



MARINE MICROBES RESEARCH UPDATE

**JUNE
2015**

Exploring Synergies between Three EU Flagship
Marine Microorganism Research Projects

INTRODUCTION

The ocean covers approximately 70% of the Earth's surface and up to 80% of life on Earth is found in the ocean. Marine microorganisms are tiny, single-celled organisms that live in the ocean and account for more than 98% of ocean biomass. They offer an almost unlimited resource of enzymes and bioactive compounds and could potentially provide clues that will help mitigate climate change, control disease and generate alternative energy sources.

This newsletter provides updates and insights from three EU-funded research projects that aim to improve our ability to exploit this virtually untapped resource of biotechnological potential.

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Industry Expert Workshop

MaCuMBA 

www.macumbaproject.eu

micro3 

www.microb3.eu

PHARMASEA 

www.pharma-sea.eu



PROJECT UPDATE

MICRO B3: MARINE MICROBIAL BIODIVERSITY, BIOINFORMATICS AND BIOTECHNOLOGY

PROGRAMME: FP7 Cooperation, Ocean of Tomorrow
FP7-OCEAN-2011

TOTAL BUDGET: €11,507,843

EC CONTRIBUTION: €8,987,491

DURATION: January 2012 – December 2015 (48 months)

COORDINATOR: Frank Oliver Glöckner; Jacobs University Bremen gGmbH, Germany

CONSORTIUM: 32 partners from Germany, Belgium, France, Greece, Iceland, Ireland, Italy, Macedonia, Spain, The Netherlands, Turkey, United Kingdom, three international organisations ICES (Denmark), CIESM (Monaco), IUCN (Switzerland); including one large private company and six SMEs.

WEB: www.microb3.eu

SOCIAL MEDIA: www.facebook.com/microb3osd



Micro B3

Micro B3 is improving Europe's capacity for bioinformatics and marine microbial data integration for the benefit of a variety of disciplines in biosciences, technology, computing and law. It facilitates the whole process from sampling and data acquisition to analysis, leading to better understanding of marine ecosystems and their (meta)genomic background, thus paving the way for novel biotechnological applications.

Micro B3 is developing and validating open access to biodiversity, genomic, oceanographic and Earth observation databases through the integrated **Micro B3** Information System (Micro B3-IS). This system is building on global standards for sampling and data processing with interoperability as a key feature for data transfer of sequence and contextual data to and from users, institutions, and public repositories.

The **Micro B3** partnership's combined expertise facilitates the whole process of knowledge generation from the legal and technical aspects of sampling and data acquisition to integrated data analysis and sound statistics.

Research in **Micro B3** has provided several annotation pipelines to identify sequences in metagenomic reads as well as the Multivariate Analysis Applications for Microbial Ecology (MASAME) tool, an interactive tool for ecological analysis. Different biodiversity case studies have been chosen to explore the marine microbial ecosystem, including spatial monitoring done through expeditions and temporal monitoring programmes for long-term ecological research sites.

Bioinformatics work has led to interoperable structures for submission, storage and exchange of data between the established archives SeaDataNet, EurOBIS, the European Nucleotide Archive (ENA at EBI) and the **Micro B3-IS**. Several integrated software tools based on joint standards and interoperability structures can now be used in research, such as a Genes Mapserver (<http://blast2.mpi-bremen.de/gms>), and a Metagenomic Trait Database (<https://mb3is.megx.net/mg-traits>).

To support biotechnological applications, specific bioinformatics tools have been developed for:

- ➔ Computational prediction of substrate selectivity of homologues of genes with known activities
- ➔ Determining functions of still unknown genes found in marine microbes using co-occurrence networks for determining hypothetical functions of unknown genes from marine microbes
- ➔ Three-dimensional protein structure prediction

Results from (meta)genome mining for anti-tumour compounds, enzyme databases, libraries, assays and new expression systems for experimental screening are becoming available. A range of promising microbial cultures are being subjected to high-throughput processing. Industry leaders are targeted through expert workshops and think tanks to promote understanding of the value of integrating environmental and 'Omics' data.

