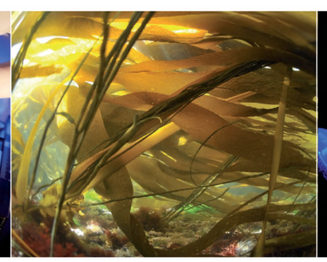
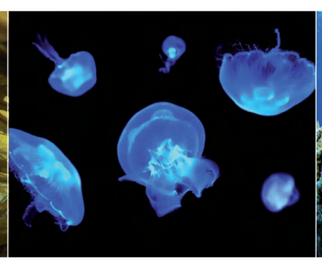
SEVENTH FRAMEWORK PROGRAMME

BOOK OF ABSTRACTS

Marine Biotechnology in the European Research Area:

Challenges and Opportunities for Europe




Final Conference of the CSA MarineBiotech Project

11-12 March 2013

Royal Flemish Academy of Belgium for Science and the Arts,
Brussels, Belgium

Koninklijke Vlaamse Academie van België voor Wetenschappen en Kunsten

MarineBiotech

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Final Conference of the CSA MarineBiotech Project

Marine Biotechnology in the European Research Area: *Challenges and Opportunities for Europe*

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SEVENTH FRAMEWORK PROGRAMME

MarineBiotech

CSA MarineBiotech final conference:

'Marine Biotechnology in the European Research Area: Challenges and Opportunities for Europe'

The CSA MarineBiotech project (**www.marinebiotech.eu**), an ERA-NET Preparatory Action in Marine Biotechnology, was designed to deliver the first concrete steps towards better coordination of relevant national and regional Research, Technology Development and Innovation (RTDI) programmes in Europe, and paving the way for common programmes and cooperation in the provision and use of research infrastructures.

The CSA MarineBiotech is funded by the EU FP7 Framework Programme, Contract number 289311, October 2011 – March 2013.

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www.esf.org/marineboard/

The CSA MarineBiotech conference is organized with support from the Royal Flemish Academy of Belgium for Science and the Arts (KVAB).

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PREFACE

The Coordination and Support Action in Marine Biotechnology (CSA MarineBiotech), is a collaborative network funded by the European Commission under the 7th Framework Programme. It consists of 11 partners from 9 countries that support marine biotechnology research and development in Europe. Since October 2011, the partners of the CSA MarineBiotech, with support from a growing number of associated stakeholders, have worked intensively to explore the opportunities and needs for European coordination, trans-national cooperation and joint activities in the area of marine biotechnology research.

The CSA MarineBiotech is not without history and responds to coordination requirements identified during various earlier initiatives. In fact, interest in marine biotechnology from the scientific community, and to some extent from industry, has grown rapidly in the past decade owing to a recognition of the sheer scale of opportunity presented by the largely unexplored and immense biodiversity of our seas and oceans and the need to meet growing demands for food and energy that cannot be satisfied from terrestrial sources alone. The marine environment accounts for over 90% of the biosphere and marine biotechnology is the key to unlocking the potential of the unique biodiversity of marine organisms and ecosystems.

Over the last decade, several science policy initiatives[1] have highlighted the importance of marine biotechnology and its potential to make a significant contribution to sustainable development on all fronts, including social, economic and environmental. However, these initiatives have also identified a number of important barriers and challenges that will need to be tackled at various levels for Europe to remain a key player in marine biotechnology research. To overcome the challenges in a coordinated way, scientists, policy makers and industry representatives have contributed to the formulation of a Vision and Strategy for marine biotechnology which is widely shared by the stakeholders[2] and provides key recommendations to improve collaboration and advance marine biotechnology research in Europe[3].

It is only recently that a concerted effort has been initiated in Europe to take action on many of the issues identified, to improve the coordination of marine biotechnology research, raise its profile, and contribute to the establishment of the European BioEconomy. Notably, the FP7 CSA MarineBiotech has been preparing the grounds for a network of funding organisations and programme managers interested in joint support for marine biotechnology research that aims to launch in late 2013 (if awarded).

Hence, we are at a crucial time as we complete one major coordination effort to prepare for the next one. It is therefore very timely to take stock of the current situation and evaluate progress towards realising the vision and strategy for marine biotechnology in Europe and what challenges remain to position marine biotechnology as a key component of the European knowledge-based economy.

To this end, the final conference of the CSA MarineBiotech project brings together scientists, industry representatives, policy makers/advisors and other key stakeholders involved or interested in marine biotechnology research in Europe, to:

- Provide insights into some of the most important recent and ongoing marine biotechnology research, coordination and policy projects and initiatives, including the CSA MarineBiotech project, and look forward towards a future MarineBiotech ERA-NET;
- Discuss the status and recent progress of European marine biotechnology research efforts and capacity at various scales;
- Identify critical needs, gaps and challenges to inform future marine biotechnology policy and coordination efforts.

More information about the project, its activities and outputs are available from the CSA website at www.marinebiotech.eu

[1] Major marine biotechnology science policy initiatives and events include the 2006 Bremen Meeting, the 2010 Marine Board Working Group position paper on marine biotechnology, the European Commission Collaborative Working Group scoping paper on Marine Biotechnology and the EU-US Task Force on Biotechnology events.

[2] See Marine Biotechnology: a New Vision and Strategy for Europe, Marine Board Position Paper 15 available at www.marineboard.eu/publications

[3] See www.marinebiotech.eu for recommendations from Stakeholders from two CSA MarineBiotech Workshops held in Portugal (Faro, 26-27 April 2012) and Germany (Hamburg, 8-9 October 2012).

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Màire Geoghegan Quinn

COORDINATION AND SUPPORT ACTION FOR EUROPEAN MARINE BIOTECHNOLOGY RESEARCH (CSA MARINEBIOTECH)

Steinar Bergseth[1] and Jan-Bart Calewaert[2] on behalf of the CSA MarineBiotech Partners[3]

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The Coordination and Support Action in Marine Biotechnology (CSA MarineBiotech), is a collaborative network funded by the European Commission under the 7th Framework Programme and consisting of 11 partners from 9 countries that support marine biotechnology research and development in Europe. From October 2011 to March 2013, these MarineBiotech partners: (i) prepared the foundation for an ERA-NET in marine biotechnology; (ii) mobilised and engaged funding agencies and stakeholders; (iii) established a Strategic Forum and a Stakeholder Group; and (iv) increased the number of funding agencies involved in the partnership committed to develop an ERA-NET in marine biotechnology. At the basis of these efforts, the group engaged in a dedicated mapping exercise to obtain more information about the current marine biotechnology science policy landscape in Europe and internationally.

One of the main achievements of the CSA MarineBiotech include the organisation of a successful series of networking events to assist in the mobilisation and engagement of funding agencies and stakeholders to guide the development of a future ERA-NET and support the dynamic marine biotechnology research community in Europe. Another central component of the CSA MarineBiotech project, is the development of a European marine biotechnology webportal (www.marinebiotech.eu). This portal serves both as a project website for the CSA and a long-term support tool for the growing marine biotechnology community in Europe by integrating dynamic and interactive modules and information systems, notably the MarineBiotech Infopages (WIKI) and a European MarineBiotech Database with projects and relevant organisations.

This presentation will look back at some of the main achievements and lessons learned from the CSA MarineBiotech in paving the way for an ERA-NET on marine biotechnology and working towards a long term support mechanisms for the European marine biotechnology community.

References

[1] http://www.marinebiotech.eu

ARE WE REALISING THE VISION AND STRATEGY FOR EUROPEAN MARINE BIOTECHNOLOGY RESEARCH?

Joel Querellou

Former Ifremer Head of Microbiology of Extreme Environments Laboratory, Ifremer
Former Chair of the Marine Board Working Group on Marine Biotechnology, France
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Marine biotechnology has been recognized as a strategic field of activity to prepare the transition from an oil-based economy to a bio-based economy by most of the leading countries in the world, from EU countries to the US, Japan, China, etc. Considering the trends that were observed during the first decade of this century in Europe, several initiatives have been developed in recent years. Marine biotechnology opportunities and challenges were thoroughly discussed within several Working Groups and initiatives (EU Collaborative Working Group on Marine Biotechnology, ESF-Marine Board Working Group on Marine Biotechnology, and of course the ongoing CSA MarineBiotech). A new vision and an appropriate strategy were adopted and key recommendations proposed as major guidelines for future policies (Marine Board Position Paper 15 on Marine Biotechnology, CWG-MB final report).

Since the publication of the ESF-MB PP15, different programmes and projects have been launched. Several of these projects are in perfect agreement with the recommendations or directly inspired by the conclusions of the ESF-MB PP15. The current initiative to implement a Marine Biotech ERA-NET is also an important step forward. Nevertheless, considering the economic and social crisis in EU, and notably the North-South gradient in the ability to fund national RTD projects, an ERA-NET is a necessary component of the future policy but might not be sufficient to keep national policies aligned during the next decade. Additional mechanisms should be discussed and the EC should keep a direct support to marine biotechnology research projects, in relation with health, food, energy and environmental policies.

SESSION 1

Perspectives from the scientific community

Session chair: **Jan-Bart Calewaert**
European Marine Board

SEA ANEMONE TOXINS: INSECTICIDES AND PAINKILLERS OF THE FUTURE?

Steve Peigneur[1], László Béress[2], Carolina Möller[3], Frank Marí[3], Wolf-Georg Forssmann[2] and Jan Tytgat[1]

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Nature has provided sea anemones with cells called, nematocysts, that contain a venom for defensive and offensive purposes. In such venom, numerous bioactive molecules (toxins) can be found. Since these molecules appear to be extremely potent and selective, the use of these toxins for purposes like pharmaceuticals (read: the development of new generations of drugs, like antibiotics, analgesics, ...), or agricultural compounds (read: novel generation of pesticides that are environmental friendly without resistance known) has triggered a strong interest.

Sea anemones pray on crustaceae (like shrimps, lobsters, ...), but can also be attacked by them. So no wonder that nature has designed and equipped sea anemones with toxins that target crustaceae. Very interestingly, since crustaceae are evolutionary linked to insects, it was found that the same toxins from sea anemones also are effective against insects. So even when a sea anemone will never encounter an insect during his life, nature has engineered beautiful insecticides in the sea, and we can exploit these molecules to be applied/used in a different habitat/environment.

The target in insects is the voltage-gated sodium (Na) channel, not surprisingly, since this target is also the one used by the oldest generation of insecticides like DDT.

As such, the toxins found in the venom of sea anemones provide a unique resource for future development of new generation(s) of insecticides, with the advantage that no resistance against these toxins exists and moreover that they are environmentally friendly which is a clear plus point as compared to DDT and related molecules.

In this study, particular attention was paid to APETx3, a novel peptide isolated from the sea anemone *Anthopleura elegantissima*, being a naturally occurring mutant from APETx1, only differing by a Thr to Pro substitution at position 3. APETx1 is believed to be a selective modulator of human *ether-á-go-go* related gene (h*ERG*) potassium channels with a *K*d of 34nM. We have subjected APETx1, 2, and 3 to an electrophysiological screening on a wide range of 24 ion channels expressed in *Xenopus laevis* oocytes:10 cloned voltage-gated sodium channels (NaV1.2-NaV1.8, the insect channels DmNaV1, BgNaV1-1a, and the arachnid channel VdNaV1) and 14 cloned voltage-gated potassium channels (KV1.1-KV1.6, KV2.1, KV3.1, KV4.2, KV4.3, KV7.2, KV7.4, hERG, and the insect channel *Shaker* IR). Surprisingly, the Thr3Pro substitution results in a complete abolishment of APETx3 modulation on h*ERG* channels and provides this toxin the ability to become a potent (EC50 276nM) modulator of voltage-gated sodium channels (NaVs) because it slows down the inactivation of mammalian and insect NaV channels. Our study also shows that the homologous toxins APETx1 and APETx2 display promiscuous properties since they are also capable of recognizing NaV channels with IC50 values of 31nM and 114nM, respectively, causing an inhibition of the sodium conductance without affecting the inactivation. The inhibitory effects observed on particular isoforms of NaV channels predicts these toxins to be a novel class of analgesics.

