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WHAT IS MASTS?
The Marine Alliance for Science and Technology Scotland (MASTS) is a research pooling initiative that brings together the majority of Scotland’s marine research capacity. MASTS pools the talent of about 700 researchers and the management of resources consisting of over £66 million annually, in marine science from across Scotland.

WHAT IS THE PURPOSE OF MASTS?
MASTS aims to ensure that marine science in Scotland can remain internationally competitive and provides the academic platform and knowledge for marine governance and commerce by helping to establish a Scottish strategy for marine science that will deliver increased value to the public from its investments. MASTS is increasingly recognised nationally and internationally as an organisation that represents the marine science community. Members of the MASTS community are actively involved in helping to drive the marine science agenda and we are represented at the highest level within the UK, EU and further afield.

MASTS delivers a new approach to marine research and governance, moving away from competition between small research centres, and creating strong strategic collaborations. MASTS partners:

1. Make better use of their collective resources;
2. Maximise the impact of evidence and analysis;
3. Improve interactions among marine experts and interested parties in all sectors, including those responsible for policy development and legislative control;
4. Build efficient and effective communications and networks between MASTS members and organisations through seminars, workshops, symposia and conferences; and
5. Offer Graduate School training and networking opportunities tailored to the needs of marine scientists through the MASTS Graduate School.

WHO ARE THE MASTS PARTNERS?
Major Universities, Research Institutes, principal regulators and other key stakeholders with an interest in the marine environment are members of MASTS. Find out who already benefits from membership of MASTS: www.masts.ac.uk/about/masts-partner-institutions/or contact us if you are interested in joining MASTS on masts@st-andrews.ac.uk or 01334-467200.

WHAT ARE THE BENEFITS OF MASTS MEMBERSHIP?
- MASTS provides a unique network through which to access knowledge, expertise, cutting edge technology and other physical and intellectual resources.
- The capacity of MASTS to co-ordinate and deliver marine science at a national level is recognised through our relationships with Government, regulators and industry. From an academic perspective, our member institutions benefit from having national and international representation as well as the necessary critical mass to attract multi-institutional and multidisciplinary research funding.
- MASTS actively seeks to break down institutional barriers to ensure that its members maximise their potential to secure research funding and use available resources efficiently.
- MASTS is linked to a number of internationally recognised and influential marine research bodies both directly and through its members. We actively seek to ensure that MASTS representatives populate opinion forming and decision making bodies relevant to marine science, governance and regulation.
- MASTS promotes the expertise of its members, takes an active role in relevant consultation processes and seeks to provide the best available evidence to inform decision making.
- MASTS has an established record in commissioning R&D and in the provision of policy advice. The associated administrative infrastructure makes MASTS an attractive organisation for cost effective R&D procurement and for disbursing funds. MASTS members already benefit from this capacity and the ability to actively co-ordinate both funding and associated research activity as an important strategic advantage for MASTS members.
- MASTS has a legal and charitable status which allows MASTS to act more effectively and flexibly on behalf of its members. This status is particularly important in securing international agreements, leading project consortia and in our R&D commissioning capacity.

MASTS ANNUAL SCIENCE MEETING
Come and join the largest UK gathering of marine scientists and practitioners at our Annual Science Meeting. Everyone welcome!

More details at: www.masts.ac.uk/annual-science-meeting

WORKING WITH INDUSTRY – MASTS CAN PROVIDE ACCESS TO RESOURCES, EXPERTISE AND FUNDS TO SUPPORT INDUSTRY R&D.

Does your organisation face challenges; generate ideas; or data that you never seem to have the time or resources to deal with? If the answer is yes, then perhaps you should consider the option of working with MASTS staff, interns, or PhD students. Depending on the nature of the challenge you face, MASTS may be able to provide your organisation with a broad spectrum of expertise, tapping into the skills of some of our brightest post-graduate and post-doctoral researchers, backed by the significant research infrastructure and capacity of their host institutions and the wider MASTS network.