Media contact: Johanna Wesnig, Environmental & Marine Project Management Agency, contact@microb3.eu



PROJECT UPDATE

MACUMBA: MARINE MICROORGANISMS: CULTIVATION METHODS FOR IMPROVING THEIR BIOTECHNOLOGICAL APPLICATIONS



MaCuMBA

PROGRAMME: FP7 Cooperation, KBBE

INSTRUMENT: Collaborative project

TOTAL BUDGET: €12,015,209.80

EC CONTRIBUTION: €8,999,948.00

DURATION: August 2012 – July 2016 (48 months)

CONSORTIUM: 23 partners from Austria, Belgium, Denmark, France, Germany, Iceland, Ireland, Italy, The Netherlands, Spain, and the UK

COORDINATOR: Lucas Stal, Koninklijk Nederlands Instituut voor Onderzoek der Zee (NIOZ), The Netherlands

WEB: www.macumbaproject.eu

SOCIAL MEDIA: www.facebook.com/MaCuMBAProject

MaCuMBA focuses on the development of techniques that will increase the rate with which we can isolate marine microorganisms (of any of the three domains of life: Bacteria, Archaea, Eukarya) and increase the success rate with which we can grow these organisms in the laboratory.

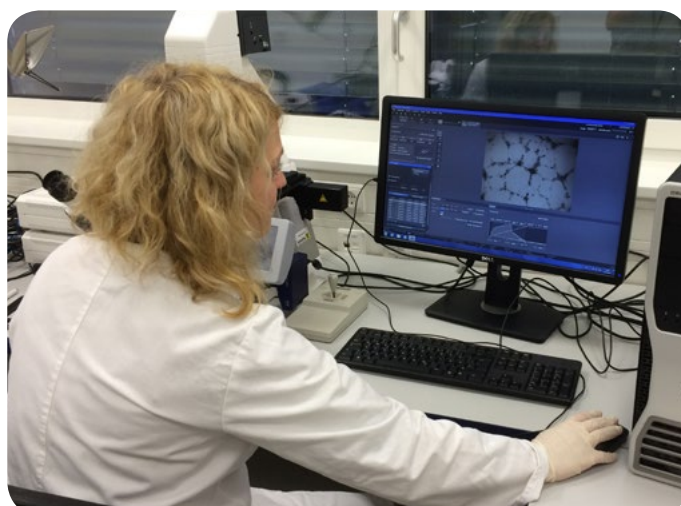
It is expected that the marine environment harbours an untold diversity of these microorganisms. This unknown majority may possess novel and unexpected properties and bioactive compounds that could be used e.g. as pharmaceuticals.

MaCuMBA therefore samples symbiotic microorganisms and microorganisms from a wide range of marine habitats including those from extreme environments; from which we expect particular interesting applications. **MaCuMBA** also screens newly isolated microorganisms for bioactive compounds.

MaCuMBA has developed a selection of high throughput isolation techniques, including further development of colony picking robotics, the micro Petri dish, and gel encapsulating and cell sorting, in addition to single cell isolation techniques. **MaCuMBA** has sampled (and continues to sample) a wide variety of environments and has isolated many thousands of new strains. These are now being identified, stored in dedicated culture collections, and screened for bioactive compounds.

MaCuMBA will end in 2016 with a large event that comprises an industry seminar and exhibition of the project's achievements, back-to-back with an open science meeting on marine microbiology in the last week of June 2016 in Berlin-Adlershof. During that meeting a book on marine microbiology written by **MaCuMBA's** scientists will be presented.