FP7 MARINE METAGENOMICS FOR NEW BIOTECHNOLOGICAL APPLICATIONS (MAMBA) – LESSONS FROM SUCCESSFUL PAN-EUROPEAN COLLABORATION

Peter N. Golyshin and The MAMBA Scientific Consortium

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Marine Metagenomics for new biotechnological applications (MAMBA) is a Collaborative Project, funded by EU within the FP7 program [1]. The MAMBA consortium is built on the expertise of biochemists, geneticists, microbiologists, pharmaceutical chemists and process engineers from the academia. It also involves three companies dealing with synthesis of fine chemicals and biocatalysis and bioprospecting for anti-cancer and anti-ageing agents. The project is focused on a search and use of new microorganisms-derived activities from marine environments that are difficult to access, populated by complex microbial consortia with culturable and unculturable bacterial and archaeal members and characterized by extreme values of hypersalinities, high/low temperatures, high pressure and other parameters. A number of different samples from various sites of Mediterranean Sea and other marine environments have been conducted for the preparation of small, medium and large-insert metagenomic libraries, furthermore more 1.1 thousand positive fosmids and phagemids have been selected after enzymatic screenings of interest with a number of most interesting items fully characterized. The presentation will summarize the major achievements, point at the bottlenecks and show possible pathways of impact of this multinational collaboration beyond the end of the Project.

Authors thank the European Commission for its support (Contract Nr KBBE-2008-226877)

[1] http://mamba.bangor.ac.uk/

MARINE GENETIC RESOURCES AND THE LAW OF THE SEA

Charlotte Salpin

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Marine biodiversity, in particular issues related to marine genetic resources, have become a central topic of discussions of international policy-makers and lawyers. At stake are a number of political, economic, social, environmental, legal and ethical interests. In recent years, in the context of the United Nations, States have sought to ensure the sustainable use of marine biodiversity, while at the same time protecting vulnerable ecosystems from various impacts. Marine biodiversity beyond areas of national jurisdiction is particularly vulnerable owing to the current legal and institutional framework, which remains sector-based. Several international instruments apply, yet none of those instruments specifically addresses this issue. First and foremost among those instruments is the United Nations Convention on the Law of the Sea (UNCLOS), which sets out the framework for all activities in the oceans and seas and establishes various regimes within different maritime zones. Several global and regional intergovernmental organisations also have sectoral competences in areas beyond national jurisdiction but coordination remains minimal.

Discussions at the General Assembly are now seeking to ensure that the legal framework for the conservation and sustainable use of marine biodiversity beyond areas of national jurisdiction effectively addresses those issues by identifying gaps and ways forward, including through the implementation of existing instruments and the possible development of a multilateral agreement under UNCLOS. The issue of marine genetic resources of areas beyond national jurisdiction is a key component of the discussions, including with a view to addressing questions of access and equitable sharing of the benefits arising out of their utilization as well as capacity-building needs and technology transfer. In the context of those discussions, Member States are to consider, inter alia, the extent and types of research, uses and applications of those resources, technological, environmental, social and economic aspects, intellectual property rights issues, as well as global and regional regimes on genetic resources, experiences and best practices.

The presentation will provide an overview of the on-going process at the United Nations, highlighting the relevant legal and institutional aspects, including the rights and obligations of States within various maritime zones as set out under UNCLOS, issues of access and benefit sharing as well as intellectual property rights.

References

General Assembly resolution 67/78, 'Oceans and the law of the sea', 11 December 2012.

General Assembly resolution 66/288, 'The future we want', 27 July 2012.

Letter dated 8 June 2012 from the Co-Chairs of the Ad Hoc Open-ended Informal Working Group to study issues relating to the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction, United Nations document A/67/95, 13 June 2012.

Letter dated 30 June 2011 from the Co-Chairs of the Ad Hoc Open-ended Informal Working Group to the President of the General Assembly, United Nations document A/66/119, 30 June 2011.

Letter dated 16 March 2010 from the Co-Chairpersons of the Ad Hoc Open-ended Informal Working Group to the President of the General Assembly, United Nations document A/65/68, 17 March 2010.

Report of the Ad Hoc Open-ended Informal Working Group to study issues relating to the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction: Letter dated 15 May 2008 from the Co-Chairpersons of the Ad Hoc Open-ended Informal Working Group to the President of the General Assembly, United Nations document A/63/79 and Corr.1, 16 May 2008 and 3 December 2008.

Report of the Ad Hoc Open-ended Informal Working Group to study issues relating to the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction, United Nations document A/61/65, 20 March 2006.

Reports of the Secretary-General, 'Oceans and the law of the sea', United Nations documents A/66/70, A/64/66/Add.2, A/62/66/Add.2 and A/60/63/Add.1.

MARINE BIODIVERSITY AND GENE PATENTS – BALANCING THE PRESERVATION OF MARINE GENETIC RESOURCES (MGR) AND THE EQUITABLE GENERATION OF BENEFITS FOR SOCIETY

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Marine Genetic Resources have been identified and included in patent applications increasingly in recent decades. The number of patent applications including genes from marine organisms is growing at 12% per year (Arrieta *et al.*, 2010). However, human appropriation of marine genetic resources is poorly regulated, particularly in international waters where no legal framework exists. The absence of a clear regulation about the property of MGRs results in an absence of mechanisms to ensure proper protection of these resources in international waters. Moreover, access to the World's MGRs is limited by technological capacity. 90% of patent claims associated to genes of marine organisms originate from only 10 countries (Arnaud-Haond *et al.*, 2011). Thus, there is an urgent need to provide a clear access and benefit-sharing framework for MGRs in international waters.

Conversely, within the EEZ of different countries, where the property of MGRs is well established, the fear of biopiracy often results in too many restrictions to bioprospecting and to basic research in general. This fear of biopiracy could be greatly alleviated implementing specific requirements to disclose the geographical origin and taxonomic affiliation of the source organisms in patent applications involving natural genetic resources.

References

Arnaud-Haond S., J.M. Arrieta and C.M. Duarte. 2011. Marine biodiversity and gene patents. Science 331(6024):1521 -1522.

Arrieta J.M., S. Arnaud-Haond and C.M. Duarte. 2010. What lies underneath: conserving the oceans' genetic resources. Proceedings of the National Academy of Sciences 107(43):18318 -18324.

PANEL DISCUSSION 1

Aligning and linking national research efforts with European research collaborations, challenges and developments

Moderator: Niall McDonough
European Marine Board, Belgium

Aim

One of the aims of the future ERA-NET will be to improve the coordination of national research efforts. To this end this panel will bring together principal investigators/coordinators of major national research projects to discuss the challenges, opportunities and needs for better linking and for improving transnational collaboration of national research efforts at the European scale. The aim is to discuss specific needs and challenges for the development of marine biotechnology.

Set-up

Principal investigators will briefly present their major national and European research efforts followed by a moderated discussion culminating in a clear set of recommendations.

Participants

Principal investigators or representatives from a selection of major national research endeavors and collaborations currently running or recently completed. Some panel members may have experience with regional and pan-European scientific collaborations, but this is not a prerequisite as the starting point is national research efforts and how they tie-in with wider scale efforts.

- **Alan Dobson**, University College Cork, Ireland – Beaufort Bio
- **Antonio Figueras**, Immunology and Genomics Group, Institute of Marine Research, CSIC Vigo, Spain – AQUAGENOMICS
- **Michael Schnekenburger**, Laboratoire de Biologie Moléculaire et Cellulaire du Cancer (LBMCC), Luxembourg
- **Roman Wenne**, Department of Genetics and Marine Biotechnology Institute of Oceanology, Polish Academy of Sciences, Poland
- **Jean-Paul Cadoret**, French Research Institute for Exploration of the Sea (Ifremer), France - Greenstars project

SESSION 2

Academic-industry collaborations

Session chair: **Meredith Lloyd-Evans**
Biobridge, UK

VARIETY CREATES WEALTH - (BIO)DIVERSITY AS A SOURCE OF HIGHER VALUE-ADDED PRODUCTS FROM MARINE LIVING RESOURCES

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Two decades of R&D activities in the field of marine ecology, sustainable aquaculture and marine biotechnology and one decade of marketing products originating from marine living resources have been accomplished by the sister companies CRM – Coastal Research & Management and oceanBASIS GmbH, located in Kiel, Northern Germany. This presentation gives an interim balance of these activities and what the future could hold for Marine Biotechnology in Europe from an entrepreneurial and societal perspective.

It will be discussed, how (bio-)diversity might play a key role for exploiting the potential of Marine Biotechnology on an entrepreneurial as well as on broader economic scale.

We will give some examples of own economic activities within or deriving from Marine Biotechnology. These examples include research activities in the fields of tissue engineering, wound-healing, and screening of antitumoral and anti-infectious properties, but also development, production and marketing of seaweed and shellfish from an Integrated Multitrophic Aquaculture (IMTA) facility, bioactives for the cosmetic industry, and the natural cosmetics brand 'Oceanwell'.
A lot of people, mainly biologists, are propagating, that Marine Biotechnology as a concept will broadly contribute to overcome societal challenges, therefore raising high expectations. There are some supporting arguments for this point of view. However, whereas Marine Biotechnology is in a process of definition and stakeholders pave ways for it into research and policy, there is still no evidence for Marine Biotechnology becoming a relevant economic sector. Though great technological developments always comprise high risk, it would be responsible to scale down expectations a little bit and to face and to name also the risk of failure.

References

Krost P. and T. Staufenberger. 2012: Sustainable aquaculture and climate change (German), EUCC Deutschland. Küste und Meer 3:39.

Piker L. 2007. Mariculture - solution or meander (German)? EUCC Deutschland, Küste und Meer 2007: 28.

Piker L. 2010. Algae against cancer – New active components for oncology (German), GIT-Laborfachzeitschrift 9/2010, Marine Biotechnologie – Life Science: 678-680.

INDUSTRY PERSPECTIVES AND EUROPABIO'S PROPOSED PUBLIC PRIVATE PARTNERSHIPS IN INDUSTRIAL BIOTECH

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Europe must seek to improve its capacity to innovate through bringing the results of research to market when compared with its worldwide competitors such as China, the US, India and Brazil. Although part of the problem is lower spending of GDP on research and development a bigger issue is that the EU takes too long to transform research and innovation results into marketable products and historically has lacked the support mechanisms to bridge the EU 'innovation valley of death'.

However, with the European Commission's proposal for a new European Strategic Framework for Research and Innovation, Horizon 2020, the EU has taken a decisive step towards improving its competitiveness. The proposed approach is the right one: to focus on developing demonstration biorefineries and to develop access to risk finance and partnerships for the development of sustainable bio-based products, processes and services. These moves will help Europeans to take advantage of the social, economic and environmental benefits of the bioeconomy.

