including a haplosporidian-like protozoan. The parasite was found infecting the antennal gland of crabs from across the surveys size range (10-70mm carapace width). Prevalence levels were consistently high throughout the sampling period and severity was linked to animal size. Disease prevalence was not found to vary seasonally. Histopathological analysis suggested that the haplosporidium-like parasite causes destruction and hyperplasia of the antennal gland and in severe infections enters the blood to cause a septicaemic infection which has the potential to cause host mortality. This disease may be of significance to the sustainability of crab populations which is of relevance to commercial fisheries.

**A novel fungal infection in pre-recruit edible crabs, *Cancer pagurus***

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In 2010, the edible crab (*C. pagurus*) fishery within the U.K. landed 26,600 tonnes of crabs, worth £35.2 million (FAO, 2012). Little is known about diseases within the pre-recruit (juvenile) populations of this highly economically important species compared to that of the fished adult population. During a study on the overall health of pre-recruit edible crab populations, crabs collected between May and September at two locations in South Wales, U.K., were found to have fungal infection. Animals were surveyed using a variety of techniques, including histology and live blood preparations. Two main stages of infection were identified in histological sections, each with distinct characteristics. Lower severity infections had fungal cells encapsulated within haemocytes in the gill and hepatopancreas, whereas in higher severity infections fungal cells were seen free within the haemolymph. 96% of infected animals had a co-infection with the known dinoflagellate parasite, *Hematodinium*. The novel fungus infection appears to be fatal in pre-recruit crabs, with fungal septicaemia being the primary cause of death. Hence, this fungal pathogen may be a substantial bottleneck in the recruitment of individuals to the U.K. edible crab fishery.



## Health status of European lobster (*Homarus Gammarus*) populations

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This project looked at shell disease syndrome in the European lobster, *H. gammarus*. Shell disease syndrome is a disease state that affects the cuticle of decapod crustaceans leading to pitting and erosion of the cuticle.

Mainly a disease associated with the American lobster; *Homarus americanus*; there have been over 26 confirmed reports of these non-native animals found in UK waters since 1988.

The causative agent of the condition is unknown but bacteria are likely to be involved in lesion progression. In this study, both juvenile European and American lobsters were abraded and the development of ensuing lesions monitored histologically and by scanning electron microscopy. In addition, the nature of the microbial populations in the lesions were assessed using a variety of molecular methods.

The results show that the microbial populations change as the lesions develop. The nature of the bacterial assemblages will be discussed, as well as predicted effects on UK fisheries.

This work was partially supported by a grant from the Fisheries Challenge Fund to A.F. Rowley & M. Tlusty.

## Potential for microplastics to cause harm in the marine environment

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Microplastics are small fragments of marine debris which now appear to be widespread in the marine environment and have been reported at the sea surface, on shorelines and on the sea bed. Microplastics have been identified as particles less than 5 mm in diameter, but fragments much smaller (< 20 mm) than this are widely reported including pieces of nylon, polystyrene, polyethylene and PVC. Since they occupy the same size fraction as sediment grains, microplastics may be ingested by low trophic infauna adopting indiscriminate feeding strategies, the ecotoxicological costs of which remains unknown. It has been suggested that microplastics present potential mechanisms for the transport of persistent organic pollutants (POPs) and the release of chemical additives from plastics, to organisms. Unplasticised PVC (uPVC) and ultra high molecular weight polyethylene (UHMW PE), in the size range 200 to 250 µm, were investigated for their potential to sorb and desorb persistent organic pollutants (POPs) in seawater and also in gut surfactants to simulate the physiological conditions of marine organisms. The sediment-dwelling marine polychaete *Arenicola marina* is a widely distributed, OSPAR-approved species and forms an important component of marine food webs. *A. marina* has already shown the capacity to ingest microplastics. Current work aims to determine the transfer of sorbed contaminants

to organisms and the potential effects of microplastics on the behaviour and health of an ecologically important benthic model invertebrate species. We are using an integrated approach combining sublethal toxicological measurements at the individual level with population level parameters. The results will offer insight into the potential impacts of marine litter on fundamental physiological processes in this important component of the marine benthos and will be used by DEFRA in developing better methods for controlling marine litter as part of the EU Marine Strategy Framework Directive.

### **Recovery of a temperate reef Marine Protected Area – Lyme Bay case study**

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Lyme bay reefs were subject to scallop dredging and demersal trawling, which damaged the fragile mudstone habitat and the associated reef faunal assemblages. In 2008, 206 km<sup>2</sup> of Lyme Bay was granted protection from bottom towed fishing gear while the deployment of static gear such as pots and nets, and SCUBA diving to hand collect scallops are still permitted. This Marine Protected Area was the first in the UK to be established to protect marine biodiversity with no fisheries agenda. It was therefore important to monitor the damaged reef to determine if, when and how the associated fauna recovered. We undertook a four year study examining changes in benthic species assemblages resulting from the closure. A suite of indicator species were selected *a priori* for univariate analyses to represent the range of Lyme bay species' life history traits,

susceptibility to damage, and recoverability. We developed a new, cost-effective and relatively non-destructive method which employed a High Definition video camera, mounted on a towed, flying array to remotely sample the benthic assemblages. Video transects were taken in the newly closed area and at control locations. To quantify changes in the reef nekton and mobile cryptic species, we deployed the High Definition video on a baited static frame. Due to the long lived nature of many of the characteristic sessile species of Lyme bay, such as the pink sea fan *Eunicella verrucosa*, from the offset we anticipated that the time-scale of the project was insufficient to fully determine 'recovery'. However, we suggest that we have detected the early stages of recovery of the reef faunal assemblages and that the benefits of an MPA can still be seen despite the continuation of static fishing gear use.

### **The Front Line: Investigating the Influence of Ocean Fronts on Marine Apex Predator Spatial Ecology**

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Ocean fronts are transition zones between water masses, characterised by steep horizontal gradients in temperature, salinity, turbidity, density and/or colour. These physical features are candidate biological hotspots, acting as aggregation and proliferation zones for pelagic prey species. As such, fronts could be significant features in the foraging seascape of marine top predators. Using novel remote sensing techniques coupled with satellite telemetry, we can acquire near real-time information on the

oceanographic conditions experienced by an animal moving freely through its natural environment, over unprecedented spatial and temporal scales. Working cross-taxa, through collaboration with multiple partners, we aim to investigate and quantify the influence of ocean fronts on the spatial ecology of higher marine vertebrates, across foraging guild and in different oceanographic regimes. Preliminary results indicate that seasonal frontal frequency could be an important indicator of preferred foraging habitat for seabirds, suggesting that these central place foragers target regions of predictable profitability linked to the persistence of ocean fronts. Elucidation of the oceanographic conditions that create intensive-use foraging zones could inform conservation efforts for marine top predators, many of which are of paramount conservation concern.