Media contact: Marieke Reuver, AquaTT, marieke@aquatt.ie





PROJECT UPDATE

PHARMASEA: EXPLORING THE HIDDEN POTENTIAL: NOVEL BIOACTIVE COMPOUNDS

PROGRAMME: FP7 Cooperation, KBBE

TOTAL BUDGET: € 13,289,395

EC CONTRIBUTION: € 9,465,907

DURATION: October 2012 – September 2016 (48 months)

COORDINATOR: Peter de Witte, Katholieke Universiteit Leuven, Belgium; scientific lead: Marcel Jaspars, Marine Biodiscovery Centre at the University of Aberdeen, United Kingdom

CONSORTIUM: 24 partners from Belgium, UK, Austria, Denmark, Chile, China, Costa Rica, Germany, Ireland, Italy, New Zealand, Norway, South Africa, and Spain

WEB: www.pharma-sea.eu

SOCIAL MEDIA: www.linkedin.com/company/pharmasea



PHARMASEA

The **PharmaSea** project brings research groups together around the world in search of novel antibiotics. The project focuses on the biodiscovery and the development and commercialisation of new substances from marine organisms.

Its primary goal is to collect samples from the oceans, home to some of the hottest, deepest and coldest places on the planet. These samples will be screened to uncover marine microbes and new bioactive compounds and to evaluate their potential as novel drug leads (e.g. antibiotics).

Access to really deep water is restricted by access to oceanography ships and deep-sea sampling equipment. **PharmaSea**'s solution for this is to develop inexpensive and robust equipment based on that developed for the salvage industry. Using fishing vessels, researchers lower a sampler on a reel of cables to the trench bed to collect sediment.

To find new species with capacity to produce new bioactive compounds, **PharmaSea**'s researchers will use selective isolation techniques, poly-phasic taxonomy, and will assess biosynthetic potential using genome scanning. Chemometrics, data mining and computer aided structure elucidation will be used to speed up the discovery of chemical novelty. Finally, **PharmaSea** has developed innovative assays and counter screens to uncover new compounds with novel mechanisms of action.

PharmaSea's researchers are confident that they will find a number of exciting new drug leads. The early results are promising: several compounds being tested at the

University of Tromsø in Norway and at the University of Aberdeen in Scotland are showing initial signs of antibacterial properties. The researchers have worked on over 1,000 bacterial strains from many extreme locations on the globe including Greenland and Antarctica and have tested more than 12,000 extracts in more than 40,000 biological tests. A number of these have been highlighted as active in screens against infection and central nervous system diseases and a number of new compounds have been identified.

A good start, with a long way still to go. The planned legacy of the **PharmaSea** project is to eradicate the issue of antibiotic resistance. Who knows where the next penicillin will be found? Perhaps it will be in the icy Norwegian Arctic or in a deep oceanic trench in the Pacific Ocean.

Media contact: Annette Doerfel, BIOCOM AG,
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UPCOMING EVENTS

OSD Ocean Sampling Day
(OSD) 2015
Ocean Sampling Day 21 June 2015
www.oceansamplingday.org

The Ocean Sampling Day (OSD) is a simultaneous sampling campaign which aims to analyse marine microbial biodiversity and function of the world's oceans. The **Micro B3** Consortium initiated the idea of an orchestrated OSD with the ambitious aim to turn this one-day event into a long-term time series.

These cumulative samples, related in time, space and environmental parameters, provide insights into fundamental rules describing microbial diversity and function and contribute to the blue economy through the identification of novel, ocean-derived biotechnologies. OSD data will be a reference dataset for generations of experiments to follow in the coming decade.

The first OSD took place on 21 June 2014. This event involved 191 registered sites which sampled at 153 marine locations from all continents ranging from tropical waters around Hawaii to extremely cold environments such as the Fram Strait in the Arctic Ocean. Best practice guidelines for microbial biodiversity assessments in rich environmental context were agreed, tested and gathered in an OSD Handbook (http://www.microb3.eu/sites/default/files/osd/OSD_Handbook_v2.0.pdf).

For more information, visit: www.oceansamplingday.org



9th European Marine Natural Products Conference (ECMNP 2015), Glasgow
30 August – 2 September 2015
www.ecmnp2015.com

ECMNP 2015 is a 'must attend' conference for young researchers in the field of marine natural products not only from Europe but around the world, where senior experts and rising stars of the future will present their work in a mixture of plenary and poster sessions. The main objective of the conference is to stimulate engagement of young scientists in the research area as well as to put their involvement at the forefront.