EuropaBio is therefore calling on the EU Member States to support Horizon 2020 by endorsing research and innovation in industrial biotechnology, and the bioeconomy including through the Public Private Partnerships (PPP) BRIDGE (Biobased and Renewable Industries for Growth and Development in Europe) and through safeguarding the budget allocated to both the Bioeconomy and to Industrial Biotechnology as a Key Enabling Technology.

AN INTEGRATIVE ACADEMIC-INDUSTRY COLLABORATION FOR BIOTECHNOLOGY-DRIVEN DISCOVERY OF NEW FUNCTIONS IN MARINE ENVIRONMENTAL METAGENOMES

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The large scale integrated FP7 EU project 'Marine Microbial Biodiversity, Bioinformatics and Biotechnology' (Micro B3, www.microb3.eu) builds on the expertise of 25 academic and 7 industrial partners. This highly interdisciplinary consortium comprises world-leading experts in bioinformatics, computer science, biology, ecology, oceanography, bioprospecting and biotechnology, as well as legal aspects. Micro B3 is set out to create innovative bioinformatic approaches and a legal framework to make large-scale data on marine viral, bacterial, archaeal and protistic genomes and metagenomes accessible to marine ecosystems biology and to define new targets for biotechnological applications.

The talk will outline the challenges faced integrating high volumes of heterogeneous data from biodiversity, genomic, oceanographic and earth observation databases into one Micro B3 Information System (MB3-IS), based on global standards for sampling and data processing. The developed standards, legal framework as well as analysis tools and pipelines will be immediately put to test in Micro B3's 'Ocean Sampling Day (OSD)'. OSD is planned as a simultaneous, coordinated sampling campaign of the world's oceans on summer solstice (June 21st) 2014. The resulting integrated datasets will provide insights into fundamental rules describing microbial diversity and function, and will contribute to the blue economy through the identification of novel, ocean-derived biotechnologies.

The consortium values open access to data and open source software products which are based on clear communication of intellectual property rights. This open, integrative and cross domain spirit has created a stimulating environment for academic-industry cooperation for integrated software development and the discovery of new processes and enzymatic functions in marine metagenomic data.

SOCIAL SCIENCE INFORMED SUPPORT SYSTEMS TO BETTER UNDERSTAND THE EUROPEAN MARINE BIOTECHNOLOGY LANDSCAPE AND INNOVATION LINKS

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Interest in Marine Biotechnology is increasing, and the potential fruits that could be harvested from a well-organised Marine Biotechnology community means that support tools that can inform coordination are necessary (a key driver for a Marine Biotechnology ERA-NET).

Such coordination would benefit from social sciences-based support systems, and we propose three ways that such a support system could be put to work:

Mapping the present landscape: social sciences could help better understand the current marine biotechnology landscape by tracing the Marine Biotechnology community, its activities and degree of collaboration, the central hubs and those on the periphery, the existing industry academia collaborations. This knowledge will help identifying emerging 'Innovation Pathways' between research and industry.

Charting futures: qualitative forward-looking exercises can assess the growth potential for the main applications of marine biotechnology (e.g. seafood, drugs, biofuels and other marine biotechnology output that can foster the bioeconomy).

Revealing societal implications: recent developments of technology have shown how critical has become the social acceptability of new technological knowledge, as seen from recent experiences in green biotech, nanotechnology and more recently synthetic biology. At the crossroad of genomics, nanotechnology and synthetic biology, marine biotechnology will face an important challenge in convincing a large array of stakeholders that, on the one hand, it does not build on irresponsible knowledge, and, on the other hand, it can fulfill the numerous promises it has announced. Such a perspective could help identifying the main bottlenecks that could impede the development of this technology and could therefore provide guidance in dealing with the corresponding policy issues with a view to the recent European move to Responsible Research and Innovation.

References

Arnaud-Haond S., J.M. Arrieta, C.M. Duarte. 2011. Analysing marine biodiversity and gene patents. Science 331(6024):1521-1522.

Gurney T., A. Schoen, E. Horlings, K. Sumikura, P. Laurens, P. Van Den Besselaar and D. Pardo. 2012. Knowledge capture mechanisms in bioventure corporations. 17th International Conference on Science and Technology Indicators (STI), 5-8 September 2012. Montreal, Quebec, Canada.

Robinson D.K.R., L. Huang, Y. Guo and A.L. Porter. 2012. Tracing promising nanotechnologies for diseases prevalent in ageing populations. Presentation at 2nd Global TechMining Conference. Montreal, Quebec, Canada. September 5th, 2012.

Robinson D.K.R. and A. Rip. 2012. Socio-economic dynamics of innovation and uptake. Joint OECD/NNI International Symposium on Assessing the Economic Impact of Nanotechnology. Washington. March 27- 28.

Robinson D.K.R. 2013. Controlled speculation about potential combinations of Nanotechnology and governance arrangements: structured social science informed scenarios. Chapter in 'Proceed with Caution?: Concept and Application of the Precautionary Principle in Nanobiotechnology'. Lit Verlag.

Robinson D.K.R., L. Huang, Y. Guo and A.L. Porter. 2013. Forecasting Innovation Pathways (FIP) for new and emerging science and technologies, Technology Forecasting and Social Change, doi:10.1016/j.techfore.2011.06.004.

Schoen A., T. Könnölä, P. Warnke, R. Barré and S. Kuhlmann. 2011. Tailoring foresight to field specificities. Futures 43(3):232-242.

INDUSTRIAL BIO, MARINE BIO AND BIO-BASED ECONOMY

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The Biobased economy is one of the strategic growth areas for DSM. Energy and materials will be made from plant biomass in the future and DSM is developing technology for this. The biobased economy is here to stay, there is no other alternative. In this field algae technology will play an important role as well. However there are several breakthrough steps needed to turn phototrophic algae technology into an economical viable option. This presentation sketches the position of algae technology in the biobased economy and key steps for a successful implementation of phototrophic algae technology are discussed. Options for cost price reduction of algae biomass are presented and DSM's view on technology breakthroughs which are needed to achieve this, will be explained.

The different markets for algae biomass (regionally and functionally) are tightly linked to cost price reductions needed to unlock these market potentials. A stepwise development from high value product to commodity products which are produced by phototrophic algae technology is the most realistic way forward. This roadmap for the future of algae technology will conclude this presentation.

PANEL DISCUSSION 2

Academic-industry collaborations: lessons for the future

Moderator: Torger Børresen
DTU Food, Denmark

Aim

It is generally accepted that successful development of a strong marine biotechnology sector in Europe can only materialise taking an industry-academic collaborative approach. How can we gain a better understanding of the marine biotechnology sector, existing and potential knowledge networks and transfer mechanisms to support its role in the future European bioeconomy in order to meet the grand challenges outlined in the Horizon 2020 vision? How can national and European science policy efforts and support mechanism, and in particular a future ERA-NET, be developed and deployed to overcome the existing barriers, involve industry and foster industry-academic collaboration? To this end this panel will bring together key representatives from the scientific community, industry and regional clusters to discuss the challenges, opportunities and needs to gain a better understanding of the sector to improve links between industry and academic research efforts.

Set-up

Participants present their perspectives on successful industry-academic collaborations followed by a moderated discussion culminating in a clear set of recommendations.

Participants

Selected representatives from the scientific community, industry and regional clusters.

- **Rui L. Reis**, University of Minho (UM), Portugal
- **Rachel Sellin**, Chair of the Marine Biotech committee of Pôle-Mer Bretagne (regional cluster in Brittany), France
- **Andrew Mearns Spragg**, Aquapharm, UK
- **Kjersti Lie Gabrielsen**, Biobank of Arctic Marine Organisms (Marbank), Norway

SESSION 3

Marine Biotechnology Science Policy and Coordination: status and challenges for Europe

Session chair: **Catherine Boyen**
Centre National de la Recherche Scientifique (CNRS), France

SUBMARINER – TOWARDS A REGIONAL NETWORK TO STRENGTHEN THE ROLE OF BLUE BIOTECHNOLOGY WITHIN THE BALTIC SEA REGION

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The Baltic Sea Region faces enormous challenges including new installations, fishery declines, excessive nutrient input, the effects of climate change as well as demographic change. At the same time blue-green innovations and use combinations of new maritime and marine products and technologies may contribute to the creation of a bio-based economy stimulating blue growth also in disadvantaged coastal regions as well as improving the marine environment.

Overall awareness of the potential for innovative and sustainable uses of Baltic marine resources is still low. Thus the so-called 'SUBMARINER compendium' (Schultz-Zehden & Matczak, 2012) has been designed as to provide for the first time a comprehensive assessment of their potentials. Topics covered macroalgae harvesting & cultivation, mussel cultivation, reed harvesting, large-scale microalgae cultivation, blue biotechnology, wave energy, sustainable fish aquaculture and combinations of such uses with offshore windparks. For blue biotechnology the state-of-the-art within all Baltic Sea Region countries has been mapped, further applications evaluated, technical requirements defined, economic aspects considered and existing strategies analysed.

It has been shown that the marine organisms within the Baltic Sea show great potential for exploration with the added advantage of cost-efficient access under clear legal conditions. Research centres exist in almost all BSR countries with special expertise in all different Blue Biotechnology fields as well as in the operation of necessary equipment for biotechnology. Some investment is needed in order to develop sufficient upscaling of equipment and related quality assurance processes.

What is most needed, however, is a focused Baltic Sea wide strategy for the implementation of Blue Biotechnology, based on national strategies and being aligned with the EU level. Such pan-Baltic strategy should consider most urgent market needs and make use of complementarity of national strengths improving modalities of technology transfer, making better use of existing support technologies and platforms while strengthening application-oriented approaches and ensuring that blue biotechnology is truly blue and sustainable, i.e. to the benefit of the sea.

In addition to the pan-Baltic compendium, Norgenta, the life science agency of Hamburg and Schleswig-Holstein, developed a master plan for marine biotechnology in Schleswig-Holstein within the framework of the SUBMARINER project. Schleswig-Holstein, Germany´s northernmost federal state is known as the 'land between the seas'. Its economy is closely linked to the North Sea and the Baltic Sea. Marine Biotechnology as a promising future technology is expected to become an integral part of it. To implement integrated maritime policy Schleswig-Holstein launched the initiative 'Sea our Future' already in 2004 and the so-called 'Masterplan for Marine Biotechnology in Schleswig-Holstein' (Klose *et al.,* 2013) will now be one part of it. But it may serve as a model for a long-term development strategy for other countries around the Baltic Sea Region as well. The process included identification of the main industrial topics and markets (nutraceuticals, renewable energy, functional food, active pharmaceutical ingredients, cosmetics, and aquaculture) as well as academic topics (marine genomics, marine microbial diversity, biologically active substances, biobanking, and biopolymers). An overview of products and services already on the market was conducted. In addition, stakeholder panels were put in place to participate in this process to develop ideas for future actions. Charged by the Cabinet of Schleswig-Holstein, the Ministry of Economic Affairs, Employment, Transport and Technology Schleswig-Holstein will generate an implementation concept until the end of summer 2013.

It is expected, that the recommendations of the SUBMARINER project formulated within its Roadmap 2020 to be published in summer 2013 will form the basis for new actions to be taken up by the future SUBMARINER flagship initiative, which has recently been approved under the revised European Union Strategy for the Baltic Sea Region.

References

Klose D., R. Duckert, I. Kröger, T. Frahm and I. Schneemann. 2013. Masterplan Marine Biotechnologie Schleswig-Holstein – eine regionale Entwicklungsstrategie. Kiel & Hamburg.