## **UK-Integrated Marine Observing Network (UK-IMON)**

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There is pressure to reduce the cost of marine data collection, currently estimated at around £80 million per year in the UK. At the same time, new data-intensive observing systems and models are driving a 'data deluge' that

challenges our capability to fully realise the benefits. In addition there are many players using diverse observing systems, but very limited 'common language'. So far attempts to coordinate across the different UK ocean observing communities have had partial success. However, more remains to be done to ensure all marine data, whatever the purpose of its collection, are put to good use and are available to meet future critical information needs. Against this background a workshop held in November 2011 brought together the key UK marine policy, science and operational organisations as well as industry representatives who agreed to form the UK Integrated Marine Observing Network (UK-IMON).

It was agreed that UK-IMON should 'serve societal needs by providing reliable marine data and information, for a better understanding of marine systems, improving safety, enhancing our economy and protecting the environment'. UK-IMON will build on the existing UK marine observing infrastructure.

This poster will provide an overview of partner observing programmes as a step towards the type of information required to identify overlap and opportunities for greater synergy in the future. A list of core variables will be shown that could form the basis of a shared vision of the common measurements to be made across all future UK-IMON partner programmes. An approach is described that will make best use of the existing UK data management and dissemination infrastructure to streamline the process of transforming ecological data into useable information. New web based technologies use this information to provide better evidence and new knowledge of ecosystem structure, function and status.

## **DASSH - The UK Archive for Marine Species and Habitats Data**

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Since 2005 the Marine Biological Association of the United Kingdom (MBA) has hosted DASSH, the Marine and Environmental Data and Information Network (MEDIN) accredited national Data Archive Centre (DAC) for marine species and habitats data.

DASSH provides a focal point for access to marine biodiversity data within the UK and delivers MEDIN and Government data requirements and associated services for the biodiversity community. The centralization of data holdings simplifies the process of data acquisition for users of marine data, greatly reducing the time taken to identify and access relevant datasets. In addition DASSH provides a service to the data providers, acting as a custodian and ensuring data are archived in line with international best practice and current standards.

The data held within DASSH is critical in supporting Marine Spatial Planning, Environmental Impact Assessments and to provide the evidence base to achieve Good Environmental Status (GES) under the Marine Strategy Framework Directive (MSFD). In addition DASSH assists in meeting the reporting requirements of UK Marine Monitoring and Assessment Strategy, which in turn addresses the reporting for more than 40 national and international obligations including OSPAR, Water Framework Directive (WFD) and other marine environmental directives. Potential future sustainable development of our oceans requires access to all available data.

## **The Atlantic Meridional Transect (AMT)**

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AMT has provided an *in situ* observation system for the Atlantic Ocean between ~50°N and ~50°S since 1995. AMT is unique in its ability to acquire data on long NS transects of the Atlantic and to make observations on basin scales. It represents the only programme based in the Atlantic Ocean that makes repeat measurements of core parameters and that is coordinated to foster collaboration with other UK and International groups. It represents by far the longest time series of data on basin scales. AMT has given UK science a globally recognised brand and recognition of the Natural Environment Research Council's (NERC) leadership role in international marine science, aligns to three themes of Defra's Evidence Investment Strategy, contributed to Charting Progress 2 and works closely with agencies including the Met Office. During this period of rapid change to our climate and biosphere AMT informs on time and space trends in biodiversity and function of the Atlantic ecosystem and under continued NC funding will quantify the nature and causes of ecological and biogeochemical variability in the planktonic ecosystems of the Atlantic Ocean, and to assess the effects of this variability on biological carbon cycling and air-sea exchange of atmospherically important gases and aerosols.

## Ecological indicators in support of integrated ocean observing

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Ecological indicators applied to observations-based monitoring programs are now widely accepted as resource management tools to support comprehensive assessment of ecosystem. The term indicator is collectively used by scientists, policymakers, and the general public. However, understanding and applications of indicators by the different groups are widespread. We review ecological indicators in context of both marine policy and science.

Indicators formulation and selection framework are beginning to reach consensus, albeit their implementation and interpretation remains challenging, especially when encompassing the whole diversity of ocean observing systems. *In-situ* observations have the outstanding advantage of allowing direct measurements across ecosystem levels from microscopic virus to higher trophic organisms. Unfortunately, spatial and temporal coverage of *in-situ* programs remains scarce over the oceans vastness.

Ocean colour remote-sensing provides a cost-effective and high repeat-frequency alternative. Here, we show the benefits of extracting and selecting ecological indicators from multiple streams of observations by analyzing two original case studies: 1. Multi-decadal variability in phytoplankton phenology using *in-situ* Continuous Plankton Recorder survey and ocean colour remote-sensing; and 2. Trends in phytoplankton biomass and size fractions using *in-situ* Atlantic Meridional Transect expeditions and ocean colour remote-sensing. We identify and discuss innovative approaches to

integrated-analysis of ocean observations based on a framework of ecological indicators. From the experience so far, we outline minimum requirements in the data and provide recommendations for future ocean observations.

## Meroplankton: Understanding the unknown

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Meroplankton, including the larvae of bivalves and decapods, are an important and yet understudied component of coastal marine food webs. These temporary members of the planktonic community compete with holoplanktonic grazers for nano- and microplankton food and in turn are a source of prey for higher trophic levels such as fish larvae. The role meroplankton play in the pelagic environment is little understood and yet their success is crucial to the establishment and sustainability of marine benthic communities. As meroplankton move from planktonic to benthic life stages they are affected by local and global marine stressors such as warming of sea surface temperature, loss of habitat, competition with invasive species and chemical and plastic pollution. It is therefore imperative to understand the baseline of meroplankton ecology, such as community composition and feeding processes, in order to reliably establish and predict the sensitivity of meroplankton to environmental stressors.