Besides the traditional topics of isolation & structure elucidation, synthesis and biological activity of marine natural products, the conference will also include topics on marine polymers and biomaterials from marine sources as well as new methods of dereplication involving metabolomics and innovative perspectives in marine industrial biotechnology. This will bring together a diverse mixture of scientists from many disciplines, which will ensure a very stimulating conference.

Workshop for Young Academics @ ECMNP 2015

30 August 2015

www.pharma-sea.eu/ecmnp-workshop.html

Young researchers can also register for free for a full-day pre-conference workshop on 30 August 2015. The aim of the workshop is to exchange methodologies in an interactive way. The four sessions will be chaired by experts from the EU projects SeaBioTech, **PharmaSea**, **MaCuMBA**, Bluegenics and **Micro B3**.

- 1) Genomic Databases (**Micro B3**)
- 2) Culture Management (**MaCuMBA**)
- 3) Dereplication and Chemical Databases (**PharmaSea** and SeaBioTech)
- 4) Bioprocessing and Biopolymers (Bluegenics and SeaBioTech)

Registration is now open until end of June 2015 with a limited number of places.



PROJECT COORDINATOR DISCUSSION



At the recent Marine Micr'Omics for Biotech Applications Industry Expert Workshop, the MaCuMBA, Micro B3 and PharmaSea project coordinators sat down to discuss issues relating to their projects' research. Marieke Reuver facilitated the discussion.



MARIEKE REUVER (MR)
LEADER OF MACUMBA WP9:
DISSEMINATION, KNOWLEDGE
MANAGEMENT AND LINKAGES



MARCEL JASPARS (MJ)
PHARMASEA PROJECT
LEADER



LUCAS STAL (LS)
MACUMBA PROJECT
COORDINATOR



**FRANK OLIVER
GLÖCKNER (FOG)**
MICRO B3 PROJECT
COORDINATOR

MR: How do the aims of MaCuMBA, Micro B3 and PharmaSea complement each other?

FOG: Well, **MaCuMBA** and **PharmaSea** are more applied and **Micro B3** is more focused on ecosystem and basic research, where the application is part of it but not the main topic.

LS: Yes, **MaCuMBA** is more involved in finding the organisms, isolating them and cultivating them. Everybody does some bioinformatics, everybody does some cultivation and sampling and screening for bioactives and so on.

MJ: Well the main emphasis of **PharmaSea** is the application. At the end of it all we are trying to find where the roadblocks are. We are taking advantage of what **Micro B3** and **MaCuMBA** are doing and trying to progress what we're doing towards the end. Having the ability to talk to people about bioinformatics and cultivation really helps!

FOG: I think in this case the projects are really complementary! **Micro B3** is focused on marine biodiversity and metagenomics, by collecting DNA from the environment, **MaCuMBA** is doing the cultivation and **PharmaSea** is ready for the application.

MJ: If you see it as a pipeline, **Micro B3** comes first, they have a role at the beginning, **MaCuMBA** has a role in the middle and we have a role at the end.

FOG: There needs to be some overlap, because otherwise you have nothing to do with each other and it is good to have these relationships.

MJ: I think so, and then you have these productive discussions on all the aspects.

FOG: And from the legal point of view we have all the same goals: to find a way to work with the Nagoya Protocol!

MJ: Yeah sure that is important! We have a committee that meets once a year where we invite all the partners and consortia to sit down with the policy makers and NGOs to make sure that we talk the same language.

LS: We were informed about Nagoya by eCoast, who is also in **PharmaSea**, so we got the information and we had a discussion at the last general assembly but there was a lot of confusion about it. I understand that **Micro B3** invests a lot on this topic as you have a whole work package on these legal issues. And that is something that we could learn from each other, because I think **Micro B3** is far more knowledgeable about this area than **MaCuMBA**.

MJ: We decided that because they had got so far with the Nagoya Protocol we would go predominantly for the Biodiversity Beyond National Jurisdictions policy which, with the UN decision recently, means we are in the right place at the right time. We are learning from what **Micro B3** has done and translating that to open seas.