Schultz-Zehden A. & M. Matczak (Eds). 2012: SUBMARINER Compendium. An Assessment of Innovative and Sustainable Uses of Baltic Marine Resources. Gdansk.

GLOBAL PERSPECTIVES ON MARINE BIOTECHNOLOGY SCIENCE AND TECHNOLOGY POLICY

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Scientific advances - the development of technology and tools to access and study marine organisms and ecosystems - are increasing our knowledge of marine biodiversity. Marine bioresources are a source of novel products and processes, yet remain largely untapped. Through biotechnology we have the potential to help to address the global challenges of food and energy security and of health, and to contribute to green growth and sustainable industries. But it is imperative that we maintain a sustainable relationship between the conservation and use of marine bioresources.

The application of biotechnology to the marine raises distinctive challenges for policy makers. The vast interconnected systems of oceans contribute to the regulation of the planet's temperature and atmospheric conditions and currents carry marine life, nutrients and wastes within and across national borders. Governance of our shared marine environment presents challenges related to both access to and development of marine resources.

The work at the OECD Division for Science and Technology Policy considers the twin tensions of ocean productivity and sustainability faced by those seeking to realise the potential of marine biotechnology. It seeks to identify the potential of the field and the support required to realise that potential, and explores the challenges – and possible next steps for policy development - to sustainable development, recognising the unique features of the marine environment and maximising the integrity and sustainability of that ecosystem for future generations.

PERSPECTIVES FROM THE EUROPEAN COMMISSION DG RTD ON THE ROLE OF MARINE BIOTECHNOLOGY IN HORIZON 2020

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Biotechnology plays a vital role in the competitiveness of the European economy – from health care and pharmaceuticals to industrial processing, primary production and food. Biotechnology enables the development of medicines tailored to the specific needs of individual patients, of more efficient ways to use scarce resources like biomass and water and of new processes for the production of essential chemicals, food additives and materials while protecting our environment. Europe is in the lead in many of these areas, and our biotechnology industries have an important role to play for economic growth and job creation.

With the largest part of the world biodiversity still undiscovered in the oceans, biotechnology is an essential enabling technology to open new avenues for exploring and exploiting the huge potential of marine resources for innovative products and applications.

Boosting marine innovation through biotechnology-related activities is specifically mentioned in Horizon 2020: under the priority 'Better Society'. In particular under the Challenge 'Food security, sustainable agriculture, marine and maritime research and the bio-economy' marine biotechnology will support the development of sustainable approaches to further explore and exploit the large potential offered by marine biodiversity and aquatic biomass to bring new innovative processes, products and services on the markets with potential application for example in sectors including chemical, biochemical and material industries, pharmaceuticals, fisheries and aquaculture or energy and biofuels supply.

Under the priority 'Competitive Industries', key enabling technologies marine biotechnology will be further advanced for use in multiple sectors, industries and services using a new, technology-driven approach.

At the heart of Horizon 2020 objectives will also be the need to develop cross cutting marine and maritime scientific and technological knowledge with a view to unlock the blue growth potential across the marine and maritime industries. This strategic coordinated approach for marine and maritime research across all challenges and pillars of Horizon 2020 will be key to support the implementation of relevant Union policies and to help deliver blue growth objectives.

The objective to better align and link national research efforts with European research collaborations moving towards a coherent pan-European science policy and coordination for Marine Biotechnology Research perfectly fits HORIZON 2020 aims.

PERSPECTIVES FROM THE EUROPEAN COMMISSION DG MARE ON THE ROLE OF MARINE BIOTECHNOLOGY IN THE EC BLUE GROWTH STRATEGY AND THE INTEGRATED MARITIME POLICY (IMP)

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The Integrated Maritime Policy (IMP) seeks to provide a more coherent approach to maritime issues, with increased coordination between different policy areas focusing on issues that do not fall under a single sector-based policy e.g. 'Blue growth' and issues that require the coordination of different sectors and actors e.g. 'Marine knowledge'. Therefore the IMP seeks to coordinate, not to replace policies on specific maritime sectors.

The concept of the blue economy is a new one, looking at maritime sectors as a whole, rather than at individual sectors. The synergies between maritime and coastal activities are evident: skills are largely transferable between sectors, the sectors are to some extent inter-dependent, and they all rely on use of the sea in a sustainable way. Many of them also stand to benefit and grow from the development of new marine technologies and the growth of economic activity offshore.

'Blue growth' is a long-term strategy to support growth in the maritime sector as a whole. It aims to: Identify and tackle challenges affecting all sectors of maritime economy, to highlight synergies between sectoral policies, to study interactions between the different activities and their potential impact on the marine environment and biodiversity and to identify and support activities with high growth potential in the long term.

An analysis of the employment-creation potential, as well as the potential of research and development to deliver technology improvements, has suggested that the following five value chains could deliver sustainable growth and jobs in the blue economy: blue energy, aquaculture, maritime, coastal and cruise tourism, marine mineral resources and blue biotechnology.

The blue biotechnology sector is expected to develop on three phases: In the very short term, the sector is expected to emerge as a niche market focused on high-value products for the health and cosmetic sectors. By 2020, it would grow as a medium-sized market producing metabolites and primary compounds (lipids, sugars) as inputs for the food and feed processing industries. In a third stage, in around 15 years' time and subject to technological breakthroughs, the biotechnology sector could become a provider of mass product markets.

CLOSING SESSION

Towards a coherent pan-European science policy and coordination for Marine Biotechnology Research

TOWARDS AN ERA-NET IN MARINE BIOTECHNOLOGY

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The CSA MarineBiotech project has been successful in the establishment of a network of funding organisation, stakeholders and programme managers interested in joint support for marine biotech research and development. A proposal for an ERA-NET in Marine Biotechnology (ERA-MBT) was submitted (February 2013) in response to the last FP7 call of theme 2: Food, Agriculture and Fisheries, and Biotechnology. If awarded, this ERA-NET will aim to take-off late 2013 for a duration of 4 years and will involve 20 partners from 14 countries.

The ERA-MBT is designed to deliver better coordination of relevant national and regional Research, Technology Development and Innovation (RTDI) programmes in Europe, reducing fragmentation and duplication, and paving the way for common programmes and cooperation in the provision and use of research infrastructures and knowledge. This is a necessity to make sustainable use of the unique resources of the marine environments for the benefit of Europe's development into a bioeconomy based society.

ERA-MBT will work with stakeholders from industry and organisations to identify needs and gaps in the value chain from research and development, through optimising research results for proof of concept and industrial uptake and valorisation. At least three transnational calls will address these challenges, and cooperations with complementing activities will be explored to add value and power to enable the development of a horizontally applicable technology like marine biotechnology.

In doing so, it will advance progress in this field towards the vision of a European Research Area (ERA)1 and promote and position marine biotechnology as a tool which can deliver "smart, sustainable and inclusive growth", a core objective of the Europe 2020 Strategy2.

References

[1] http://ec.europa.eu/research/era/index_en.htm
[2] http://ec.europa.eu/europe2020/index_en.htm

PANEL DISCUSSION 3

How to strengthen pan-European science policy and coordination for Marine Biotechnology Research

Moderator: Steinar Bergseth
RCN, Norway

Aim

One of the long term goals as identified by many previous science policy events and documents entails the need to improve coordination between the various programmes, policies and support initiatives at national, macro-regional and pan-European level. The future ERA-NET will play an important role in this regard but on the long run other initiatives such as the JPI Oceans may also play an important role. Another key question is how to deal with the lack of dedicated support mechanisms at the national level in some countries and the disparity between the approaches of others. To this end this panel will bring together key representatives from national and regional organisations as well as leaders of relevant pan-European science coordination initiatives to discuss the challenges, opportunities and needs for better linking/collaboration of national, regional and pan-European marine biotechnology policies and programmes.

Set-up

Participants will present their background, experience and perspectives followed by a moderated discussion culminating in a clear set of recommendations.

Participants

Selected representatives from national funding agencies and/or representative organisations, macro-regional collaborations and pan-European initiatives.

- **Kathrine Angell-Hansen**, JPI Oceans, Norway
- **Catherine Boyen**, Centre national de la recherche scientifique (CNRS), Euromarine, France
- **Laura Giuliano**, Mediterranean Science Commission (CIESM), Monaco
- **Wiebe Kooistra**, Stazione Zoological Anton Dohrn, European Marine Biological Resources Centre (EMBRC), Italy

POSTERS

EU FP7 BAMMBO: SUSTAINABLE PRODUCTION OF BIOLOGICALLY ACTIVE MOLECULES OF MARINE BASED ORIGIN

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The current growing demand for marine resources, in particular High Value Added molecules (HVAB's) could pose a serious threat to marine ecosystems and marine biodiversity. Instead of exploiting the natural marine resources, environmental friendly and economically sustainable ways for culturing organisms with economically interesting composition should be developed.

BAMMBO addresses all key issues associated with the culture of marine organisms and will overcome these bottlenecks by designing economically sustainable and scalable culturing methodologies for industrial scale production of HVAB's. BAMMBO will screen and identify a broad range of marine organisms (e.g. bacteria, fungi, sponges, microalgae, macroalgae and yeasts) from diverse global locations for potential as sustainable producers of HVAB's. BAMMBO will apply various analytical methods for the extraction, purification and enrichment of targeted bioactive compounds. Moreover, a detailed life cycle analysis of the production pathways developed in the project will be undertaken to fully evaluate the sustainability of production of biologically active products from marine organisms.

The EU funded FP7 project BAMMBO started in 2011. BAMMBO has brought together a multidisciplinary consortium of specialist research and SME partners. The knowledge and technologies developed during the project is transferred to relevant stakeholders in industry and the research community, as well as to policy-makers. Innovative technologies developed in the project will be demonstrated with the involvement of industry partners, and the results will be of interest not only to companies directly involved in the marine sector, but to other large scale industry players such as pharmaceutical companies with interest in added-value bioactive compounds.

The laboratory of Protistology and Aquatic Ecology (PAE), Ghent University has focused on HAVB's derived from microalgae. Three microalgal species: *Phaeodactylum tricornutum*, *Cylindrotheca closterium* and *Haematococcus pluvialis* were selected by the consortium as model species. All three are producers of bioactive molecules: EPA, fucoxanthin and astaxanthin, respectively. The production of HVAB's is often elicited by the alteration of environmental and nutrimental parameters, so called abiotic stressors. PAE has focused on the optimization of growth, harvest and screening of *P. tricornutum*, *C. closterium* and *H. pluvialis*. The elicitation of secondary metabolites was investigated *in vitro* at the flask scale by measuring metabolite production in response to various stresses.