Find out more: www.masts.ac.uk/about/masts-working-with-industry
THE MASTS RESEARCH AGENDA AND THEMES

The primary focus of the MASTS research agenda is scientific excellence, but we also recognise the Scottish Government’s Marine Vision for clean, healthy, safe and productive seas. MASTS supports this high level strategy and will help to deliver this through a better understanding of marine systems and their biological and physical dynamics. MASTS has established three overarching Research Themes to promote these objectives. Themes are underpinned by research forums which are the major delivery mechanism for MASTS science.

PRODUCTIVE SEAS

The theme of productive seas is an area of high priority that is attracting inward and outward investment. This is a key area of MASTS activity with major scientific challenges encompassing the balance of exploitation against the resilience and capacity of natural systems to supply resources against a backdrop of increasing demand and climate change. Both energy and food security are fundamental drivers for marine science. Scotland is in many ways at the forefront of marine energy production through established and emerging fossil fuel extraction and marine renewableables development in particular. Aquaculture is pivotal to the rural economy of some areas within Scotland and is likely to expand into the production of other non-food products and services through biofuels, marine biotechnology and genomics. Scotland’s capture fishery remains one of the largest in Europe and its long-term survival will hinge upon the development of sustainable fisheries management founded on good science. As well as delivering strategic science, the Forums within this theme are also actively engaged with the policy regulation and industry to address more immediate challenges.

DYNAMICS AND PROPERTIES OF MARINE SYSTEMS

This theme embraces the fundamental physical attributes and dynamics of marine systems including marine physics, chemistry, sedimentology, geomorphology and oceanography. The description of the marine system includes the analysis of past condition, spatial mapping of present conditions, and the impacts of future change on the dynamics and properties of the system. Therefore, important aspects of climate change such as predicting sea-level rise, modelling ocean-atmospheric exchange and sea-ice extent fall within this theme. This theme also includes technological and modelling developments that allow improved interpretation of marine systems.

MARINE BIODIVERSITY, FUNCTION AND SERVICES

The link between the diversity, distribution in space and time, and resilience of marine organisms is central to this theme. In addition, the role of marine biodiversity in supporting ecosystem function and providing ecosystem services across the variety of marine habitats, from coastal wetlands and estuaries to the deep sea, are included. This theme encompasses research on the societal value that is placed on marine habitats and the socio-economic impacts of exploitation and climate change. Maintaining marine ecosystem goods and services, and addressing the challenges of climate change are vital to the Scottish economy and the management of ecosystems is essential for the conservation of key habitats and species.

MASTS FORUMS

MARINE RENEWABLE ENERGY FORUM

Scotland is a major international hub of activity and expertise for marine renewable energy including offshore wind, wave and tidal-stream in particular. The Marine Renewable Energy Forum (MREF) delivers scientifically excellent research to inform the sustainable development and operation of the infrastructure used to produce energy in the marine environment. The focus will include understanding the key renewable energy and environmental change. This approach will be achieved through increased collaboration between ecologists, biologists, engineers, oceanographers, social scientists and economists as well as awareness across the science community of the end uses of this new knowledge in marine spatial planning, licensing and monitoring programmes.

Developments are now moving from single devices to multiple initial subsets of arrays with the ambitions to expand to large-scale arrays in a few years’ time. What is essential for that transition is strategic and joined up approaches across academic, statutory and industry partners to assist in: 1) targeted multidisciplinary research to answer the current critical uncertainties that still remain in terms of potential direct interactions such as collision risks and barrier effects; 2) the design of strategic, hypothesis-led monitoring programmes for the longer term that address key constraining aspects of impact assessments; and 3) the definition of standardised methods and well-housed, transparent shared data bases.

OIL & GAS FORUM

The MASTS Oil & Gas Forum engages with the oil and gas sector, regulators and academic community together with other MASTS forums to raise awareness of relevant marine science research. Reflecting upon the status of the industry and the significant challenges facing this sector, the Forum helps to provide a credible platform for bringing together the scientific community to address strategic research requirements and help inform policy.

The Forum:

• seeks to help identify and inform key environmental research issues facing the industry in Scotland and internationally;

• fosters a more cohesive, multidisciplinary and collaborative approach to oil and gas related marine science research across the MASTS community and, the industry;

• encourages innovation, exchange and use of marine environmental data and knowledge derived through statutory and non-statutory monitoring and research.