*There needs to
be some overlap,
it is good to
have these
relationships.*

*– Frank Oliver
Glöckner*

➔ **MR: What are the advantages of having a number of different projects focusing on related topics running simultaneously?**

MJ: I think the fact that we have interactions, but also the fact that we have multiple partners who are in more than one consortium. That really helps because they have internal knowledge of what's going on as well as having the formal relationships between us. The commission has asked us to work together on dissemination and legal work packages, so it helps a lot.

FOG: This workshop is a perfect example of the integration. The question that is often asked is if we are competitors, but for us that is not the case! It is really complementary

and we can learn a lot from each other as we are not that deep into the application phase. The last meeting we had with **PharmaSea** was really an eye opener, I thought: "Wow, you can do that with all this stuff?" While for us we are just at the level of sequences which can sometimes get a bit boring!

MJ: Frank Oliver is on our advisory board, he comes to the meeting every year and sees what we are doing and what the progress is so he gets internal knowledge and we get feedback.

➔ **MR: What do you foresee as being the combined impact of the results and activities of these three projects?**

FOG: Well I think that the legal stuff will definitely be combined. If we bring together the legal frameworks under- and beyond national jurisdiction and move from the more molecular and environmental fields towards the cultivation and application, then the whole package will really unfold at the end.

MJ: I think that having industry involved at all stages of the pipeline also really helps. There are companies who were not necessarily working in the marine environment beforehand who are now convinced that there is something to be done and something of value to be gained by working in the marine and on these bigger projects.

LS: Our advisory board was actually saying that the relationships and the cooperation with the industry partners in the project could be better than it is, that both the academics and the SMEs could benefit more from each other. I was wondering if you also had such comments in **Micro B3** and **PharmaSea**? Because I feel that this could indeed be improved, but it is not so clear to me how we could do that. There are different objectives and philosophies, if you like, between traditional academic partners and industry partners. Also, we should be mindful of the different commercial pressures and demands that our industry partners face.

MJ: You have to make sure that industry partners are aware that they are supposed to deliver an element of the project and that the sum is greater than the parts.

LS: The awareness is there, but perhaps we have to plainly say what we have to deliver, and that only when this has been achieved have we done our duty.

FOG: In our case, Ocean Sampling Day (OSD) is the glue that keeps everything together, because it is a central goal people are aiming for. Originally, it just started out as an organisational task to trigger that at a certain point in time, in June 2014, everybody has to be finished in terms of having the legal stuff and the basic bioinformatics capacities in place and having a common



FRANK OLIVER GLÖCKNER

sampling procedure that everyone can follow. And it turned out to really bring everyone together because of having a common deadline to work towards. And now as we prepare to repeat it for 2015, I feel this momentum building up again.

LS: The SMEs also participated in the ocean sampling day?

FOG: Well, they take profit from this because of the samples, and some of them even did some sampling. Bio-Product is focused on bioinformatics, so they can take advantage of the sequences. Ribocon is mostly involved in the training for OSD.

➔ **MR:** What do you think has been the most important discovery/development in the field of marine microbiology in the past 10 years?

LS: I can't really say only one thing. There have been so many developments at the same time and we have had these sampling excursions with metagenomics that have revealed a huge amount of information that is still being explored. We have seen really tiny organisms. We have seen new nitrogen fixers that basically put the whole nitrogen cycle upside down again. We have seen that a few groups of organisms dominate the plankton. And we have also seen these aggregate developments in the cold seeps and the smokers. It has been tremendous!

On the other hand, I bought [Claude Ephraim] ZoBell's original book on Marine Microbiology [Marine Microbiology – A Monograph on Hydrobacteriology], and reading that book you see we don't know so much more today! There have been lots of exciting discoveries, but our understanding of the system has not evolved since ZoBell wrote this book in, I think, 1946.

MJ: I think that as a chemist I would look at this with amazement that life thrives wherever you go. You go below to the sea floor, you find marine life. When people drill into oil wells they find that there are bacteria there. They find life in the deepest parts of the ocean. From a chemical perspective, some of these organisms, they need to have a completely different metabolism, so it is exciting! It is a realisation as a chemist that there is more to microbiology than what you get out of microorganisms.