At Plymouth Marine Laboratory we are using a multidisciplinary approach to investigate many angles of meroplankton ecology. These range from traditional long-time series analysis of species composition and phenology at the Western Channel Observatory (WCO) to the investigation of feeding preferences of key meroplankton using traditional and molecular approaches. Our studies also include

experimental investigation of the uptake of microplastics by plankton and the use of DNA barcoding and Next Generation Sequencing (NGS) for the identification of morphological identical bivalve larvae and mixed zooplankton assemblages respectively.

We aim to further develop some techniques, for example DNA barcoding and NGS such that they may one day become part of the Western Channel Observatory *in situ* analysis.

### **Subtidal surveys to investigate fine-scale distribution of *Sepia officinalis* spawning habitat within the English Channel**

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During the spring, sexually mature adult cuttlefish migrate to shallow coastal waters to breed and lay their eggs. These eggs are attached to various benthic structures which project from the seabed. Whilst the presence of targeted coastal trap fisheries have enabled the description of broad spawning areas for *Sepia officinalis* within the English Channel, the finer scale attributes and locations of these areas, together with the patterns of egg laying within them (both spatial and temporal), remain largely unknown. To examine spawning patterns and to increase our knowledge of the range of habitat structure suitable for *S. officinalis* spawning, *in situ* observations of natural spawning grounds at study sites along both the English and French coastline of the English Channel were undertaken. The study indicates that the range of structures and habitats used varies between spawning locations with a larger range of structures identified at studied

spawning sites in France compared with England. Whilst this wide variety in structure use between sites makes it difficult to interpret what (if any) female “preference” for spawning structure may exist overall, the predominant use of seagrass beds at English spawning sites may indicate a potential spawning habitat preference at these sites, which needs to be investigated further. Evidence was also found that many spawning areas within the study sites were used repeatedly over multiple years with inter-annual variations in the condition of the benthic structures (affected by both natural and anthropogenic factors) showing a relationship with the pattern and density of egg laying. The identification of key spawning sites and habitats from *in situ* observations provides important information on the suitable spawning habitat for *S. officinalis* which may help to direct potential management strategies for this commercial fisheries species into the future.

*Financial support: EU Interreg IV CRESH project*

### **Presence-only modelling to investigate large-scale distribution of *Sepia officinalis* spawning grounds within the English Channel**

E: [isblor@MBA.ac.uk](mailto:isblor@MBA.ac.uk)

Bloor, I.<sup>1, 2</sup>, Marshall, C.<sup>2</sup>, Attrill, M.J.<sup>1, 2</sup>, Jackson, M.L.<sup>1, 2</sup>

<sup>1</sup>Marine Biological Association of the United Kingdom; <sup>2</sup>The Marine Institute, Plymouth University

Information on the spatial and temporal distribution of spawning grounds is essential for both stock assessments and good fisheries management. The common cuttlefish (*Sepia officinalis*) is an important commercial species in the English Channel and in spring, sexually mature adult cuttlefish concentrate in shallow coastal areas on both sides of the Channel to

reproduce and spawn. Whilst the presence of targeted coastal trap fisheries has already allowed the identification of broad scale spawning grounds and locations, predictive habitat modelling allows the location and scale of these grounds to be identified (predicted) independently and at a finer resolution. The aim of this study was to develop a distribution model for spawning *S. officinalis* to predict suitable (potential) spawning grounds along coastlines of the English Channel. Maximum entropy (Maxent) modelling (a presence-only based modelling approach) was used to relate key environmental variables (e.g. bathymetry, water temperature, salinity, chlorophyll, turbidity, bed shear stress and sediment) to data of known locations of cuttlefish eggs (a true measure of spawning). The results of the model indicate that the attenuation coefficient, which in this context represents both turbidity and chlorophyll, and bed shear stress (a measure of the friction of water on the seabed due to the mean tidal current) are the two most important variables contributing to the model and thus to determining the presence of potential spawning habitat. It is expected that the outputs from such models can be used to investigate the applicability of various fisheries management techniques to this stock, including the closure of important spawning grounds to fishing.

*Financial support: EU Interreg IV CRESH project*

### **Assessing a bioremediation strategy in a shallow coastal system affected by a fish farm culture - Application of GIS and shellfish dynamic models in the Rio San Pedro, SW Spain**

E: [claudio.silva@uca.es](mailto:claudio.silva@uca.es)

Silva, C.<sup>a,b,c</sup>, Yáñez, E.<sup>c</sup>, Martín-Díaz, M.L.<sup>a,b</sup>, DelValls, T.A.<sup>a</sup>

<sup>a</sup>UNITWIN/UNESCO/WiCoP. Physical Chemical Department, University of Cádiz, Spain;

<sup>b</sup>Andalusian Center of Marine Science and Technology (CACYTMAR), University of Cádiz, Spain; <sup>c</sup>School of Marine Science, Pontificia Universidad Católica de Valparaíso, Chile.

An integrative methodology for the assessment of integrated multi-trophic aquaculture (IMTA) modelling scenarios for shellfish aquaculture as bioremediation strategy in an area impacted by fish farms effluents, combining geographical information systems (GIS) and dynamic farm-scale carrying capacity modelling was developed. The methodology combines 2 stages: (i) suitability using a multi-criteria evaluation of factors, constraints and criteria to generate a final map showing the most appropriate areas using GIS tools; and (ii) detailed analysis of production, socio-economic outputs and environmental effects of suitable areas at different IMTA scenarios by the use of FARM model.

The methodology was tested for Pacific oyster (*Crassostrea gigas*) suspended longline culture in areas affected by gilthead sea bream (*Sparus aurata*) and European sea bass (*Dicentrarchus labrax*) farming effluents in Rio San Pedro creek (south-west Spain), in order to explore the approach and make management recommendations for potential application. The identification of 0.44 km<sup>2</sup> of suitable sites in the study area using a GIS approach was made considering regulatory and social constraints; physical factors; growth and survival factors; environmental quality factors; water and sediment quality criteria; factor suitability ranges; and a final multi-criteria evaluation. The final assessment of IMTA scenarios of production at three (Dorada, Flamenco and Isleta) potentially suitable sites indicates that Isleta and Flamenco are promising sites for shellfish aquaculture; and Dorada site is of marginal interest. Isleta shows a potential harvest of 47.7 tons over a 305 day cultivation period for the test farm, and an average physical product of 19.88. Mass balance estimation was carried out to determine potential positive

impact of the IMTA suitable sites by the carbon and nitrogen removal from water through filtration of algae and detritus by shellfish. Biodeposition of organic material from longline leases was also simulated, and found to have a low negative impact on sediment quality.