THE PLACE OF SUSTAINABLE AQUACULTURE IN 'BLUE GROWTH' STRATEGY FOR THE BALTIC SEA

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Among the Baltic Sea countries only Finland has essential fish farming production based on marine aquaculture. The amount of food fish cultivated in Finland in 2010 was about 11.8 million kilograms. Value of food fish production was EUR 44.0 million. The food fish supply consisted of 11.0 million kilograms of rainbow trout, about 0.7 million kilograms of whitefish (*Coregonus lavaretus*) and just under 0.1 million kilograms of other food fish species. The major part (80%) of farmed fish is from the seawaters. However the potential capacity of Baltic Sea is about 300 million kilograms for annual aquaculture total harvest. Just three of Baltic countries like Finland, Estonia, and Russia are able to produce up to 70 million kilograms in the Gulf of Finland waters. Nowadays the stake of European aquaculture is only 4,5% from the World production and fish farming in brackish water in Europe has the minor part. The Baltic Sea is a reserve for brackish water aquaculture growth in Europe.
The Baltic Sea Region faces enormous challenges including fishery declines, eutrophication due to excessive nutrient input as well as the effects of climate change. But innovative technologies provide opportunities for new uses of marine ecosystems, which can be both commercially appealing and environmentally friendly (Blue Biotechnology in the Baltic, 2012). Nowadays typical aquaculture is intensive monoculture. This concept has several disadvantages both from an environmental point of view. The environmental pollution is a very important problem in the intensive fish farming. It is well known that salmon rearing causes the drift of 5-25% feed mass from the net cages. On the other hand polyculture production systems could represent ways of increasing production volume and utilizing the biodiversity of marine ecosystems. Combining cage system with an artificial reef could solve the problem of the waste conversion. The reefs installed around the cage become inhabited with various filtering organisms. Waste products from the cage might be used as food and contribute to the strengthening of bio-filtration belt, thus increasing the self-cleaning capability of the sea area (Bugrov, 1991). The most advanced systems are termed Integrated Multi-Trophic Aquaculture (IMTA) and combine the cultivation of fed species (e.g. finfish) with extractive species, which utilize the inorganic (e.g. seaweeds) and organic (e.g. suspension and deposit feeders) excess nutrients from the fed aquaculture (Marine Board-ESF, 2010).
There are engineering and biological aspects that we need to consider as risk factors to provide an accurate estimation for sustainable aquaculture development in the Baltic Sea. Among engineering aspects the main is risk of damage of floating cages because conventional floating cages at water surface cannot withstand storm waves and ice fields. Key biological aspects are wave impact to fish and overheating in the summer season. Submersible cage system is the solution for offshore aquaculture. This is the way to avoid conflicts between users, reduces risk of fish overheating, cage damage by storms, drifting rubbish or ice and enables successful fish farming in open sea areas. At ice-infested waters submersible cages could be used for all-year round and seasonal fish farming. Before winter time cages will sink into safety depth to prevent the ice hazard (Bugrov, 2006). IMTA sea farms based on a submersible concept are able to produce different fin fish species, macro algae (*Furcellaria lumbricalis)* and blue mussels (*Mytilus edulis)* as row material for new pharmaceutical and cosmetics products, as well as may be a way to remove nutrients from the Baltic Sea.

References

Bugrov L. 1991. Fish-farming cages and artificial reefs: complex for non-waste technology - Abstracts of Fifth International Conference on Aquatic Habitat Enhancement, 3-7 November, 1991. Long Beach, California, USA. p.25.

Bugrov L. 2006. The 'Sadco' underwater fish-farming system /'Underwater Technology & Ocean World', Scientific and Technical Journal about World Ocean Resources Development 1:34-45.

Blue Biotechnology in the Baltic Sea Region. 2012. New Strategies and Future Perspectives. Perspectives from the SUBMARINER Blue Biotechnology Cooperation Event. Kiel, Germany, 9-10 May 2012.

Marine Board-ESF Position Paper 15. 2010. Marine biotechnology: a new vision and strategy for Europe. 2010.

SUBMARINER - SUSTAINABLE USES OF BALTIC MARINE RESOURCES

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The Baltic Sea is one of the world's largest brackish waters. To use its resources in an economical and environmental-friendly way, 19 institutions from 8 countries work on the 3-year-project 'SUBMARINER - Sustainable Uses of Baltic Marine Resources'. In an already published compendium, solutions for new innovative applications together with coordinated cross-border implementations are highlighted. This compendium is the guide and basis for politicians and stakeholders for a positive development of the Baltic Region. Additionally, a network is generated which should be expanded further after the finished project.

In Mecklenburg-Vorpommern (Germany), BioCon Valley MV e.V. is working on marine functional genomics as part of the chapter 'blue biotechnology' in the compendium.
With modern molecular biological methods the theoretical genomic potential as well as specific activities of microorganisms or their products can be estimated. New metabolic activities and adaptation strategies can be developed with model organisms, bioactive substances can be isolated from distinct organisms for use in the pharma-, cosmetic- and food industry and the environment can be monitored and protected.
With the Ernst-Moritz-Arndt-University and the Institute of Marine Biotechnology e.V. (IMaB), Greifswald is one of the main players in biotechnology research in Germany. Experience as well as prominent platform technology is excellent with marine proteomics as a unique selling point.

The poster gives more insights in the possibilities to transfer research in marine genomics in applicable techniques to better understand the microbial life in the Baltic Sea, improve the environment and use the bioresources to positively develop the whole Baltic Sea Region.

References

www.submariner-project.eu
www.bcv.org

THE EUROPEAN JOINT PROGRAMMING INITIATIVE FOR HEALTHY AND PRODUCTIVE SEAS AND OCEANS (JPI OCEANS)

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The European Joint Programming Initiative Healthy and Productive Seas and Oceans (JPI Oceans) is a coordinating and integrating platform, open to all EU Member States and Associated Countries who invest in marine and maritime research. In its role as a coordination platform JPI Oceans is the only high-level strategic body that exists, to provide a long-term integrated approach to marine and maritime research and technology development in Europe.

While bringing together the interested Member States and Associated Countries JPI Oceans aims to add value by avoiding fragmentation and unnecessary duplication; planning common and flexible initiatives; facilitating cooperation and foresighting; and establishing efficient mechanisms for interaction and knowledge transfer between the scientific community, industry & services, and policy makers at high level to more effectively solve the grand challenges.

As a coordination platform, JPI Oceans focuses on making better and more efficient use of national research budgets, which represent 85% of the marine-maritime funding within Europe. One of the JPI goals is to develop joint research programs in which countries can be involved on a voluntary basis (variable geometry). Participating countries will also decide what contribution to make: this may include institutional, project-related or new funds.

JPI Oceans is run by a high-level Management Board with representatives from each country with sufficient authority to agree on joint action plans and potential funding initiatives across all sea basins in Europe.

The Management Board has put in place a Strategic Advisory Board of high-ranked representatives from science, industry, public authorities and civil society to advise on future actions to be taken.

The daily follow up of the JPI is taken care of by the JPI Oceans secretariat which is based in Brussels

Website: www.jpi-oceans.eu
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RITMARE ITALIAN RESEARCH AND INDUSTRY FOR THE SEA

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Italy is finally looking ahead towards the Mediterranean Sea, therefore intensifying its exchanges with the neighbouring countries, and investing more and more in activities designed to sustainably exploit the sea. The awareness of the socio-economic and cultural importance of the 8,000 km of coastline have incited the Italian industry and research system to implement a national programme of scientific and technological research for the sea, pluri-annual and open to the participation of all public and private stakeholders. The RITMARE objectives aim at promoting a significant evolution of the national economy of the sea, supporting networking, co-operation and internationalization actions in harmony with the indications of the Blue Book.
Partners of the project are, public research organisations: CNR, INGV, OGS, SZN, ENEA, CONISMA, CINFAI, private sectors, Technology Districts: Sicilia NAVTEC, DLTM, AgroBioPesca, DITENAVE; industries: Fincantieri, CETENA, CONSAR, UNIMAR, RINA and authorities appointed to the management, monitoring and safeguard of marine environment, Ministry of Education, University and Research. A special attention will be paid to support integrated policies for the safeguard of the environment (the health of the sea); to enable sustainable use of resources (the sea as a system of production); to implement a strategy of prevention and mitigation of anthropogenic or natural impacts (the sea as a threatened system; the sea as a potential source of risks for humans).
RITMARE partially overlaps with the Marine Biotechnologies CSA as to the following activities: 1) Bioprospecting for the detection of molecules and biological processes in deep-seas with potential applications in biotechnology (Goods and ecosystem services provided by deep marine environments) 2) Innovation in aquaculture, 3) Development of new green approaches for the recovery of contaminated waters associated with spills of toxic and / or hazardous substances to timely respond to these events.
By means of its network, which includes researchers of various disciplines and industrial partners, RITMARE will facilitate new multi-sector partnerships (i.e. including those concerned by bio-medicals/pharmacology). More particularly, the transfer of knowledge and technology across the various collaborating sectors, relying on the National Research Council facilities, will be carried out by means of a targeted dedicated office. From the very early stage of the project, this office will be responsible for market potential assessments, and will assist researchers in the definition of contracts, in tasks related to the management of intellectual property and for the filing of patent applications. It will also provide support during the phases of prototyping and engineering, and will look for partners potentially interested to acquire the produced patents. The possibility of facilitating the creation of new high-tech companies (spin-off) is also envisaged. This task will be fulfilled via entrepreneurial training programs, business planning and preliminary support to the management and coordination of the business incubator.
While being a national project, RITMARE can integrate (or inspire) other at international (i.e. European) level.
The Italian maritime zones harbour various ecosystems with great potential for bioprospecting. Among various, shallow hydrothermal vents (Panarea, Vulcano, Ischia), submarine volcanoes (Marsili, Palinuro), mud volcanoes (Strait of Sicily, Calabria dorsal), hypersaline anoxic lakes (Ionian sea) offer unique opportunities to study the adaptive mechanisms of micro- and macro fauna to the extreme conditions, and the possible inter-species interactions (including symbioses) allowing their survival in such harsh environments
Bioprospecting activities, especially aiming to search for bioactive molecules and enzymatic reactions with potential industrial applications will be carried out by means of a large set of modern methodologies, including (meta) genomics, (meta) transcriptomics and (meta) proteomics. optimised screening platforms. Once isolated, compounds with biotechnological potential will be characterized chemically. Among the possible applications, bioremediation treatments for the recovery of oil-polluted marine environment will be a priority target.

www.ritmare.it

UNRAVELING THE UNKNOWN UNKNOWNS IN THE METAGENOMIC PROTEIN UNIVERSE USING GRAPHICAL MODELS

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Metagenomic surveys, like the Global Ocean Survey (GOS), generated a huge amount of genetic data and allow performing more holistic approaches to study marine ecosystems. Moreover, metagenomics proofed being valuable in discovering missing pieces in marine biological processes. However, metagenomics not only expanded our limited view on the diversity of the known protein universe, it also increased the number of genes of unknown functions. Metagenomics reveals a large number of known unknowns like the domains of unknown function (DUF) and unknown unknowns, putative coding sequences without any hint of potential function. Here we propose a novel approach to extract valuable information from the co-occurrence of individual protein domains involved in biological processes in metagenomic complex systems using Graphical Models. Using an integrative approach, we combine the knowledge of the known protein domain families and 16S rDNA with the unknown unknowns to explore the GOS metagenome. As a result, we are able to reveal new associations in biological processes within known protein families and between known protein families and unknowns.

In conclusion, our approach provides a better understanding of the known biological processes and generates a list of candidates from the unknowns or unknown unknowns related with known processes for experimental verification. In some cases we could even suggest specific cultured organisms for performing lab experimental on genes of unknown functions. Thus, our approach might play an important role in bioinformatics biodiscovery pipelines for biotechnology.

THE KIEL CENTER FOR MARINE NATURAL PRODUCTS – INNOVATIONS IN MARINE BIOTECHNOLOGY

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The Kiel Center for Marine Natural Products (Kieler Wirkstoff-Zentrum KiWiZ) is a biotechnological research platform for marine natural products specifically from marine microorganisms covering aspects from the habitat to the hit for drug candidates. It has built up national, European and international networks to promote the research on bioactive substances from the laboratory to industrial application. The activities of KiWiZ include research on ecological aspects of natural products as well as on their biotechnological production. It performs studies on the biology and chemistry of marine natural products and their producers, marine bacteria and fungi. The exploration of the marine microbial biodiversity with respect to natural products, the development of methods for their biotechnological production with minimized risks for nature and man as well as their sustainable use is considered by KiWiZ.