FOG: Looking from a bioinformatic point of view as I am, there has been a revolution that started around 2005 with the next generation sequencing. It was a technological advancement, but it gave us the ability to assess the marine system on a global level. **Micro B3** is trying to attain a global snapshot of marine microbial biodiversity and function, and knowledge of where the baseline is, so that we will hopefully be able to know what is changing over the next few years. This is only possible through this

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We have seen new nitrogen fixers that basically put the whole nitrogen cycle upside down again.

– Lucas Stal

kind of technological development, which also triggered the area of bioinformatics for sure. It is also now stimulating a lot of research in the field of metagenomics and the field of applications which would not have been possible before. Cheap sequencing capacities plus a lot of changes that sped up lab processes, such as proteomics and transcriptomics, allow us to get a much better, much more detailed



picture of the marine ecosystem and environmental parameters than we could have ever had before.

LS: That is all true and there is now a massive amount of knowledge, but it's all very descriptive. At the moment we still do not understand how the system works and that is really lacking in my view. And, also because of the low cost of sequencing, people go out and they extract the DNA and sequence it and use more bioinformatic tools and it goes on and on and there is more and more data, but it is still very descriptive, it still doesn't help us to understand how the system works.

FOG: Well, we clearly distinguish between data, information and knowledge. We produce data, and we hopefully then turn them into information and end up with knowledge. So we are still on the way to knowledge, we just haven't reached it yet!

LS: Yes, but it is not only interesting and important that we find compounds to help us defeat cancer, for instance. That is very important, but why do these organisms produce that compound? If we know why they do that, it could help us to understand much more, and to direct the search for these kinds of compounds, and to know much more precisely in which ecologies these organisms can be found. I think it is too simple because everyone can do a filtration and send it out for sequencing and you sit behind the computer and get your sequence!

FOG: I fully agree about the explorative research, going out and doing research just because you can do it doesn't mean that it provides new knowledge. But, on the other side, if you look back 100 years, biologists just started to collect data and they found new things. Now we have to bring it together. This is our next challenge, to bring these things together and create a picture that gives us a better understanding, not just data generation. I agree, it is ridiculous in some respects how much sequencing is done and wasted, because it is cheap, with no experimental design or question behind it.

➔ **MR: How can the transfer of knowledge between research and industry in the biomarine sector be improved?**



MARCEL JASPARS

MJ: This is a complicated question! The problem is an understanding for industry of what the marine environment gives to you and what the advantage is. And I always say that you have to show an advantage and it has to be economic. So an advantage could be a product that is already out there, but you make it better or cheaper, or it is a property that nothing else has ever had, like a new enzyme or a new drug that is completely novel, so therefore there is no parallel. If you have that, the industry will adopt it, but there are many barriers in the way of this happening.

At the moment the main problem is ignorance, the industry doesn't know about the marine environment, they have always dealt with terrestrial organisms, plants and bacteria. So once we get trained people into industry from marine backgrounds, then all of a sudden the picture will change! I think and there are enough of us around now in big industry that suddenly people are saying, "Hey, what about thinking about the marine environment?"

LS: I think the primary issue is with big industry, not with academics. The academics already understand that they have to help society to justify the money they spend. The problem is industry, I don't mean small or medium sized. I mean the big industry, because for the big things you need the big industry, as they have the capital to get the things moving. And they are chiefly not interested. They wait until something is there and then they buy it, and this is something that has to be changed! Because a lot of the money that goes into developing these patents is from public funding. If you have a company and you have a product that the big companies know they can use, they give you an offer you cannot refuse and they take it!

FOG: I agree! A lot of big companies formerly did a lot of R&D and now they outsource it by looking around to see who is emerging, what new SMEs and start ups are doing. The one that gets it right will be bought! And then they just take the patents and the knowledge. It is better

for them, because if they are doing their own R&D they must be successful, but through screening the market to see who is being successful, and then buying them, they don't have to take the risk, someone else takes the risk.

LS: I think we need to have different laws so that this doesn't happen! