



# MASTS

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## THE MARINE ALLIANCE FOR SCIENCE AND TECHNOLOGY FOR SCOTLAND

[www.masts.ac.uk](http://www.masts.ac.uk)

## Research and Innovation Strategy

Scientific excellence remains central to MASTS, supporting the application of innovative research to underpin sustainable economic performance, climate change adaptation, and food, water and energy security.

MASTS supports the ecosystem-based approach to managing the multiple impacts of human activities on the environment – acknowledging humans as an integral part of the ecosystem.

MASTS facilitates interdisciplinary cooperation and, whilst prioritising some areas of research and innovation, recognises the right of researchers to pursue their own goals.

Our strategy is to learn from the past, support best practise across marine science disciplines and address major emerging challenges.



**CLIMATE CHANGE**

Sea level rise, coastal erosion and inundation will have a significant impact on coastal populations including some of the world's major cities. Storm intensity and frequency together with increasing sea temperatures and the effects of ocean acidification are likely to become more obvious and will have more direct impacts on the marine environment and those that depend upon it. This will result in enforced migration placing significant economic and security burdens particularly where a combination of geographic, political and economic factors amplify the flow and concentration of migration.

**POPULATION GROWTH**

Global population growth and economic development will increase pressure on energy, food and water security. Pressure to secure raw materials such as deep-sea mineral deposits, marine hydrates and remaining fossil fuel deposits will increase in some countries, particularly where they seek to establish regional geopolitical and economic power. In developing countries with rapidly expanding populations, environmental concerns are likely to be tempered by the need to supply the growing population with shelter, food, water and energy at least cost.

**FOOD SECURITY**

Growing pressure on land-based resources will result in greater interest in utilising marine systems and processes to produce food and other raw materials currently derived from land based agriculture. Mariculture (marine-based aquaculture) will expand significantly to meet the need of nutritious food for human consumption, and animal feed. Mariculture may also serve as the basis for the production of other raw materials used in current or potential future manufacturing processes.

There will be pressure to maximise production from the capture fishery through more efficient use of available fisheries, the use of lower trophic level species, and mesopelagic stocks. However, capture fishery production has plateaued and any major increase in marine food production will have to come from mariculture.

**ENERGY SECURITY**

Energy security demands growth of renewable alternatives to fossil fuels that reduce CO<sub>2</sub> emissions dramatically. Political, economic and technical barriers have thus far constrained the potential development of marine renewable energy. However, recent reductions in the cost of offshore wind power together with renewed focus on reducing the cost of tidal stream power suggests that, regionally, marine renewable energy could see a significant expansion over the next 20 years. Energy security and reducing reliance upon imported energy is also likely to reflect political tensions and strategic alliances – which favours diversification of energy supplies over least cost.

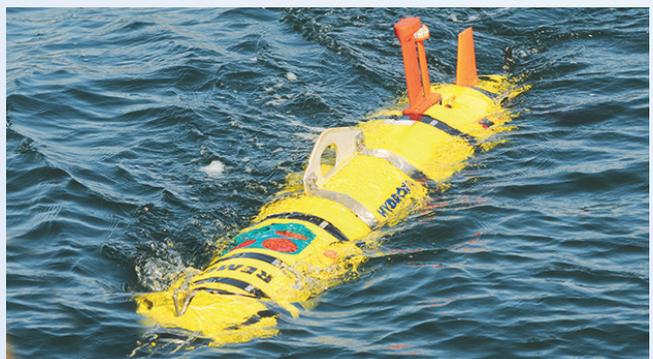
Whilst the offshore oil and gas sector in Scottish waters has probably plateaued and is likely to decline over the next 20 years, it will still represent a significant economic focus with ongoing requirements for research relevant to the MASTS community. Decommissioning of man-made structures in coastal and shelf seas will increase unless there is a substantial policy shift.