### **GreenSeas Analysis Framework: Time series analysis giving a quantified science-fact identification approach**

E: [jbru@pml.ac.uk](mailto:jbru@pml.ac.uk)

Bruun, J., Somerfield, P., Allen, I.

Plymouth Marine Laboratory

In order to assess the current state of the marine planktonic ecosystem on an Atlantic basin scale it is necessary to provide a consistent framework through which historical data and knowledge can be used to identify and help estimate the impact of key drivers of the current state and function of the planktonic ecosystem.

The GreenSeas analysis Framework provides a holistic approach where time series data from irregular in-situ samples, and regularly sampled data from earth observation and biogeochemical numerical models are utilised to provide as full perspective of the plankton ecosystem. We outline the use of Box-Jenkins Time Series analysis tools which provide a systematic approach to identification of complex linear and non-linear systems. The identification approach provides a fact based approach to accept / validate current models or if relevant reject current models and in doing so provides an integrated cross-disciplinary method to propose model improvements based on available knowledge.

We illustrate these tools with applications to environmental time series.

### **Modelling archaeological palaeolandscapes for offshore renewable impact assessments**

E: [dafydd.lloydjones@marinespace.co.uk](mailto:dafydd.lloydjones@marinespace.co.uk)

Gribble, J.<sup>1</sup>, Leather, S.<sup>2</sup>, Jones, D.L.<sup>3</sup>

<sup>1</sup>Sea Change Ltd; <sup>2</sup>PMSS Ltd; <sup>3</sup>MarineSpace Ltd

For much of the last million years the European continental shelf was a terrestrial landscape of fluctuating size and extent. In the south and east of the UK this formed a land bridge with the Continent and was a resource-rich landscape which early humans could, and did, occupy and exploit. Understanding these landscapes, through regional geological modelling, is key in allowing sense to be made of the distributions of archaeological sites and materials, to make predictions regarding the likely distribution of other sites, and to contextualise recovered materials.

As part of the development of offshore renewable energy schemes, geophysical and geotechnical techniques are used to provide an understanding of the geology and stratigraphy underlying the development area. This understanding drives engineering and technical decisions.

Archaeological assessment of geological data can provide an indication of the presence, extent and thickness of buried sediments of archaeological interest, and can be used to build sub-surface models and reconstruct palaeolandscapes. The landscapes discernible in geological data are not strictly fossilised 'Mesolithic' or 'Upper Palaeolithic' landscapes but represent stacked time periods; however information representing different landscapes can be present within geotechnical data to varying degrees.

Modelling techniques broadly fall into two categories. Firstly, predictive modelling which commonly involves the use of Geographical



Information Systems (GIS) to provide the medium in which the modelling occurs. Secondly palaeogeographic reconstruction – the reconstruction of patterns of the earth's surface at given times and through time. Regional models can be used as an archaeological or cultural heritage management tool within the EIA and offshore development process. In the context of offshore renewable energy such models can act as a measurement of risk, both to the development and the submerged prehistoric record.

### **The use of concrete base foundations in offshore wind – The environmental considerations**

E: [ian.reach@marinespace.co.uk](mailto:ian.reach@marinespace.co.uk)

Reach, I.<sup>1</sup>, Jones, D.L.<sup>1</sup>, Langman, R.<sup>1</sup>

<sup>1</sup>MarineSpace Ltd, Ocean Village Innovation Centre, Ocean Way, Southampton

Future offshore wind farms, including UK Round 3, will typically be in deeper waters, and on different seabed types than those currently in construction and operation. The different conditions will require alternative foundations to the monopile that the UK market has commonly used. It is therefore necessary to understand the potential environmental impacts from alternative engineering solutions, such as concrete gravity base foundations (CGBFs).

The current evidence base for offshore wind farm foundations has been reviewed, relating the potential environmental footprint to other foundation solutions. Evidence has also been drawn from other relevant sectors where CGBFs have been employed, e.g. oil and gas. The possible environmental effects and pathways associated with the various phases of CGBFs have been identified including ground preparation (if required); emplacement; scour

protection (if required); operation; and decommissioning.

As a result of the location of Round 3 sites, all potential foundation solutions are likely to have greater direct and indirect footprints than UK Round 1 and 2 wind farms. CGBFs will, however, have similar footprints to other solutions considered for Round 3 sites, in terms of foundation extent, seabed preparation, scour protection and blockage effects.

CGBFs have distinct environmental advantages when considering underwater noise, and the removal of structures at decommissioning. No piling or hammering is required during installation of CGBFs, which mitigates underwater noise and sound pressure wave impacts upon sensitive species. Since no piles are used complete removal of a CGBF is possible; unlike steel jackets and tripods where complete removal at decommissioning is currently unproven.

With increased requirements for consideration of noise in legislative controls, underwater noise impacts will be a primary consideration for deep water solutions used at Round 3 developments, and the lack of noise emissions will be the greatest environmental advantage of CGBFs.



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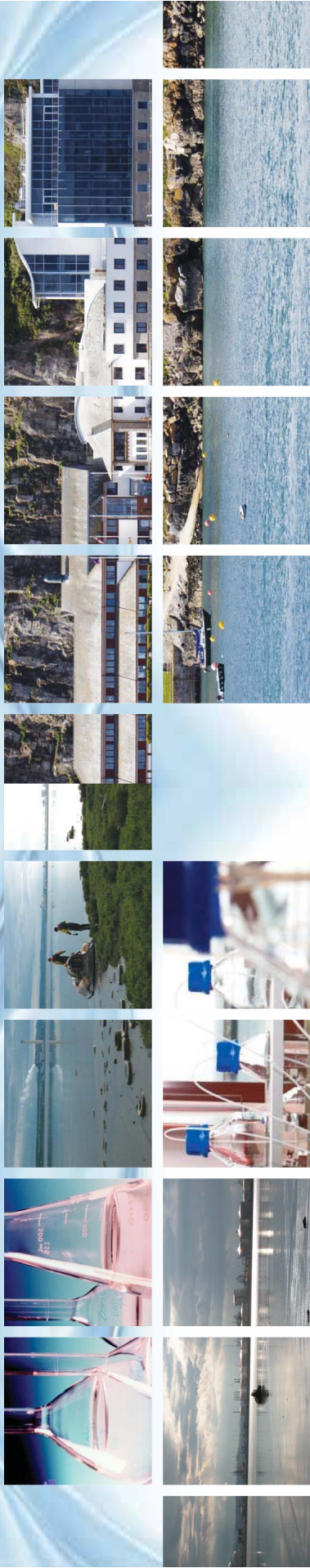




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## HISTORY

Brixham Laboratory was established in 1948 as a marine research station for ICI Paints. The location was selected for its excellent communications links via the Great Western Railway to headquarters at Slough, together with fine harbour facilities and access to a source of clean sea water for marine testing.

