MARINE BIOTECHNOLOGY RESEARCH AND THE EU 7TH RESEARCH FRAMEWORK PROGRAMME

Introduction

The overriding importance of a dynamic and robust research environment able to stimulate the economic and social development of Europe is reflected in the vision for the European Research Area (ERA) which sets out to

- Bring more dynamism and innovation into all sectors of industry and services, resulting in more and better jobs;
- Address important issues of European and even global dimension, such as health, energy supply and climate change; and
- Create a society in which knowledge is shared, taught and valued as an essential source of personal and collective development.

Covering around 70 percent of the earth's surface and accounting for in excess of 90 percent of the biosphere, the oceans remain host to an as yet relatively untapped and underutilised source of biodiversity.

The Galway Declaration brought into focus, the challenges faced by Europe in understanding the impact of the oceans on our future development. Delivering economic benefits from a diverse marine environment requires the generation of new knowledge. Research in the areas of marine science and technology has a key role in providing such knowledge and unlocking the full potential of the marine.

The Maritime Green paper highlights both the importance of developing a European marine research theme and its potential to contribute to the economic development of other sectors. Marine research, and in particular marine biotechnological research, enables economic activity. They each draw from and develop as a result of many scientific and technological disciplines, to generate new knowledge. The impact of such outputs extend much further than the marine: it stimulates activity in areas such as health, food, energy, pharmaceutical, environment and transport amongst others.

In the context of future marine science and marine biotechnology research the 7th Research Framework Programme (FP7) is a key enabling instrument. In conjunction with national initiatives it represents a powerful source of research funds. However, there are limits to what can be achieved by these funds, in the absence of a clear strategy or roadmap for this research.

The Bremen meeting

Against a background of achievement and great optimism about the ability of Europe's marine science research community to address new research challenges, the European Commission primed a debate on marine biotechnology research. Coinciding with German Presidency conference on European Maritime Policy, the European Commission organised a side event to consider and position marine biotechnology research within activity supported by the FP7. It set out to explore new opportunities; to seek ways of

reducing barriers; and to identify actions to allow the potential of marine biotechnology to be captured.

The framework questions set by the EU and considered by 40 experts drawn from across Europe's academic, industry and policy institutions and including both the private and public sectors were;

- What is the 'State of the art' of marine biotechnology research in Europe and how do we compare with the rest of the world?
- How may the future work programmes of FP7 be modified to maximise the opportunity for beneficial collaboration and sharing of resources and facilities between Member States?
- Is there scope for developing a wider Strategic Research Agenda that would be helpful to both private and public sectors throughout Europe?
- How may the potential benefits of marine biotechnology be realised and key obstacles to further developments be overcome?
- Do issues such as Intellectual Property Rights (IPR), innovation and availability of finance need special attention?

Policy, academic and industry viewpoints

Invited speakers gave insights to marine biotechnology from three perspectives; policy and in particular, the policy background to marine biotechnology; from institutional and academic research performer viewpoint and finally, observations from industry about the challenges of commercialising research.

Policy perspective

Awareness regarding the potential of marine biotechnology to create and sustain new areas of economic activity is increasing. That our oceans remain largely undiscovered, the opportunity for the sustainable exploitation of marine biodiversity remains to be fully defined. Against this background, marine science and other related disciplines, have significant scope to initiate and engage in new research.

European developments in the area of marine biotechnology don't as yet match the progress achieved by other regions. The USA, Japan, China and Brazil invest heavily in marine biotechnology research. The priorities of engaging in this research and the level of funds allocated to, it remain ahead of Europe's commitment.

Support from member states and the FP7 is relevant in future marine science research and in building a European capacity in marine biotechnology. There remains, however, questions concerning a European response to international developments; on establishing scientific and economic priorities; and on reaching an agreement on how best to capture and align European research expertise with the opportunities that marine biotechnology offers.

Academic perspective

Marine biotechnology can unlock the potential of the marine environment's biodiversity; leading to new knowledge, improved industrial competitiveness and supporting Europe's economic growth. Fundamental to delivering such impacts is the imperative to continue to generate and build upon knowledge from all levels of marine and related areas of scientific research. In Europe, the priority for marine science research in rising. However, European marine biotechnology research capacity remains relatively underdeveloped. Though pockets of significant research capabilities exist in marine biotechnology, they remain isolated. Understandably, against this background, research effort is often fragmented.