The focus of the KiWiZ at GEOMAR is on identification, production and promotion of new natural products from marine microbial sources and the investigation of their biological activities and ecological function. Studies of the KiWiZ include all aspects from sampling, isolation and identification of the microorganisms in order to describe biodiversity, their preservation in culture collections, revelation of genomic potentials, as well as the extraction, purification, structure elucidation and characterisation of natural products from the cultured bacteria and fungi in order to describe and understand chemodiversity of marine microbes. In addition, optimisation of production conditions and scale up to a pilot scale for biotechnological production of bioactive natural products are considered as part of a sustainable approach for marine biotechnology. The research of KiWiZ relies on the extremely high diversity of marine microorganisms either newly cultured with special intention or contained in the large culture collections of KiWiZ containing marine bacteria and fungi covering more than 15.000 isolates, with a high proportion of new and unknown taxa. Important aspects became the growing panel of biological assay systems, in which suitability for specific applications is tested and the establishment of a substance library of pure marine natural products. With its unique setup and resources, the KiWiZ has developed into an excellent scientific centre on new natural products from marine microorganisms, being operated by an interdisciplinary team of scientists. Basic aspects on both biology and chemistry of marine natural products as well as applied research topics are considered. In addition to numerous publications and several patents, the strategy of KiWiZ in the frame of marine natural product research is included in a recent review on this topic (Imhoff *et al.*, 2011). Highlights of the research activities of KiWiZ and its networks will be presented.

References

Imhoff J.F., A. Labes and J. Wiese. 2011. Biomining the microbial treasures of the ocean: new natural products. Biotechnol Advances 29:468-482.

FP7 PROJECT KILL·SPILL: INTEGRATED BIOTECHNOLOGICAL SOLUTIONS FOR COMBATING MARINE OIL SPILLS

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Oil spill disasters are a worldwide problem and current technologies do not satisfactorily address the issue. It is important to recognize that 'miracle microorganisms' and 'magic elixirs' sprinkled on an oil spill will not do the job. An integrated approach considering at the same time: (1) metabolic requirements of biodegrading organisms alongside the properties of the oil, (2) environmental limitations on oil biodegradation and (3) innovative delivery mechanisms for agents that alleviate these bottlenecks is critical. This is the essence of the Kill●Spill project. It represents a European initiative fully committed to tackle oil spill disasters in an integrated and interdisciplinary fashion employing highly efficient remediation strategies.

The principal objective of Kill·Spill (http://www.killspill.eu/) is to develop highly efficient, economically and environmentally viable solutions for the clean-up of oil spills caused by maritime transport or offshore oil exploration and related processes, which have been fully validated in large mesocosm facilities under controlled conditions and by application to real life oil spills. In general, once crude oil is spilled, it takes at least one week before biodegradation processes begin to take effect. Kill·Spill aims to shorten this start up period to the absolute minimum by providing technologies for example, that provide the necessary nutrients together with hydrocarbon degrading consortia and/or enhancing compounds (biosurfactants) to both accelerate and maximize bioremediation rates from the time of application. In addition, when the use of dispersants is recommended, the previously mentioned biostimulation and bioaugmentation formulations will be applied together with specific compounds acting as dispersants that take the oil from the surface to the water column and ultimately to the sea floor. Taking into account that as we go deeper in the water column, the amount of dissolved oxygen is more difficult to replenish by diffusion, Kill·Spill also offers specific novel technologies (Oxygel™ and Aerobeads™) that release oxygen over longer periods of time. It maintains as a result greater bioremediation rates of dispersed oil in the water column, even when it reaches the sediments. In cases where it is not feasible, this approach will be complemented with the development of processes to stimulate oil biodegradation anaerobically in anoxic sediments. Once the dispersed oil reaches the sediments, bioremediation rates are substantially reduced due to the prevailing anoxic conditions. Kill·Spill provides a series of highly innovative technologies (e.g., 'Kill·Spill snorkel', 'Kill·Spill Robot', 'Kill·Spill Sed-Cleaner') that overcome this problem and induce enhanced biodegradation rates in the sediments. These technologies can also be used for the remediation of recurrently polluted sediments (from old oil spills) in all types of environments from the Eastern Mediterranean to Disko Bay in Greenland. In addition, several other innovative products will be developed, e.g., 'Kill·Spill All-in-One', 'Kill·Spill Deep-sea', 'Kill·Spill Bio-boom', besides the 'Kill·Spill Biosensor' for *in situ* monitoring of oil degradation.

The Kill●Spill project involves 14 universities, 4 research institutions, 14 SMEs and one spill industry trade association active in complementary areas, contributing to the development of innovative and integrated solutions and tailored strategies for the oil spill cleanup market. The solutions developing from the Kill●Spill project are evaluated against current industry solutions, and promoted to the European spill industry through conferences and seminars. Thus, Kill●Spill consortium will generate new industrially driven foreground and deliver innovative processes and services to policy makers and European citizens. The Kill●Spill project has also much to offer to the Marine Strategy Framework Directive (MSFD). For example, all the technologies developed for hydrocarbon polluted sediments can be part of the mitigation measures to return marine environments to Good Environmental Status (GES). Furthermore, the monitoring tools can be used by Member States in the requested initial assessment to identify current environmental status. Moreover, many of the Kill●Spill biostimulation strategies can be applied to sea areas faced with chronic pollution.

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THE EUROPEAN MARINE BIOLOGICAL RESOURCE CENTRE

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The European Marine Biological Resource Centre (EMBRC; www.embrc.eu) will comprise a distributed ESFRI Research Infrastructure of key European marine biological and molecular biology laboratories, together providing: 1) access to European coastal marine biota and ecosystems; 2) an integrated supply of marine organisms for interdisciplinary research, including models; 3) coordinated services including biobanks and platforms for genomics, structural and functional biology, microscopy and bioinformatics; 4) interdisciplinary training in marine biological sciences and genomics; and 5) outreach and consultancy. New and improved services will be provided for research, training, education and innovation. EMBRC targets users from across the biological, biomedical, geochemical and environmental sciences, from the public (academia, government, NGO) as well as the private sector (industry, SME), wishing to apply state-of-the-art approaches to study marine model organisms. EMBRC is currently in its third year of the preparatory phase with founding partners from Italy, France, Germany, Greece, Norway, Portugal, Sweden, and the UK together with aspiring partners from e.g. Belgium, Denmark, Israel and the Netherlands wishing to join in the implementation and construction phase. EMBRC plans to obtain ERIC status and is currently developing a Memorandum of Understanding with business plan and consortium agreement. The operational EMBRC will contribute to finding coherent solutions for exploiting the full economic potential of the seas in a sustainable way, minimizing the impact on the marine environment, following EUROPE 2020 and MARINE KNOWLEDGE 2020 objectives.

MARINE FUNGI - NATURAL PRODUCTS FROM MARINE FUNGI FOR THE TREATMENT OF CANCER

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The aim of the FP7 funded project MARINE FUNGI is the demonstration of sustainable exploitation of marine natural resources providing appropriate culture conditions for the underutilised group of marine fungi, thus enabling efficient production of marine natural products in the laboratory and also in large scale cultures, avoiding harm to the natural environment.

The focus of MARINE FUNGI are new anti-cancer compounds The project carries out the characterisation of these compounds to the stage of *in vivo* proof of concept ready to enter further drug development in order to valorise the results of the project. MARINE FUNGI covers two approaches to gain effective producer strains: a) Candidate strains originating from one partner's strain collection are characterised and optimised using molecular methods; b) New fungi are isolated from unique habitats, i.e. tropical coral reefs, endemic macroalgae and sponges from the Mediterranean. Culture conditions for these new isolates are optimised for the production of new anti-cancer metabolites. MARINE FUNGI will develop a process concept for these compounds providing the technological basis for a sustainable use of marine microbial products as a result of 'Blue Biotech'. The project explores the potential of marine fungi as excellent sources for useful new natural compounds. This is accomplished by the formation of a new strongly interacting research network comprising the scientific and technological actors, including 3 SMEs and 2 ICPC partners, necessary to move along the added-value chain from the marine habitat to the drug candidate and process concept. The generated and existing knowledge will be disseminated widely for the valorisation of the project results.

References

www.marine fungi.eu

FLEMISH ALGAE PLATFORM (VLAAMS ALGENPLATFORM)

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The Flemish Algae Platform is a **networking and innovation stimulating project** funded by the Flanders Innovation Hub for Sustainable Chemistry (FISCH).

Microalgae are photosynthetic microorganisms that abound in the world's oceans, rivers and lakes. These algae offer many new opportunities. Applications of microalgae cover a broad spectrum, including the food and (livestock) feed industries, chemicals, bioenergy, cosmetics, healthcare and environmental restoration or protection. These applications also come with many challenges to produce sustainably on large scale. The goal of the Flemish Algae Platform project is to create a **network** linking Flemish organisations (companies, research institutions and associations) that currently have activities concerning microalgae or that have plans to do so in the future. This network will **facilitate** and encourage the embedding of existing algae activities and the development of new microalgae related business activities.

Activities which will be carried out in this project aim to **map, inform and motivate** the various actors in the algae value chain and support them with the implementation of their innovation process. The Flemish Algae Platform will also **identify and resolve collective needs of technological, economic and regulatory nature**, creating a favorable environment for the development of a Flemish microalgae economy. In the field of microalgae there is a strong need for such a project because of the strategic importance and the early development stage of most of the activities and collaborations.

The Flemish Algae Platform is open for all stakeholders active or interested in algae. More information about membership can be found on our website: www.vlaamsalgenplatform.be.

MARINE ENZYMES WITH APPLICATIONS IN BIOCATALYSIS

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Enzymes isolated from marine archaea, bacteria and algae offer potential for use in industrial biocatalysis. At the Exeter Biocatalysis Centre, we have studied several such enzymes including vanadium haloperoxidases from marine algae, dehalogenases from several marine bacterial species in collaboration with Aquapharm, UK, L aminoacylase, alcohol dehydrogenase and lysophosholipase from marine isolated thermophilic archaea and marine viral proteins.

These activities have application for the synthesis of pharmaceutical intermediates. Many of the enzymes have novel properties from their counterparts isolated from other environments.
The presentation will include details on enzyme discovery, cloning, characterisation including X-ray structural determination and molecular modelling.

We are also part of a large EU grant 'Hotzyme' where we will also be including discovery of hydrolase enzymes from marine environments.

References

Guy J.E., M.N. Isupov and J.A. Littlechild. 2003. The structure of an alcohol dehydrogenase from the hyperthermophilic archaeon *Aeropyrum pernix*. J. Mol. Biol. 331:1041-1051.

Isupov M.N., A.R. Dalby, A.A. Brindley, Y. Izumi, T. Tanabe, G.N. Murshudov and J. Littlechild. 2000. Crystal structure of dodecameric vanadium dependent bromoperoxidase from the red algae *Corallina officinalis*. J. Mol. Biol. 299:1035-1049.

Littlechild, J., E. Garcia Rodriguez and M. Isupov. 2009. Vanadium containing bromoperoxidase – Insights into the enzymatic mechanism using X-ray crystallography. Journal of Inorganic Biochemistry 103:617-621.

Novak H.R., C. Sayer, M.N. Isupov, K. Paszkiewicz, D. Gotz, A. Mearns Spragg and J.A. Littlechild. 2013. Marine *Rhodobacteraceae* L-haloacid dehalogenase contains a novel His/Glu dyad which could activate the catalytic water. Febs J. in press.

Toogood,H.S., E.J. Hollingsworth, R.C. Brown, I.N. Taylor, S.J.C. Taylor, R. McCague and J.A. Littlechild. 2002. A thermostable L-aminoacylase from *Thermococcus litoralis*: cloning, overexpression, characterization, and applications in biotransformations. Extremophiles 6:111-122.

THE ECONOMICS OF MARINE BIOTECHNOLOGY: THE GOLDEN TRIANGLE OF BLUE GROWTH

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Many marine resources could be used by marine biotechnology in order to be transformed into food, medicine, cosmetics and energy. The marine biotechnology is not restricted at creating new industrial products; it could also contribute to the bio-economy and grand societal challenges. The golden triangle of blue growth (marine resources, demand and market development, product and innovation) shows that marine biotechnology has a high potential in strengthening the regional economic development and in allowing a more sustainable use of marine resources. However, many problems exist in the process of marine resource uptake (availabilities, transportation costs, marketing conditions). The present work relates two case studies of regional development focusing on algae and co-products of fisheries and aquaculture in Brittany (France) and Tohoku (Japan). This study aims to: 1) identify opportunities and constraints for the development of marine biotechnology using Value Chain Analyses; and 2) identify public-private partnerships in the areas of research and innovation and market development (poles, clusters). Constraints and opportunities are based on the organisation of the sector and the links with the regional economy. The golden triangle of blue growth will be examined to a regional level rising questions as: Is the regional marine food industry adapted to a better use of living marine resources? What are the main barriers to a regional level for an efficient organisation of the marine biotechnology industry? Public-private partnerships have to improve technology transfer pathways by strengthening the basis for proactive interaction between academic research and industry. What is 'the state of art' on marine biotechnology and is there a technological transfer between academic research and the industry on a regional basis?

IDENTIFICATION OF INNATE IMMUNE MECHANISMS OF MARINE ORGANISMS

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Marine organisms live in an adverse and aggressive environment, however, most of them either lack an adaptive immune system (invertebrates) or possess a very primitive one (fish). The immune defence of these animals is mainly based on strong innate system effector molecules to fight against potential pathogens. In the last years new genomic tools, such as high-throughput sequencing methods, have helped us to identify an important repertory of putative immune genes in non model animals constituting a defence system as rich and complex as that of mammals. We have focused mainly on aquacultured animals, both fish and shellfish. In spite of the relevance of aquaculture and the associated pathological process, knowledge about these animals' immune system is still fragmentary and little is known about host-pathogen interactions. The aim of our work was to increase the genomic resources of fish (turbot), and shellfish (mussel, clam) particularly the transcriptome in response to pathogen stimulations to identify the main components of their immune pathways.

SPECIAL - SPONGE CELLS AND ENZYMES FOR INNOVATIVE APPLICATIONS

SPECIAL project consortium

University of Minho, Portugal; Tel Aviv University, Israel; Porifarma BV, Netherlands; Studio Associato Gaia SNC dei Dottori Antonio Sara e Martina Milanese, Italy; Universita degli Studi di Genova, Italy; Universitaetsmedizin der Johannes Gutenberg-Universitaet Mainz, Germany; National Research Center for Geoanalysis, China (People's Republic of); Karolinska Institutet, Sweden; Atrahasis SRL, Italy; University of Azores, Portugal; NanotecMARIN GmbH, Germany
URL: http://www.project-special.eu/
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Project partners present at this conference:
Prof. Rui L. Reis, 3B's Research Group - University of Minho (Portugal), Project Coordinator
Dr. Tiago H. Silva. 3B's Research Group – University of Minho (Portugal)
Dr. Martina Milanese, Studio Associato GAIA (Italy)

The SPECIAL project aims at delivering breakthrough technologies for the biotechnological production of cellular metabolites and extracellular biomaterials from marine sponges. These include a platform technology to produce secondary metabolites from a wide range of sponge species, a novel *in vitro* method for the production of biosilica and recombinant technology for the production of marine collagen.

Research on cellular metabolites is based upon our recent finding that non-growing sponges continuously release large amounts of cellular material. Production of biosilica is being realized through biosintering, a novel enzymatic process that was recently discovered in siliceous sponges. Research on sponge collagen is focussed on finding the optimal conditions for expression of the related genes.

Alongside this research, the project is identifying and developing new products from sponges, thus fully realizing the promises of marine biotechnology. Specifically, the project is focussed on potential anticancer drugs and novel biomedical/industrial applications of biosilica and collagen, hereby taking advantage of the unique physico-chemical properties of these extracellular sponge products.

The consortium unites seven world-class research institutions covering a wide range of marine biotechnology-related disciplines and four knowledge-intensive SMEs that are active in the field of sponge culture, drug development and nanobiotechnology.

The project is clearly reflecting the strategic objectives outlined in the position paper European Marine Strategy (2008); it will enhance marine biotechnology at a multi-disciplinary, European level and provide new opportunities for the European industry to exploit natural marine resources in a sustainable way. In particular, the biotechnological potential of marine sponges, which has for a long time been considered as an eternal promise, is definitely being realized through the SPECIAL project.

Up to now, some project results can be highlighted:
- Collection and characterisation of various species of sponges from different habitats, namely Mediterranean Sea, Red Sea, Azores and Caribbean Sea (Curaçao);
- Successful mariculture of two species of marine sponges;
- Extraction and characterisation of collagen from one species of sponge;
- Characterisation of genes regulating collagen expression on sponges;
- *In-vitro* culture of sponge cells with a primmorph development state;
- Screening of sponge extracts and subsequent fractions for anti-tumor activity in order to identify bioactive compounds;
- Development of nature made scaffolds for tissue engineering approaches from the collagen native structure of several sponge species:
- Delivery of newsletters, available through the project website (http://www.project-special.eu/)
- Production of videos on project topics (within Marine Biotechnology), available through the project SPECIAL YouTube channel (http://www.youtube.com/user/projectSPECIALeu);
- Organisation of Open Days about project outputs and Marine Biotechnology (Italy and Israel).

APROPOS – ADDED VALUE FROM HIGH OIL AND HIGH PROTEIN INDUSTRIAL CO-STREAMS

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APROPOS – Added value from high oil and high protein industrial co-streams – is a collaborative research project which addresses the FP7 KBBE-2011-5 topic BioWASTE – Novel biotechnical approaches for transforming industrial biowaste to bioproducts. The project started in January 2012 and will last until December 2014.

The main objective of APROPOS is to develop and optimize a techno-economically feasible and sustainable wasteless process based on benign, organic solvent-free fractionation technologies for the exploitation of fish filleting and rapeseed residues as raw materials, ingredients and additives for food and skin care formulations as well as chemicals for pesticides and soil improvement.

APROPOS consortium consists of 7 academic partners and 10 SMEs from the EU, India, Kenya and Uganda as well as Norway and Canada. The project will lead to greater integration of research actors and activities from across the EU, North America, Africa and Asia by utilising two raw materials with distinct origin but many similarities. This will integrate researchers and their competences from rapeseed and fish processing as well as from biotechnology and R&D in food and skin care sectors and processing industries.

The success of technological developments will be assessed in terms of economic feasibility, raw material efficiency and environmental impacts. The project will also study, how the developed residue producer-end use value chain affects the existing residue – feed/ energy -value chain.

MARINE BIOPOLYMER FOR TISSUE REPAIR: ENGINEERING CARTILAGE ON JELLYFISH COLLAGEN MATRICES

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In an aging community, defects in knee cartilage ending in knee replacements with artificial joints become a serious problem. A low-cost method to delay these severe intrusions is thus requested. We present a new material from a marine source for cartilage tissue engineering. Pure collagen from jellyfish *Rhopilema esculenta* is used to cast a porous, dry sponge. On this matrix, chondrocytes are seeded and implanted into a cartilage defect where they are thought to reproduce new hyaline cartilage.

Several matrices for MACI (matrix-induced chondrocyte implantation) were developed from bovine or porcine collagen, thus they all produce unwanted fibrous cartilage and bear the risk of passing diseases like BSE.

The new matrix from jellyfish collagen shows important advantages over other matrices. This collagen has similarities to vertebrate collagen-type II, the main type in healthy hyaline cartilage. Coming from an invertebrate, there is no risk of passing BSE or initiation of arthrosis by inflammation. Culture experiments with porcine chondrocytes showed a reproduction of hyaline cartilage, having a very high collagen-type II fraction. Additionally, stiffness of the matrix could be adjusted to aim a tissue-specific matrix. Porcine chondrocytes responded to varied stiffnesses with different collagen-type II and I patterns. On a less rigid matrix (2 kPa) chondrocytes preserved their phenotype better than on a stiffer matrix (20 kPa). This could be the fundament for engineering not only cartilage but also other tissues like skin or bone on the basis of jellyfish collagen.

References

Krost P. and T. Staufenberger. 2012: Sustainable aquaculture and climate change (German), EUCC Deutschland, Küste und Meer 3/2012:39.

Piker L. 2010. Algae against cancer – New active components for oncology (German), GIT-Laborfachzeitschrift 9/2010, Marine Biotechnologie – Life Science:678-680.

Piker L. 2007. Mariculture - solution or meander (German)? EUCC Deutschland, Küste und Meer 2007: 28

SPLASH: SUSTAINABLE POLYMERS FROM ALGAE SUGARS AND HYDROCARBONS

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The 4-year SPLASH project will develop a new biobased industrial platform using microalgae as a renewable raw material for the sustainable production and recovery of hydrocarbons and (exo)polysaccharides from the species *Botryococcus braunii* and their further conversion to renewable polymers. The project comprises 20 partners of which 40% SME and several large corporates plus universities and research institutes.