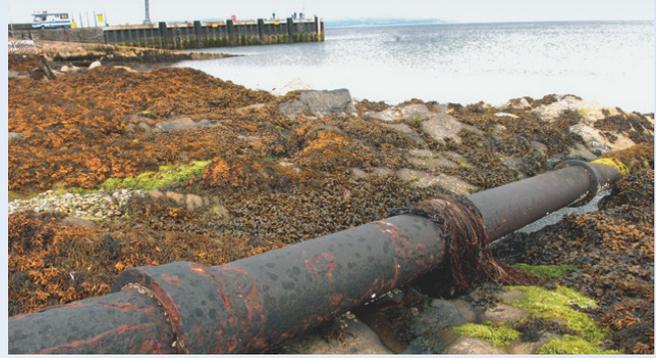
**NATURAL CAPITAL AND BIODIVERSITY**

A priority will be to protect and enhance resilience of habitats through a range of measures to maintain biodiversity, ecosystem function and adaptive capacity in the face of the multiple pressures outlined above. Understanding the finite nature of natural capital in an ecosystem context will be increasingly important in the marine environment. Ensuring decision makers at all levels are aware of the impact of their decisions on “ecosystems” which by default include humans, will require new ways of collecting and presenting complex information and securing behavioural change in the way humans interact with and value their environment.

**EFFICIENT USE OF RESOURCES**

Effort to reduce waste and consumption, with reuse and recycling will inevitably increase, together with pressure to find environmentally acceptable alternatives to materials such as plastics. The means, technology and institutions and infrastructure needed to effect this change will require research, innovation and major investment. The United Nations Sustainable Development Goals (UN SDGs) articulate many of the strategic drivers for marine science both nationally and internationally.





## EXPANDING THE MARINE KNOWLEDGE BASE

Our fundamental understanding of marine processes and systems is still growing, but lags behind terrestrial knowledge bases. Addressing core marine challenges and opportunities will require targeted investment and capacity building in fundamental areas of research which remain far from market. Basic curiosity driven research needs to be prioritised in areas where least is known about the marine environment and where there is highest risk of damage or loss as a result of anthropogenic activity.

## COUPLED GOVERNANCE AND OBSERVATION SYSTEMS

The Marine Strategy Framework Directive coupled to indicators of Good Environmental Status and the Marine Planning Directive will be significant drivers of research, helping focus on areas of need. Brexit (29 March 2019) will stimulate calls for changes in legislation and policy that will need to be underpinned by science. Sea and ocean areas beyond national jurisdiction will come under increasing pressure with respect to the potential for exploitation of the natural resources. Political and legal processes will need to be accelerated. Appropriate means of monitoring activity and enforcing regulation will need to be developed.

The array of pressures on the marine environment will demand better Governance, stronger institutions, with dynamic regulation and management. These structures will require relevant integrated scientific knowledge across disciplines. Required data will increasingly be generated from automated (smart) platforms. Robotics and artificial intelligence will be a step change in our ability to undertake marine research at low cost. New and accessible biomolecular technologies will open up a range of novel sensing capability in the marine environment.

## RESILIENT PARTNERSHIPS

The global marine challenges outlined provide a strategic direction which can align the MASTS community to build upon its established collaborative relationships and networks required for interdisciplinary “solutions-based” research. Scotland has an opportunity to lead the way and challenge conventional models of academic progress and reward, going beyond classical institutional boundaries and barriers to build world leading cross-disciplinary teams. In some respects, MASTS has managed to foster this ethos already, but given the scale, complexity and cost of addressing some of the challenges emerging, it is not realistic to assume that the future will simply represent a continuation of the past. Rapid, dynamic and disruptive change will be a feature of the next 20 years and organisations such as MASTS may provide the platform to facilitate institutions to adapt and capitalise on opportunities that arise. To achieve this vision, additional resources will be required, but predicated on dynamic, responsive and flexible resources rather than fixed staff complements and rigid institutional structures. Some of these resources will arise through UK and International competitions in which MASTS partners must be effective.

## UK REPRESENTATION

MASTS operates within a broad research landscape ranging from fundamental science through to highly applied research to inform and underpin policy, regulation and industry. MASTS is recognised by Government as a source of expertise and research capacity, through its Forums and through direct Membership of MASTS by Government bodies. At the Scottish level, MASTS interacts with an extensive network of public and private organisations. It collaborates directly with its sister research pools, SAGES and SULSA, the Innovation Centres, SNH, SEPA, MSS and JNCC.

## INTERNATIONAL REPRESENTATION

MASTS collaborates with partners at UK and EU level through representation on strategic organisations including the Marine Strategy Forum, Marine Science Co-ordination Committee, National Oceanography Centre (NOC) Association, European Marine Board and the European Marine Biological Resource Centre. In addition, MAST-Scotland has signed Memoranda of Understanding (MoUs) with a number of international organisations.