Environmental science began to dominate the laboratory's function throughout the 60s and 70s and by 1986 major expansion was needed to cope with increasing work load, as the laboratory's reputation for excellence became world renowned. Brixham Environmental Laboratory are fully GLP compliant, and were the first Environmental Laboratory in Europe to gain this status in 1979. In 1993 following the demerger of ICI, the lab transferred to Zeneca and in 1999 became part of the AstraZeneca organisation. A £12 million laboratory expansion of our Fate and Husbandry facilities in 2007 has enhanced our capacity to deliver top quality, competitively priced environmental testing. From assessing the environmental impact of marine paints in the 40s and 50s, to the present day, Brixham Environmental Laboratory has grown to become a world class environmental testing facility.



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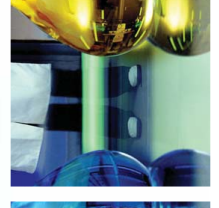
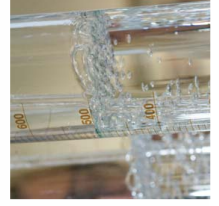
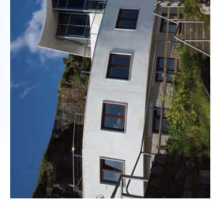
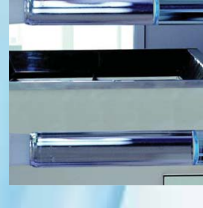
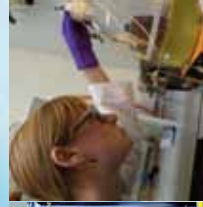
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By taking an interdisciplinary approach PML has the proven competence to analyse and interpret its scientific results, so providing meaningful and accessible information for use by a diversity of stakeholders including scientists, partner institutes and other organizations, policy makers, industry and the wider public. Of particular interest is PML's contribution to National Capability which enables the UK to deliver world-leading environmental science, support national strategic needs and respond to emergencies.

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Key to the maintenance of such systems, and a major aspect of PML's work, is an understanding of how the major elements in the surface oceans and coastal seas are cycled and influence productivity and climate and how they may be affected in a changing world. Linking social and natural marine science to understand the consequences of interactions between humans and the marine environment to improve outcomes and benefits, while

supporting sustainable and responsible stewardship, is a particular ability of PML.

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Two internationally acknowledged strengths of PML are its modelling and Earth observation capabilities. Modelling improves understanding of variability, potential impacts and feedbacks of global change and anthropogenic forcing on the structure, function and dynamics of the global ocean and its associated shelf seas, and on their capacity to provide ecosystem goods and services. Earth observation, through airborne and satellite mounted sensors, contributes data for fundamental research on marine ecosystems including: water quality monitoring, productivity, potentially; harmful algal blooms, ocean front detection and validation of algorithms and methods.

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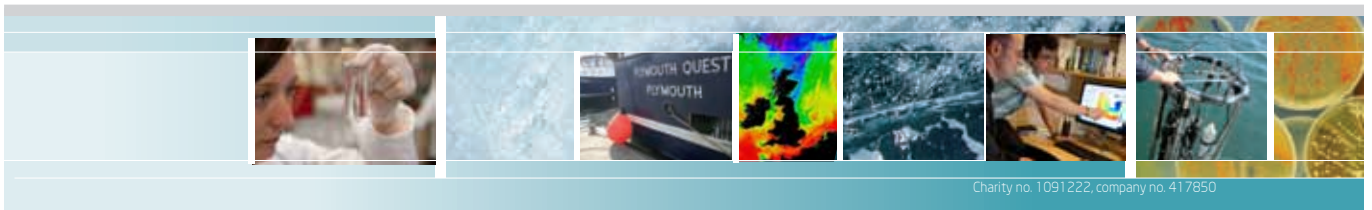
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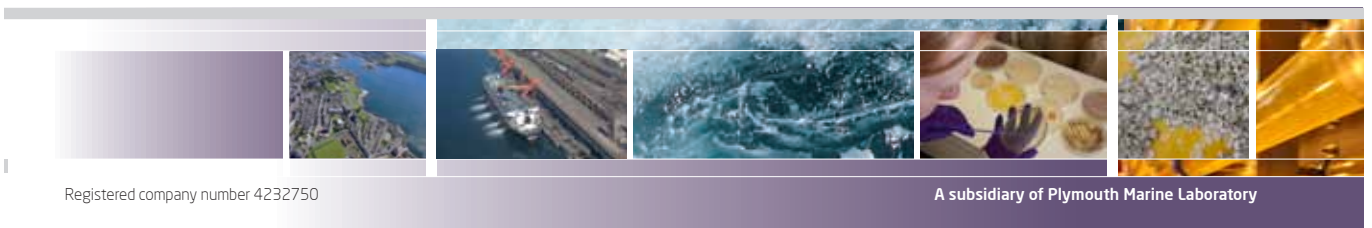
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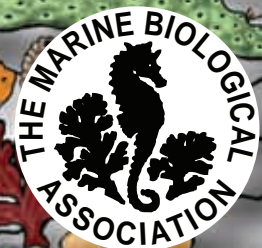
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## What is the IMarEST?

The Institute of Marine Engineering, Science and Technology (IMarEST) is an international membership body and learned society for all marine professionals. The IMarEST is a registered charity and is the first Institute to bring together marine engineers, scientists and technologists into one international multi-disciplinary professional body. With a membership of 15,000, the IMarEST is the largest international marine organisation of its kind.

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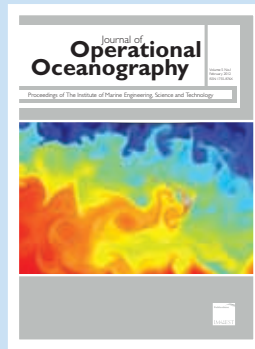
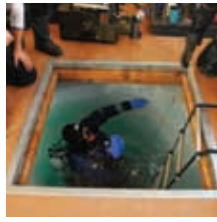
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For no obligation advice on the IMarEST please contact:

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the  
**SCIENCE**  
council





Supplying the worldwide oceanographic community with measuring equipment such as Current meters, Tide Gauges, Sound Velocity Probes, CTD's, Wave Recorders, Altimeters and Bathymetric equipment, Valeport is a household name in the academic and commercial world of marine measurement.

### History

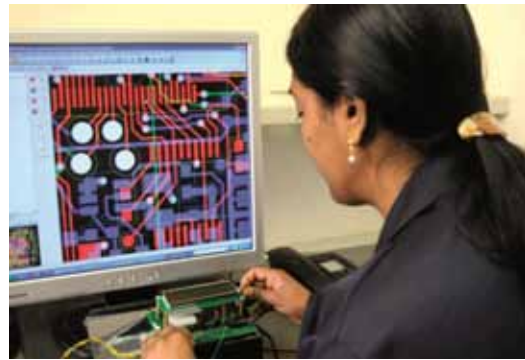
Valeport was established in 1969, in the small port town of Dartmouth in the South West of England, with a simple product range based around the Braystoke Impeller Flow Meter. It was sold in 1982 to Oceonics plc, who were keen to expand their portfolio with manufacturing companies in the underwater sector. In 1985 a strategy change saw Valeport put up for sale, and it was acquired in a Management Buy Out by Charles Quartley, Technical Director of Oceonics. Since then, Valeport has expanded its product range, and developed a strong reputation within the industry for high quality, reliable instrumentation.



In 2003, the company finally outgrew the factory in which it had been based since 1969, and acquired a site a few miles up the river Dart in the historic town of Totnes. Although not a brand new building, the new factory has been internally modified to suit our requirements and contains all the facilities necessary for the development, production, calibration and testing of all our products. In 2005, Charles stood aside as Managing Director to be replaced by his son Matthew, who has been with Valeport since graduating in 1994. The business now employs around 60 staff and continues to invest heavily both in new product development and the facilities necessary to manufacture the quality products for which Valeport is known.

### Product Design

One of the fundamental principles on which Valeport is built is the notion that we have to be in total control of all aspects of the business, from design through manufacture to test, calibration and service. With the exception of certain bought in, industry standard sensors, everything we do is designed in house. This policy requires a diverse range of skills in our R&D department, including CAD/CAM mechanical design, analogue and digital electronic design, a variety of programming languages including VHDL, C++, Delphi, VB and others for both embedded code and PC software, not to mention specialist knowledge in specific fields such as acoustics, conductivity electromagnetism and radar.



### Manufacture & Test

Having our own fully equipped CNC machine shop is critical to our flexibility, and to the quality of our products. This has been our biggest area of capital investment as we have grown, allowing us to produce and hold stock of every single mechanical part in nearly all of our products – some 1000 different items in total. In addition, as well as allowing us to rapidly produce prototypes during the development phase, it also enables us to produce our own custom jigs and test equipment to streamline other processes within the factory.

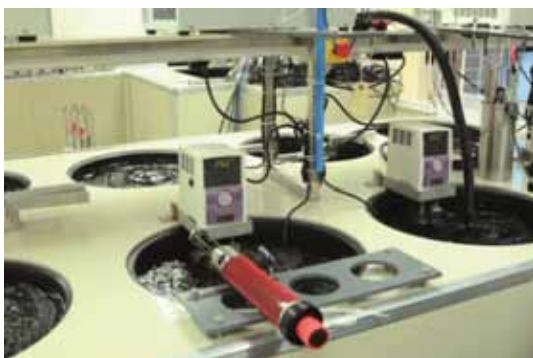




Offering a 3 year new manufacture warranty and 12 month service warranty on our products can only be done if we are confident in the quality and reliability of those products. Titanium construction is quite robust, so the prime consideration is really one of circuit board reliability. Since converting all assembly, test, calibration, storage and R&D facilities to static-free environments, we have seen long term circuit board failures reduce by over 95%. This is arguably the most important investment we have made in terms of product quality and reliability.



Product testing is equally critical to maintaining quality. Every single circuit board that enters the building is exposed to an environmental test procedure, designed to highlight any component or solder joint faults before the board is functionally tested and then allowed into stores. As well as undergoing a standard functional test, every instrument, both new and serviced, is also pressure tested before dispatch.



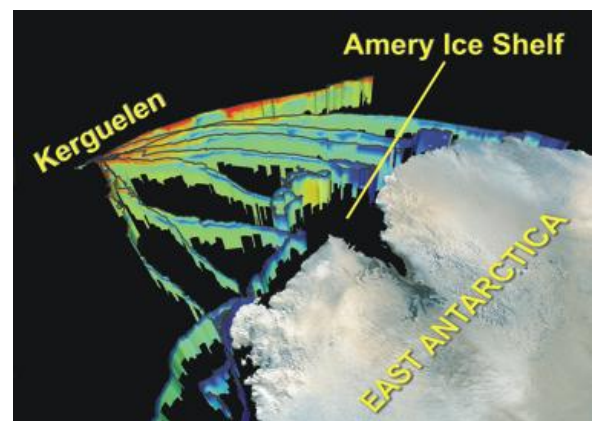
We recognise that the supply of a new instrument is the start of our relationship with our customers, not the end. As such we have a dedicated team of highly skilled technicians, able to service, repair, and calibrate all Valeport products.

## Applications

Our product diversity takes us into numerous applications covering civil, academic and military markets. Whether it be shallow water in ports and harbours or the depths of the Marianas Trench, Valeport have a presence. Recent applications have seen us provide Conductivity, Temperature and Depth (CTD) sensors for integration into monitoring tags for seal tracking by the Sea Mammal Research Unit (SMRU) of St Andrews University who are a world leader in their field. The CTD tags offer data profiles of scientific quality via satellite upload which produces cost effective data collection in the harshest of environments. The seal in the picture below poses with a fitted tag that will drop naturally off once moulting commences.