Two bioproduction platforms will be explored: (i) green alga *Botryococcus braunii* on its own and (ii) the green microalga *Chlamydomonas reinhardtii*, to which the unique hydrocarbon and polysaccharides producing genes from *Botryococcus* will be transferred. SPLASH will deliver knowledge, tools and technologies needed for the establishment of a new industry sector: Industrial Biotechnology with algae and/or algal genes for the manufacture of polyesters and polyolefins. The building blocks for these polymers will be derived from the sugars (polyesters) and hydrocarbons (polyolefins) exuded by the algae: adipic acid from galactose, 2,5-furandicarboxylic acid from glucose, 1,4-pentanediol from rhamnose and fucose, ethylene from 'green naphtha' and propylene from 'green naphtha'. The conversion of ethylene and propylene to polyolefins is common technology, and will not be included in the project. The sugar-derived building blocks will be converted to new condensation polymers, such as e.g. poly (ethylene 2,5-furandioate) (PEF). End-use applications include food packaging materials and fibres for yarns, ropes and nets. The project encompasses: (1) development of *Botryococcus* as an industrial production platform, (2) systems biology analysis, (3) development of processes for production, *in situ* extraction and isolation, (4) product development. More detailed information including project partners and coordination can be found at www.eu-splash.eu

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ELIXIR: A DISTRIBUTED LIFE SCIENCES INFRASTRUCTURE SUPPORTING INNOVATION IN MARINE SCIENCES

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ELIXIR is a distributed Research Infrastructure for the life sciences. It will ensure that researchers throughout Europe have access to the biological data they need to address pressing challenges in marine science, from the loss of biodiversity to food safety and security. These are issues of such complexity that no one institute, company, country or continent can tackle alone.
ELIXIR harnesses and builds upon Europe's strengths in bioinformatics. The central co-ordinating Hub is based alongside EMBL-EBI on the Wellcome Trust Genome Campus in Hinxton, UK, with nodes distributed throughout centres of excellence in the participating member states. At present, EMBL and the following fifteen countries are ELIXIR members: Czech Republic, Denmark, Estonia, Finland, Greece, Italy, Israel, Netherlands, Norway, Portugal, Slovenia, Sweden, Spain, Switzerland and the UK.
Discoveries in marine sciences increasingly involve computational methods. These range from aquaculture to using marine natural products for pharmaceutical development through to the monitoring of pollution, and have great potential for improving quality of life and environmental protection. Equally, these are also disciplines where European industry can thrive, helping to drive competitiveness, employment and growth.
The Norwegian ELIXIR Node[i] will provide services and resources toward marine genomics including researchers, government, and industry. The Norwegian Node will offer several integrated packages geared towards large-scale analysis of marine genomic and metageniomic data (e.g. fish genomics and marine bioprospecting). This also includes provision of web-based solutions for services, toolboxes, and computational access to reference data provided by the ELIXIR infrastructure.
Researchers in academia and industry already make great use of existing bioinformatics resources to carry out marine research: in addition to leading services provided by the Norwegian ELIXIR Node, other services run by ELIXIR partners include the European Nucleotide Archive (ENA[ii]) and UniProt[iii], which have many sequences from marine species, and Ensembl genomes, which includes genomes from some marine organisms. Additionally, there are also a number of marine metagenomics datasets on the European Bioinformatics Institute's metagenomics portal[iv].
The BioMedBridges[v] project, which is coordinated by ELIXIR, is building connections between ELIXIR and the other ESFRI Research Infrastructures including the European Marine Biological Resource Centre (EMBRC)[vi], with links to metagenomics data that will help characterise poorly understood ecosystems and to cheminformatics data to characterise the activity of isolated natural products.
ELIXIR can act as the resource to store marine-based biological data generated through nationally-funded research projects as well as through European programmes such as the Joint Programming Initiatives. Research projects funded through the JPI Oceans initiative are likely to generate large amounts of relevant data, which can be preserved, annotated and made available for further use by the ELIXIR infrastructure, ensuring maximum value for taxpayers.

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i http://www.bioinfo.no/
ii http://www.ebi.ac.uk/ena/
iii http://www.uniprot.org/
iv https://www.ebi.ac.uk/metagenomics/
v http://www.biomedbridges.eu
vi http://www.embrc.eu

HIGH MOLECULAR WEIGHT ANTIOXIDATIVE COMPOUNDS FROM MARINE MACROALGAE

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Marine macroalgae produce a wealth of different compounds with antioxidative potentials. Particularly the superoxide scavenging activities of polysulphated polysaccharides from different sources has been investigated. Fucoidans are heat stable antioxidants, able to effectively scavenge superoxide anions. This is in addition to, and independent from their other effects, such as anti-coagulant activities. Different molecular fucoidan species with different superoxide-scavenging efficiency can be isolated with high yield, dependent on source material and purification method. Specific luminescence assays are employed to reliably quantify their antioxidative activities. Pure and well characterized fucoidans may have the potential to serve many different pharmaceutical and clinical applications. They may, for example, alleviate inflammatory symptoms caused by the formation of superoxide. Current cooperative projects implicate the screening of macroalgae from the Baltic Sea for fucoidan abundance. Thereby molecular weight distributions, superoxide-scavenging activities, long-term stability, and optimisation of purification protocols are in the focus of our research.

NEW TRENDS IN MARINE BIOTECHNOLOGY AT CIIMAR

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CIIMAR - Interdisciplinary Centre of Marine and Environmental Research – (www.ciimar.up.pt) is a research and advanced training institution associated to the University of Porto. It develops high-quality research, promotes technological development and supports public policies in the area of marine and environmental Sciences. CIIMAR hosts 18 research groups, in 5 research lines, with a scientific staff of more than 250 researchers (125 PhD holders) with diverse backgrounds. CIIMAR contributes to the understanding of the biological, physical and chemical processes in the ocean and the coastal zones, to the sustainable use of aquatic resources and the evaluation of the impact of human activities on ecosystems. CIIMAR generated 700 publications in SCI-indexed journals in the last 3 years. Marine biotechnology is one of the main CIIMAR research areas, having our researchers collaborated in the ESF position paper that reported a new vision and strategy in this field (Borrensen *et al.*, 2010). Natural products of marine origin, from cyanobacteria, fungi and sponges, have been studied at CIIMAR with the aim of finding new drugs such as anticancerigens (Almeida *et al.*, 2010) or anti-viral (Lopes *et al.*, 2011) drugs. Bioactive compounds from cyanobacteria may have allelopathic activity with potential use to control algal blooms or as antifouling in the marine environment (Leão *et al.*, 2012). In the biomedical area we are also interested in the use of biological fluids such as those of *Anodonta cygnea* on the biomineralization of chitosan membranes (Lopes *et al.*, 2010). Fish aquaculture has been researched with the purpose of meeting the growing demand for sustainable and healthy seafood by designing new environmental friendly diets that also increase performance and quality of farmed fish (Cabral *et al.*, 2011, Pérez-Jiménez *et al.*, 2012). The potential use of naturally occurring microbial communities in bioremediation processes of hydrocarbons and emergent pollutants is also being studied (Almeida *et al.*, 2013). CIIMAR wants to improve its technology transfer pathway to stimulate cooperation with industry and seeks international collaboration in marine biotechnology in the framework of Horizon 2020, namely in 'Food security, sustainable agriculture, marine and maritime research and the bioeconomy' issues.

References

Almeida A.P., T. Dethoup, N. Singburaudom, R. Lima, M.H. Vasconcelos, M. Pinto, A. Kijjoa. 2010. The in vitro anticancer activity of the crude extract of the sponge-associated fungus Eurotium cristanum and its secondary metabolites. Journal of Natural Pharmaceuticals 1:25-29.

Almeida M.R., I. Reis, M.N. Couto, A.A. Bordalo and A.P. Mucha. 2013. Potential of the microbial community present in an un-impacted beach sediment to remediate petroleum hydrocarbons. Environmental Science and Pollution Research. (in press)

Borrensen T., C. Boyen, A. Dobson, M. Höfle, A. Lanora, M. Jaspars, A. Kijjoa, J. Olafsen, J. Querellou, G. Rigos and E. Wijffels. 2010. Marine Biotechnology: A new vision and strategy for Europe. Marine Board-ESF Position Paper 15:1-91.

Cabral E.M., M. Bacelar, S. Batista, M. Castro-Cunha, R.O.A. Ozório and L.M.P. Valente. 2011. Replacement of fishmeal by increasing levels of plant protein blends in diets for Senegalese sole (Solea senegalensis) juveniles. Aquaculture 322-323:74-81.

Leão P.N., N. Engene, A. Antunes, W.H. Gerwick and V. Vasconcelos. 2012. The chemical ecology of cyanobacteria. Natural Products Reports 29:372-391.

Lopes A., M. Lopes-Lima, I. Bobos, J. Ferreira, S. Gomes, R. Reis, J. Mano and J. Machado. 2010. The effects of Anodonta cygnea biological fluids on biomineralization of chitosan membranes. Journal of Membrane Science 364:82-89.

Lopes V.R., M. Schmidtke, M.H. Fernandes, R. Martins and V. Vasconcelos. 2011. Cytotoxicity in L929 fibroblasts and inhibition of herpes simplex virus type 1 Kupka viruses by estuarine cyanobacteria. Toxicology in Vitro 25:944-950.

Pérez-Jiménez A., H. Peres, V. Cruz Rubio and A. Oliva-Teles. 2012. The effect of dietary methionine and white tea on antioxidant defenses and oxidative damage of Sparus aurata. British Journal of Nutrition. 108(7):1202-120.

GENETIC RESOURCES OF FISH AND SHELLFISH POPULATIONS IN THE SOUTHERN BALTIC SEA

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Populations of sea trout *Salmo trutta* m. *trutta* L., cod *Gadus morhua* L. and mussels *Mytilus* spp. from the Baltic Sea were studied using SNPs (single nucleotide polymorphisms) genotyping methods in order to characterize their genetic differentiation. Sea trout, a migratory form of brown trout is represented by numerous populations in the Baltic Sea. Many populations are enhanced by releases of artificially reared alevins and smolts (supportive breeding). South East Baltic populations of migratory (from Poland, Lithuania, Denmark: Bornholm, Estonia and Russia) were genotyped with iPLEX Gold Sequenom method using a diagnostic panel of 23 SNPs. The highest level of pairwise Fst differences was observed between Russian population from East Gulf of Finland and Polish populations from the Baltic Main Basin and the lowest differences were between the both Polish, and Polish and Lithuanian populations. Genetic differences were found between 2 closely related *Salmo trutta* m. *trutta* populations in Poland by genotyping using an Atlantic salmon derived custom design Illumina iSelect SNP-array (Drywa *et al.*, 2013). Selected transcripts putatively involved in immune response, by using 454 pyrosequencing technology were studied in Vistula River specimens. A total of 1,440,373 reads were obtained with the average read length 334 nucleotides. At present, 3 groups of genes were identified: Mx, C7 and MHC. Differences in gene expression in hatchery *Salmo trutta* m. *trutta* and *Oncorhynchus mykiss* under stress caused by infection with a bacterial pathogen *Aeromonas salmonicida* spp *salmonicida* and non-infected were observed. Some genes were up-regulated (chaperones, mainly HSPs, Mx, interleukin IL17D a proinflammatory cytokine) and down-regulated (acute phase proteins, chemokines, cytokines, COX, lectins, lectin receptors and inflammation related proteases, TNF-related and apoptotic proteins and other) as found by the application of transcriptome hybridisations to 44K oligo-microarray (Agilent).
Populations of cod were studied using 5 SNPs. According to the obtained HRM (high resolution melting) results populations of the Baltic cod were characterized by clinal variation of alleles at loci known to be linked with salinity gradient. The obtained results confirm that eastern population of cod is a separate population of Atlantic cod. Exposure of cod from western (Kiel) and southern (Gdansk) Baltic to different salinity ranging from 3 to 33ppt revealed its high tolerance to different environmental conditions. This tolerance is being studied at the level of gene expression and high number of SNPs.
Baltic populations of *Mytilus* spp. are locally adapted, with a unique composition of loci derived from *M. trossulus* and *M. edulis* genome. To identify markers and genes associated with the hybrid zone in Danish Straits and to determine the uniqueness of Baltic populations, 60 polymorphic SNPs were used to genotype individual mussels from the Baltic, North Sea and Canada. In total 35 SNPs turned out to be significant in FST outlier analysis and therefore were clearly related to the interactions with environment. The majority of new SNPs show greater participation of *M. trossulus* than *M. edulis* genes in the nuclear DNA of Baltic *Mytilus*.

References

Drywa A., A. Poćwierz-Kotus, A. Wąs, S. Dobosz, M.P. Kent, S. Lien, R. Bernaś and R. Wenne. 2013. Genotyping of two populations of Southern Baltic Sea trout *Salmo trutta* m. *trutta* using an Atlantic salmon derived SNP-array. Marine Genomics 9:25–32.