The Forum identifies strategically important issues to be the subject of workshops or “case studies” which will help to improve understanding, raise awareness and identify research requirements. This Forum explores the potential to develop focused position papers on interest to policy, regulation, senior decision makers, the research councils and the EU. Specific areas of interest include: 1) Decommissioning; 2) Improving data access, archiving, analysis and further acquisition; 3) Understanding and mitigating the impacts of oil and gas developments in challenging and extreme environments (e.g. Arctic and deep-water provinces).
MASTS FORUMS

SUSTAINABLE AQUACULTURE FORUM
The focus of this forum spans the entirety of the Scottish aquaculture sector; encompassing the production of finfish, shellfish, invertebrates and algae. There are ambitious expansion plans for Scottish aquaculture, and the pace and scale of aquaculture development has been accompanied and underpinned by the growth of world leading aquaculture research expertise in the MASTS Universities and research institutes, many of whom have been at the heart of European and wider international efforts to develop sustainable aquaculture. Scotland has been proactive in developing a robust and effective policy and regulatory framework for aquaculture, and this process is ongoing. Whilst current commercial production remains focused on relatively few species, strategic research related to the cultivation of other marine fish and algae continues and there is an increasing pressure to moving the industry further offshore. The potential to co-locate aquaculture alongside marine renewables development is also an area of research interest. Multidisciplinary research is being commissioned and applied by the aquaculture industry in an attempt to reduce its environmental impact. Much still needs to be done towards reducing the losses related to disease and parasites, diversifying the industry, managing and genetically improving farmed species, replacing and reducing marine ingredients within aquafeeds and in the design of better sited and contained production systems.

MASTS is working with the industry to help achieve these aims.

FISHERIES SCIENCE FORUM
The MASTS Fisheries Science Forum is a collective world-class fisheries science facility which provides research and advice relevant to sustainable fisheries management. This forum works to improve our understanding of marine (fish and shellfish) systems, and the human (fisheries) influence on them, by undertaking research into the ecology, economics, sociology, and governance of commercially exploited marine fish and fisheries. This is important not only for the long-term economic future of an important global industry, but for the well-being of rural communities, and the food security and good health of the general public.

This forum complements and supplements work carried out by national agencies such as Marine Scotland, provides short-term objective scientific advice on fisheries matters, as well as expert opinion & comment, and also has a focus on medium to long-term strategic research. The Forum uses and develops innovative technology and tools in support of these goals, drawing on the broader range of expertise available in the Scottish HEI community and the Scottish fishing industry. Finally, the forum helps to develop a new generation of fisheries scientists.

MARINE PLANNING & GOVERNANCE FORUM
The MASTS Marine Planning & Governance Forum supports dialogue across the marine planning community to address the complex and wide-ranging research needed to support marine planning activities in Scotland and beyond.

In Scotland, the National Marine Plan was published in March 2015, and work is now underway to develop Regional Marine Plans across the 11 Scottish Marine Regions in territorial waters. The MASTS Marine Planning & Governance Forum leads dialogue between the Government, marine planners, local authorities, stakeholders and the scientific community, to identify and address the knowledge gaps in implementing effective marine planning.

Key activities include identification of strategic research needs for marine planning, development of research opportunities from Masters projects to long-term international funding calls, and a web-based platform to understand and connect research capacity. With close involvement of Marine Scotland and current/future marine planners, the Forum aims to bring together the academic community to strategically develop applied and interdisciplinary research essential to enable evidence-based governance for sustainable management of our marine environments.

TECHNOLOGY, PLATFORMS AND SENSORS FORUM
Marine science is largely underpinned by technology which is driven and sculpted by mutual interactions between scientists and engineers. We currently live in an era where technology is available to access, explore and sample the marine environment in its entirety. Paradoxically these capabilities have arisen at a time, where in the midst of a changing climate, funding in which to provide the pertinent high-resolution and high-replication of measurements and samples is becoming ever more challenging. Therefore, the current emphasis is not on technological capability but rather technological innovation in which to overcome these challenges.

This forum actively engages with engineers and technologists embedded within MASTS, and forges a multi-institute coherence with a regular transfer of knowledge exchange, evaluation of current expertise and capabilities, and horizon scanning. The Forum facilitates networking and information exchange by convening meetings and workshops to establish a coordinated approach to proactive engagement within MASTS.
MASTS FORUMS

MARINE BIOGEOCHEMISTRY FORUM
The Marine Biogeochemistry Forum presents a unique opportunity to ensure marine biogeochemists play a key role in shaping the future Scottish marine environment. Scientific excellence is at the core of this forum, with Scottish marine biogeochemists being respected worldwide.

A better understanding of biogeochemical rate processes and their sensitivity is required to better evaluate their response to natural and anthropogenic change in the 21st Century and beyond. Biogeochemistry is also a key component of large national and international funding schemes (e.g., UK Ocean Acidification). Effective biogeochemistry frequently requires the parallel measurement of multiple processes, and the critical mass of scientists within MASTS provides an opportunity to conduct key and high profile research of benefit in Scotland and globally. Integration and communication is achieved using themed workshops, meetings and social media.

NUMERICAL HYDRODYNAMIC MODELLING FORUM
The MASTS Numerical Hydrodynamic Modelling (NHM) Forum exists to promote numerical hydrodynamic modelling within Scotland, and provide a platform for bringing together the scientific community to address current and future research needs.

NHM models are used to simulate estuarine, coastal and ocean-scale flows, and as such have a broad range of applications, from environmental assessment, to marine energy, to climatology. MASTS NHM members have research expertise in these areas, and are involved in research projects covering a broad range of topics, from computational fluid dynamics of tidal energy devices, to coastal modelling, as well as more fundamental modelling studies of the processes behind hydrographic flow.

DEEP SEA FORUM
Scotland has a vast deep-sea area stretching out to the 200 nautical mile boundary, encompassing a range of diverse habitats as well as economic resources such as fishing, oil and gas. In addition to scientific interest in the deep sea, policy makers are required to protect many of these poorly understood habitats and the often fragile ecology and biodiversity that they support. Increasing access to deep sea habitats and exposure through various media has also stimulated significant public curiosity in the life found in these deep, cold, dark environments.

A more holistic approach to studying the deep-sea is needed which requires engagement with researchers representing a variety of disciplines, including ecologists, chemists, physicists, modellers and climate scientists. These researchers have to be supported by technology that can operate remotely under extreme conditions. Only then can we truly begin to understand how the ecosystem functions.

Deep sea researchers operating within the MASTS community have access to a variety of state-of-the-art equipment, some of which has been specifically designed to operate and sample in the deepest parts of the world’s oceans. The challenge of conducting research in these extreme environments means that much of the science is by definition, cutting edge. However, use of modern technology, together with practical ingenuity is leading to novel discoveries including species and ecosystems new to science.

MARINE STRESSORS FORUM
The Marine Stressors Forum provides an integrated platform to promote the enhanced understanding of environmental stress, both natural and anthropogenic, on marine organisms.

Environmental stress is any physical, chemical or biological factor that requires an energy consumptive compensation response by affected organisms, thus placing constraints on the productivity and development of ecosystems. The wide range of possible stressors, including noise, electrical fields, oil and oilfield chemicals, nanomaterials and plastic microparticles and litter, means that to understand and mitigate the impact of stress, a multidisciplinary approach is required.

This Forum provides a multidisciplinary network across the MASTS community and a contact point for informing policy and providing up to date advice on the impact of human activity in Scottish waters (and beyond) and the performance of existing and regulatory frameworks.

An important role of the Forum is to monitor developments in ecotoxicological biomarkers for contaminant exposure, including the effects of climate change on the behaviour and fate of contaminants, the susceptibility of organisms, and on biomarker endpoint validation, as well as policy provisions.
COASTAL ZONE FORUM
The Coastal Zone Forum provides a network for multidisciplinary marine and social science to address the management of the coastal zone and the ecosystem services it provides.

The coastal zone in Scotland is at a critical juncture with the advancement of coastal and marine planning, development of marine renewables, increasing impacts of climate change, the problems of coastal erosion and coastal defence, and implementation of marine protected areas. These drivers are creating challenges, opportunities and impacts for coastal communities and MASTS.