3500 Temperature profiles from 8 seals in 2 months, extending into rarely charted territory is typical of data provided.



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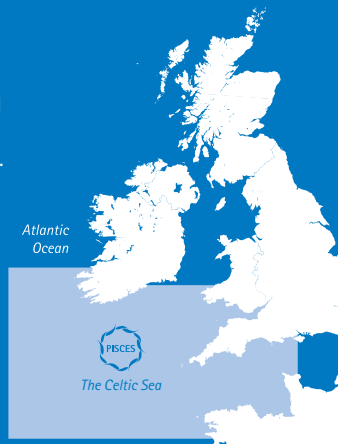


Supporting Sustainable Seas

# PISCES

PISCES (Partnerships Involving Stakeholders in the Celtic Sea Ecosystem) is a pioneering, three-year (2009 to 2012), EC LIFE+ co-funded project that has empowered stakeholders to create a practical guide to implementing the ecosystem approach in the Celtic Sea.

PISCES has translated marine policy into a practical guide for multiple sectors across a multi-national area. It is hoped that the guide will act as a blueprint for the implementation of the ecosystem approach in other marine areas.



Map of the Celtic Sea area for the PISCES project

**"The PISCES guide is essential reading for those who want to understand what marine stakeholders want to see in policy implementation"**

Ann Bell, North Sea Commission

## What is the ecosystem approach?

The ecosystem approach is a way of making decisions in order to manage our activities more sustainably (Box 1). EU countries are currently developing marine strategies based on the ecosystem approach, in order to meet the requirements of the EU Marine Strategy Framework Directive (MSFD) and other policies.

The ecosystem approach can help to ensure we have viable marine industries, prosperous coastal communities and a healthy marine environment for generations to come. PISCES stakeholders want to ensure this happens and play a role in the process.

### What is the ecosystem approach?

It recognises that we are part of the ecosystem: we affect it and we depend on the goods and services it provides (e.g. food, energy, clean water and recreation).

It requires: (a) an integrated approach that considers all ecosystem components (e.g. human activities, habitats/species and physical processes), (b) consideration of ecosystem functions and resulting ecosystem services, and (c) strong participation of stakeholders.

## What is the PISCES guide?

- Presents the voice of stakeholders, having been developed through an innovative Celtic Sea-wide partnership of marine industry and sea-user groups from the UK, Ireland, France and Spain.
- Explores what is needed to implement the ecosystem approach in the context of the MSFD. Its recommendations are also relevant to other areas and policy contexts.
- Aims to demystify terminology, and makes practical recommendations for stakeholders and governments.

## Who is the PISCES guide for?

- Stakeholders who operate in and around the Celtic Sea (e.g. fisheries, offshore renewables, shipping, tourism and recreation, ports, aggregates and aquaculture).
- Decision-makers responsible for implementing the Marine Strategy Framework Directive and other marine policies in the Celtic Sea and elsewhere.
- Everyone who has an interest in implementing the ecosystem approach in the Celtic Sea or other locations.

## How was the PISCES guide developed?

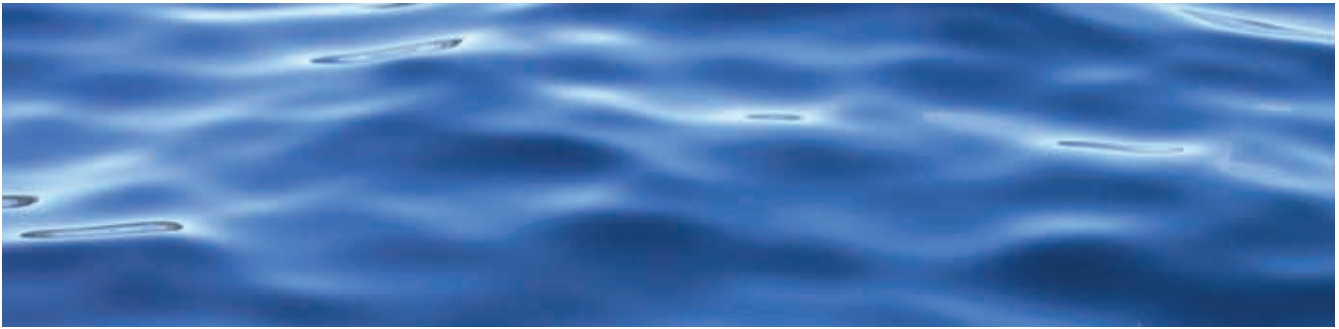
With a focus on sea users, a committed multinational, cross-sectoral group of volunteers was directly involved in determining the objectives, scope and content of the guide.

Five stakeholder workshops were held across the region (in England, Wales, Ireland, France and Spain) with 46 participants from a wide range of sea-user groups (See below). Additional information was collected through literature research, interviews, and questionnaires. The guide also benefited from the contributions of an advisory group of international experts working in the fields of marine policy, management, the ecosystem approach and stakeholder engagement and from comments from a range of other individuals across Europe (government, sea-users, NGOs, academics and others).

- Renewable energy
- Offshore infrastructure
- Commercial fisheries
- Mariculture
- Shipping
- Ports & harbours
- Coastal tourism & recreation
- Marine aggregates
- Environmental statutory agencies







## Implementing the ecosystem approach: how do we move from principles to practice?

Through the PISCES project, it has become clear that a range of actions need to be taken to implement the ecosystem approach. Detailed recommendations can be found within the guide.

Key priority areas for action are identified as:

### 1) Improving stakeholder participation in MSFD implementation.

In line with this key principle of the ecosystem approach, the MSFD requires that opportunities for "early and effective" participation are provided. PISCES has shown that at every step, stakeholders can add value, helping to ensure that marine strategies are appropriate, cost-effective, equitable and supported by stakeholders.

**"The ecosystem approach is nothing without stakeholders."**

Renewables sector representative

### 2) Encouraging stakeholders to proactively identify issues and implement their own solutions.

Voluntary actions could bring commercial benefits to stakeholders, and reduce the need for regulatory intervention. Actions need not necessarily be radical or costly. Even minor changes can be beneficial, especially if they are taken up across a sector, with other sectors, or within an entire region.

### 3) Fostering greater communication between stakeholders and between stakeholders and government.

Stakeholders should communicate their plans, activities, needs and concerns. This will help to ensure that learning is shared, developed and expanded, and governments recognise the benefits of stakeholder efforts. This could strengthen the case for voluntary actions as a means of meeting MSFD targets. Transnational, multi-sector forums should be established to help foster greater communication, cohesion and integration across borders and sectors.

**"The PISCES guide makes important recommendations about the need for transnational stakeholder forums to improve stakeholder participation in policy implementation. It is a timely contribution at a scale that makes sense."**

Prof. David Johnson, Executive Secretary, OSPAR Commission

### 4) Developing and implementing the necessary policy mechanisms to support fully integrated marine management.

Marine spatial planning (MSP) has the potential to play an important role within the MSFD, especially in terms of trans-boundary coordination, and needs to be implemented across European seas. Although sector-specific policy is increasingly reflecting ecosystem approach concepts, further effort is needed to fully integrate and harmonise policies within the context of an overarching, cross-sectoral approach.

## Communication and outreach

The PISCES guide is being launched in October 2012, through a series of events in the UK, Ireland, France, Spain and Belgium. It is available in three different languages: English, French and Spanish. A leaflet version and series of summary briefing notes are also available.

**A project website contains further information and links to project outputs:**

[www.projectpisc.es.eu](http://www.projectpisc.es.eu)

## The PISCES team

PISCES is led by WWF-UK in partnership with The Environment Council and WWF Spain, with thanks to country technical support from SeaWeb in France and the Coastal & Marine Research Centre in Ireland.

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## The Sir Alister Hardy Foundation for Ocean Science - Working with the Marine Industry to Monitor the Global Oceans

Monitoring and understanding biological change in the oceans is considered a critical area for many national and European marine policies and strategies as environmental pressures on marine ecosystems are set to increase over the coming decades. Environmental pressures such as the degradation of marine biodiversity, overfishing, climate change and pollution as well as emerging issues such as ocean acidification all affect ecosystem services. As a consequence we must monitor and try to understand these changes to formulate adaptive strategies for managing these resources in the future. However, the world's oceans represent a vast part of our globe and monitoring these changes using traditional research ships would confront us with a logistical and financial impossibility in terms of geographical coverage.

With this in mind a small research foundation – the Sir Alister Hardy Foundation for Ocean Science (SAHFOS) has managed to harness the good will of the marine shipping industry to form a partnership to build a truly unique marine monitoring survey that is global in scope. Remarkably this partnership has been in operation for over 80 years and provides essential baselines that document these marine environmental changes over many decades. In essence, the partnership works by using voluntary 'ships of opportunity' for example, oil tankers or passenger ferries that are on their normal trade routes around the world to tow a robust scientific instrument known as the Continuous Plankton Recorder (CPR). As its name implies the CPR collects plankton along the entire route of the vessel's journey sometimes covering many thousands of miles across whole oceans in one tow.

The reason why plankton are collected and analysed is that they play a fundamental role in marine foodwebs and in the earth's climate system and are particularly good at acting as rapid indicators of change in the oceans, often described as 'the sentinels of the sea'. For example, the carrying capacity of marine ecosystems in terms of the size of fish stocks as well as the abundance of marine wildlife (e.g. seabirds and marine mammals) is highly dependent on variations in the abundance, timing and composition of the plankton. These organisms also play a crucial role in planetary oxygen production and climate change through the export of the important greenhouse gas CO<sub>2</sub> to the deep ocean by carbon sequestration in what is known as the 'biological pump'. Without this process concentrations of CO<sub>2</sub> would be much higher in the atmosphere and the climate of the world would be much warmer.

After 80 years of operation and partnership with the marine shipping industry the CPR survey is now the longest sustained and most geographically extensive marine biological survey in the world. It is also one of the world's richest ecological datasets routinely recording over 500 taxa. At present the CPR survey samples over 10,000 nautical miles a month around the world from the Arctic to Antarctica and contains over 100 million data entries. Operation of the CPR monitoring programme involves five phases, in sequence: logistics, workshop maintenance, plankton analysis, archiving of data and samples and

interpretation of the results. Since the first tow of a CPR on a 'ship of opportunity' in 1931 more than 6 million nautical miles of sea have been sampled. Liaising with the ships and their operators and the management of the transfer and recovery of CPRs from these ships as well as the manufacture and fitting of specialised tow davits is a major logistical exercise. The design of the CPR and its enclosed cassette sampling system that holds the silk has changed little from original design. Indeed machines that were originally built in the 1930s are still in regular use highlighting the highly cost-effective nature of CPRs. Over the last decade the CPRs have been additionally equipped with modern chemical and physical sensors as well as molecular probes to provide an array of additional information about our changing oceans. The final stages in the operation of the survey are the archiving of the resulting data and samples and interpreting the results at its central hub in Plymouth, England. The database and sample archive together provide a resource that can be utilised in a wide range of environmental, ecological and fisheries related research e.g., molecular analyses of marine pathogens, modelling for forecasting and data for incorporation in new approaches to ecosystem and fishery management.

The CPR survey is of importance in fulfilling a number of national and European monitoring and research requirements and also makes a significant contribution to international programmes, such as the Global Ocean Observing System (GOOS) and the Group on Earth Observations (GEO). In terms of our scientific understanding of the impacts of natural variability and human-induced change on marine ecosystems the CPR survey is of global importance as it contains critical baselines covering over 80 years. Over the last eight decades the purpose of the survey has also co-evolved, with changing environmental policy, from purely monitoring plankton distributions to addressing major marine management issues ranging from fisheries, harmful algal blooms, biodiversity, pollution, eutrophication, ocean acidification and climate warming. For example, the CPR survey has documented a northerly shift of 1000 km of marine organisms around the British Isles associated with climate warming over the last four decades having large ramifications for the UK fishing industry. In the Arctic, the CPR survey has recently recorded the first modern trans-Arctic migration of a species related with declining ice coverage. This particular Pacific Ocean distributed species has been absent from the North Atlantic for over 800,000 years perhaps signifying the rapidity and unprecedented nature of climate change in the Arctic over recent geological history.

In 2011 SAHFOS, along with 12 other research organisations using the CPR from around the world, formed a global partnership that would harness the collective coverage of over 50 vessels from 40 different commercial shipping companies. This global network of CPR surveys now routinely monitors the North Sea, North Atlantic, Arctic, North Pacific and Southern Ocean. New Surveys are underway in Australian, New Zealand, Japanese and South African waters with a Brazilian survey under development. These surveys provide coverage of much of the world's oceans. This global network also brings together the expertise of approximately 50 plankton specialists, scientists, technicians and administrators from 12 laboratories around the world. Working together, pooling our data and resources and working in partnership with the marine shipping industry, this global network of CPR surveys will ultimately lead us to a better understanding of marine environmental changes at the global scale.