Though little of the biosphere has been sampled, European discovery-oriented research in deep waters identified novel micro-organisms, viruses, bio molecules and bacteria. These marine materials provide components for new healthcare, environmental and industrial products. As well as new materials, marine biotechnology is also the basis of new tools and processes of relevance to many industry sectors. Marine biotechnology is a knowledge generation and conversion process: it unlocks access to biological compounds and provides novel uses for them in areas as industrial materials, energy, transport, healthcare and the environment. This type of success emphasises the importance of increasing Europe's capacity to engage in marine biotechnology research.

National governments and the EU face challenges in both the co-ordination of priorities and improving collaboration on marine biotechnology research programmes. Resolving these issues requires a strategic approach to define priority research areas; the actions necessary to unlock and develop marine biotechnology based products; and articulate the desired impact of research effort.

The vision for such a development approach exists within the 7th FP, as does capacity to deliver this strategy. Europe's marine science research community is motivated and well positioned to bring about major changes in marine biotechnology research. It recognises the necessity to build marine biotechnology research on a foundation of basic scientific excellence and stresses the need to retain a commitment to invest in basic scientific research.

Industry perspective

Reflecting an active involvement in the entire knowledge generation and application process is a new breed of bio-pharm firm. Typical of such firms are those producing medicinal products based on novel molecules from natural sources. The marine features highly as a source of such molecules for these, and other firms involved in packaging, biofouling, energy and food sectors. Compared to the terrestrial environment, the marine environment is seen as far more likely to yield new natural products with bioactive properties. With this potential, the marine is a priority target for increased exploration.

Engaging in the discovery process is a capital intensive activity with many inherent risks. Basing a pharmaceutical product on a novel marine bioactive material can be a lengthy process and conversion rates low. It usually requires access to specialised ocean going research vessels, and equipment able to survey, capture and retrieve samples from great depths. The capacity to

manage and store data and physical samples from such voyages is essential. With such a massive biosphere to explore, industry demands include increased exploration activity; libraries of marine bioactive molecules and process that speed up the assessment and validation of bioactive potential. Institutions supported by their national governments and the EU are best placed to engage in such research.

Industry wants access to core knowledge about marine origin bioactive materials. Few firms are able to engage in exploration or develop the increasingly sophisticated process skills needed to identify and convert marine natural products to intellectual property. Adding value to marine materials – the development of new products and processes – needs access to marine biotechnology research outputs. A greater level of investment in marine biotechnology is called for by industry. This will to improve the fundamental knowledge of marine biotechnology; mobilise additional private and public sector research funds and stimulate collaborative research.

A synthesis of discussions on marine biotechnology

Awareness and visibility of marine biotechnology

There is a relatively strong recognition of the potential of marine biotechnology to contribute to the broader goals of the European Research Area. However, this is largely confined to active research performers and others with deep insights to the scientific and commercial impact of exploiting marine biodiversity. Expanding and broadening the levels of awareness are crucial in maximising the potential of marine biotechnology – a clear need for a communications initiative exits.

Many examples of the tangible benefits of using outputs from marine biotechnology research in the food, health, energy and industrial materials sectors exist; an awareness promotion initiative can be built around these. These successes will highlight the potential and strengthen the overall attractiveness of marine biotechnology to businesses outside the marine sector. Such an initiative will capture the imagination of high-potential scientific research talent to engage in related research, leading to marine biotechnology being recognised as a dynamic, exciting and rewarding area of marine sciences.

Securing the commitment of governments to support dedicated marine biotechnology initiatives, including making contributions to the formation of networks of excellence, contributes to increasing levels of awareness.

To inform and influence the European scientific research agenda, and to ensure the returns from investments in marine biotechnology are maximised, a strategic approach is called for. In any strategy for European science it is essential to clearly position marine biotechnology both as a stand-alone research area, and as a cross-cutting discipline.

Building on essential basic sciences

Knowledge generation requires scientific excellence. Building marine biotechnology capabilities need excellent scientists to lead research. There is strong support to concentrate research effort towards areas of science that enable the full potential of the biodiversity of the oceans to be explored. Only

a fraction of marine organisms have been described. Accelerating the discovery process requires support from, and access to, underpinning science areas of marine biology, biochemistry, molecular biology, genetics and natural products chemistry. It is research in these areas that creates new and improved tools and defines the protocols on which biological libraries can be built. New skills and processes in areas such as marine resource mining, targeted sequencing, bioinformatics, post-genomics, functional genomics, transcriptomics, proteomics, protein structures, metabolomics, and assays to assess bioactivity, are required. The capacity to use organisms as models for biological systems should be explored as a means of both capitalising upon and expanding the potential of marine biotechnology. Europe has to enhance its scientific capacity and capabilities to fully engage in marine biotechnology research.

Access to and improvements in the research infrastructure

Building new scientific capacity and capabilities in marine biotechnology requires access to a relevant research infrastructure. The costs of engaging in open and deep-sea discovery activities are high: requiring access to dedicated research vessels and underwater exploration platforms. There are also needs for rapid biological screening process to assess materials obtained from such cruises; traditional marine laboratories occupy a key role in this assessment and classification process. Europe's marine research laboratories are rich sources of knowledge about the marine environment. They need to be positioned to secure new "tools" that support the assessment of marine organisms and other marine materials to contribute beneficially to a wide array of industrial, social and economic sectors.

Developing a European independence in sequencing technology is an essential prerequisite in building a world-leading position in marine biotechnology. Tools used elsewhere, such as bioinformatics and functional genomics, have to be available for every day use by those engaged in marine biotechnology. Allied to this, is the requirement to identify and create new platform technologies to support the marine biotechnology sector. A means of fast-tracking the development of the biotechnology sector is to use existing mechanisms that encourage and deliver on the potential for greater collaboration between laboratories in Europe. ERA-Net type initiatives offer potential in helping to strengthen this collaboration.

Management of Intellectual Property

Securing intellectual property rights (IPR) is fundamental to exploiting the commercial potential of marine biotechnology. The markets for bioactive materials are expanding globally. Reflecting the potential returns from these novel products, these markets are also fiercely competitive. In light of new collaborative and multidisciplinary research, often extending across national and international boundaries, revisiting how IPR rights are secured, maintained and managed, would be welcomed. There is a desire on the part of researchers, whether institutional based or commercial, to reflect on how the IPR process can be modified to speed up the processes of invention and innovation, reduce time to market, and take account of different market and product life-cycles visible in the biotechnology area. The impact of process changes such as securing IPR on the basis of shared agreements, and being able to protect commercial prototypes before committing major funds

to secure patents, needs evaluating. Faced with the likelihood of spending 20 years to bring a new pharmaceutical product to market, patents may not be the most cost effective way to secure protection for IP.

Long-term and cross-cutting programmes to support the commercialisation process

In addition to finding novel marine materials, new ways to use marine biotechnology to make better use of the materials that we already have are required. Finding new materials and developing new applications takes time; it is also a risky, expensive process. Creating longer-term science programmes that are able to remain flexible and responsive to market opportunities are welcomed. These approaches create the potential to integrate marine biotechnology as a cross cutting science, able to contribute to other areas of scientific research and economic activity. Such a stance supports the exploitation of research outputs from marine biotechnology and stimulates greater awareness of its broader potential. An approach that crosses scientific boundaries expands the potential to integrate scientific advances from other areas into marine biotechnology. New technologies to support the translation of marine biotechnology research to commercial products are likely to play a major role in enabling an expansion of marine biotechnology. Exploitation of the marine bioresource is justified only where it can occur in an environmentally-sustainable manner.

Summary points presented to the Research and Innovation Session at the German EU Presidency Conference – Towards a Future Maritime Policy for the Union: A European Vision for the oceans and seas in Bremen, Germany, 2nd – 7th May, 2007

Five themes emerged from the discussions, and whilst they don't describe specific research activity, the meeting believed they require specific consideration by the Commission as enablers of Marine Biotechnology Research Activity.

The priority action recommended by the meeting was "*to develop a coherent strategy that identifies specific actions and desired scientific, technological and economic impacts in order to build a world ranking capability in marine biotechnology research*."

Action 1 - To raise the awareness and visibility of marine biotechnology

- Many success stories exist that illustrate the impact of marine biotechnology commerce, education and quality of life.
- Marine biotechnology research extends further than the marine environment and creates many new scientific and commercial opportunities.
- If such messages can be packaged they will stimulate fundamental and applied research in marine biotechnology and the commercialisation of research outputs.

Action 2 - To continue to support excellence in basic sciences

- Knowledge generation demands excellent science.

- Europe's focus must be towards support for scientific excellence.
- Stimulating activity in areas such as marine biology, biochemistry, molecular biology, genetics – will build skills needed to exploit marine biotechnology.

Action 3 - To provide access to and improve integrate research infrastructure

- Whilst cost of open sea and deepwater discovery are high, traditional marine biology labs are ideally positioned to support coastal zone biotechnology research.
- New research tools are needed to support the rapid evaluation of marine materials including the application of generic tools - bioinformatics, functional genomics marine biotechnology research.
- Support for the development of new platform technologies is called for.
- Shared/joint facilities would enhance collaboration in scientific research

Action 4 - Streamline the management of intellectual property (IP)

- Fundamental in exploiting the commercial potential of marine bio materials is access to relevant IP.
- IP procedures can be more supportive of multidisciplinary research across territorial borders.
- IP rights need to take account of different product life cycles in different industry sectors.
- Speed up the linked processes of invention and innovation and make them relevant to different business models.

Action 5 - Establish cross cutting programmes to support commercialisation

- Define new processes/techniques to support the identification of marine bioactive materials and commercialise them
- Establish long-term, flexible and response programmes to enable and support marine biotechnology research to deliver commercial potential.
- Develop novel research models that span scientific boundaries and provide translational technologies.

Meeting Agenda

10.30 Welcome, background and objectives of the meeting.
***Dr Alfredo Aguilar Romanillos**, European Commission.*

10.45 A European strategy for marine biotechnology.
***Professor Jan A. Olafsen,** University of Tromsø Norway*

11.15 The view from academia.
***Professor Grant Burgess,** University of Newcastle, UK*

11.45 The view from industry.
***Mr Simon Munt,** PharmaMar, Madrid.Spain*

12.15 How FP7 might help.
***Dr Alfredo Aguilar Romanillos,** European Commission.*

14.00 Round Table Discussion I
***Chaired by Frank-Oliver Glöckner,** MPI, Bremen.Germany*

17.30 An integrated European maritime policy
***Ms Katherine Angel-Hansen,** European Commission.*

Participants

Luc	Aguilar	Pierre-Fabre Spa
Alfredo	Aguilar Romanillos	European Commission
Sohail	Ali	Plymouth Marine Laboratory
Thor	Amlie	Norwegian Bioindustry Association
Kathrine	Angell-Hansen	European Commission
Eva-Mari	Aro	University of Turku - Laboratory of Plant Physiology and Molecular Biology
Charlie D.	Bavington	Glycomar
Willem	Brandenburgh	Wageningen University
Grant	Burgess	School of Marine Science and Technology
Jean Paul	Cadoret	Espace Interrégional Européen Bretagne/Pays de Loire/Poitou-Charentes
Ana Teresa	Caetano	European Commission
Claudiane	Chevalier	IFREMER
Francesco	Crescenzi	ENI- Enitecnologie
Frank-Oliver	Glöckner	Max-Planck-Institut für Marine Mikrobiologie
Jean	Guezennec	IFREMER
Laura	Guilano	CIESM
Dermot	Hurst	Marine Institute Ireland
Bernard	Kloareg	Station Biologique - CNRS-UPMC-INSU
Philippe	Lebaron	Observatoire Océanologique de Banyuls-sur-Mer
Maurice	Lex	European Commission
Meridith	Lloyd Evans	BioBridge
Fernando	Lobo Pereira	Tasso de Figueiredo Borges de Sousa, Depart. Engenharia Electrotécnica e Computadores
Mario	Lopes Dos Santos	European Commission
Ségolène	Martin	IFREMER
Douglas	McKenzie	Integrin Advanced Bio systems
Simon	Munt	PharmaMar
Paul F.	Nemitz	European Commission
Jan	Olafsen	ESF Marine Board
Ilias	Papatryfon	JRC
Alessandro	Piccoili	European Commission
Philippe	Potin	Station Biologique - CNRS-UPMC-INSU
Benny	Ron	Israel Oceanographic & Limnological Research Institute
Barbara	Schieferstein	Bremen Regional Development Agencies
Annette	Schimmel	Bremen Regional Development Agencies
Tim	Schröder	Freier Autor Wissenschaft/Tecnik
Ulrich	Schwaneberg	Jacobs University Bremen
Thomas	Schweder	Institute of Marine Biotechnology
Patrick	Sorgeloos	Laboratory of Aquaculture, University of Gent
Kenneth N.	Timmis	Environmental Microbiology Laboratory
Klaus	Valentin	Alfred Wegener Institute
Roman	Wenne	Institute of Oceanology, Polish Academy of Sciences
Michail	Yakimov	Istituto per l'Ambiente Marino Costiero (IAMC)