## A THEMATIC AND FORUM-BASED APPROACH

MASTS strategy will be based on past success with flexibility to respond to future challenges. MASTS will retain the overarching Theme and Forum structure bearing in mind that the Forums can be dissolved and others created as required. We aim to encourage more cross-Forum activity and communications. Further resources will be needed to help Forums to become more responsive to opportunities to interact with non-academic agendas such as requests to contribute expertise and knowledge to consultations, international working groups and institutions. This will become increasingly important post-Brexit and UK/Scottish Government should seek to ensure that the Scottish/UK position is supported with robust science and research.

From this national and international high-level vision, MASTS defined three themes:

- Dynamics and properties of marine systems
- Productive seas
- Biodiversity, ecosystem function and services

Under these themes, related cognate Forums have evolved which are designed to be flexible and responsive in terms of the nature of the research and the research community they engage. The Forums, led by an elected Convenor and an appointed Steering Group, are charged with engaging the relevant MASTS research community with a view to:

- i. Improving communication
- ii. Increasing collaboration
- iii. Defining and developing areas of research that may be taken forward collectively
- iv. Influencing funding
- v. Collectively advancing areas of research of common interest
- vi. Identifying training needs and suggesting doctoral research projects

## MASTS 2018 MEMBERSHIP

MASTS has 17 member organisations (11 Higher Education Institutions and 6 Non-HEIs including Government bodies and a private charity). MASTS will continue to support the inclusion of appropriate organisations but does not make attracting new members a priority.

## MASTS LEADERSHIP IN RESEARCHER TRAINING

The MASTS Graduate School is integral to our research strategy. Co-supervision of PhD students, the potential for joint registration and an active training programme are now embodied in a Post Graduate Professional Researcher Certificate (PG Cert.), to ensure that the Graduate School demonstrably builds capacity. MASTS under the wider umbrella of “The Scottish Universities Partnership for Environmental Research” (SUPER), has become a NERC-funded Doctoral Training Partnership (DTP), MASTS has and will continue to develop its Graduate School through a mixed funding portfolio.

Given that a significant proportion of graduates and higher degree level students do not continue in research, MASTS should anticipate this trend by actively developing “T-shaped” PhD students that have outstanding ability and a range of transferrable cross-disciplinary skills that set them apart from other graduates. In addition, MASTS should facilitate the development of each student’s network.

## MARINE GEOPOLITICS AND EMERGING INNOVATION

Over the last five years, the UK has allocated significant funding under the banner of “Global challenges” articulated through the UN SDGs to try to develop relationships with OECD, ODA listed countries – with a particular interest in those with emerging economies or of strategic geopolitical interest. This trend is likely to continue with increasing pressure to convert “collaborative” relationships into more concrete trading partnerships. For example, in December 2017, the United Nations announced the Decade of Ocean Science for Sustainable Development (2021-2030) to mobilize the scientific community, policy-makers, business and civil society around a programme of joint research and technological innovation. Given its cross-sectoral membership including Government, research and industry, MASTS should consider how it might use this capacity to assist others to develop research capacity, institutions, governance and regulation that will protect and improve the resilience of their marine resources.

## SUSTAINABILITY

MASTS financial sustainability is contingent upon a combination of core funding from the Scottish Funding Council (SFC) together with additional contributions from its members which at least match the current SFC annual commitment. These funds cover the operational costs of MASTS including the MASTS Directorate, the Graduate School, networking funds for MASTS Forums, small grant schemes and membership fees for EMB and EMBRC. Although subject to annual review, the current commitment appears stable until 2022. MASTS legal and charitable entity MAST-Scotland provides additional legal and financial flexibility for MASTS members to engage in collective agreements with third parties ranging from MoUs to fully contracted partnerships and projects. The MASTS Directorate also generate income through projects to offset the operational costs of MASTS and increase the funds available to support MASTS activities. MASTS strength as an organisation is derived from the active participation of its members at both institutional and individual staff level. We will continue to encourage participation through our Forums and related network activities. We will continue to engage with the marine science stakeholders in the broadest sense to encourage community development and identity, which sets MASTS apart from other organisations. Building and promoting the MASTS “brand” has been successful and we need to continue this process at national and international level.



### MASTS

c/o Scottish Oceans Institute  
East Sands  
University of St Andrews  
St Andrews  
KY16 8LB

+44 (0) 1334 467200  
+44 (0) 1334 463443  
[www.masts.ac.uk](http://www.masts.ac.uk)

Charity number – SC045259