This forum uses Scotland’s world leading expertise in the valuation of coastal systems and aims to strengthen the link between biodiversity research, ecosystem analysis, policy development and regulation by producing work of high scientific quality which contributes to the policy debate and the needs of stakeholders. Recent examples include sustained regeneration of habitats, work on bathing waters in Europe; investigation of eco-labelling for salmon farms; and through impact analysis of potential Marine Conservation Zones.

This forum is developing the human capital and skill sets of the MASTS community to respond to these challenges, and has been the impetus behind new interdisciplinary partnerships including joint PhD studentships and regular workshops. This forum also has excellent links with national and international research organisations.

COASTAL PROCESSES & DYNAMICS
The Coastal Processes and Dynamics (CPD) provides an integrated Forum to promote enhanced understanding of the physical functioning of the coastal zone. This group bridges the physical, biological and human influences within the coastal zone.

The Scottish coastal zone is under increasing pressure from enhanced erosion and flooding as sea levels rise, storm impacts increase and coastal sediment supply wanes. Simultaneously, human impact on the coast is at an all-time high with ongoing urbanisation and now joined by marine renewable developments, amongst other pressures. The mission of this Forum is to better understand and promote the cooperative science that underlies resilience and coastal change to help inform future adaptation at the coast.

MASTS FORUMS

MASTS RESOURCE CENTRE

MASTS member institutions have significant marine research assets ranging from large ocean going research vessels to inshore craft, remotely operated vehicles, and diving facilities together with a host of specialist equipment, services and expertise. Much of this information is captured and made available to MASTS members through our Resource Map, accessible at: www.masts.ac.uk/resource-centre

The map is a core facility of our virtual Resource Centre which is designed to encourage sharing of physical assets such as equipment and services as well as cross disciplinary utilisation of valuable intellectual resources particularly in areas such as mathematical modelling and the development of technology.

The centre is entirely web-based and provides details of a variety of intellectual, technical and operational resources that individual or groups of partner institutes wish to promote and may make accessible.

Resource searches can be undertaken using categories, keywords, or a combination of the two. Options for selecting location are also provided. Results can then be viewed as a spreadsheet style list or a map display. Previous searches can be quickly accessed using the displayed “Quick Searches” links.

For further information on the MASTS website and Resource Centre, please contact us at: masts@st-andrews.ac.uk
The MASTS Graduate School provides education and training to the MASTS student community. This training includes both technical and core skills to ensure that MASTS graduate students have the full complement of skills required to achieve the best in their future careers.

The functions of the Graduate School include:
- Provision of a Graduate School Retreat
- Coordination of specific training and workshops
- Development of the graduate internship programme
- Coordination of links with overseas institutions
- Assisting in the coordination of Making the Most of Masters projects

The annual MASTS Graduate School Retreat brings together the geographically dispersed MASTS postgraduate population and creates a tight-knit student community, while providing useful and informative training sessions and seminars.

Making the Most of Masters (MMM) is a method by which organisations can benefit through working with postgraduate students and universities to undertake specific research projects targeted to identified needs.

For more information see: www.masts.ac.uk/graduate-school/making-the-most-of-masters

There is growing interest across the higher education sector in building closer links between academia and external stakeholders: potential employers, regulatory bodies, research funders, policy makers, lobbyists, and many others. MASTS see the facilitation of internship opportunities as a core interface for bringing future cohorts of ‘influencers’ into direct contact with individuals and institutional cultures. Completing an internship should maximise impact from research and enhance personal and professional development.

Internships offer appointees an excellent opportunity to build working relationships and extend their research experience into business, policy or other settings (or vice versa) - this programme is not just for students - academics and employees are welcome to participate. Internships can last between two weeks and four months. Appointees may work either full time or part time and are generally expected to spend between 50-100% of their time in the host organisation. Contact masts@st-andrews.ac.uk for further details.

MASTS is now recognised as a brand of quality, and to support the personal and professional development of postgraduate students, MASTS will be offering a Postgraduate Certificate (PGCert) award in Researcher Professional Development from October 2017. The inclusion of credit-bearing training will assure quality and standards of training for postgraduates, build cohorts, strengthen internal and external links, enhance the student experience and improve employability and career opportunities for graduating MASTS researchers.
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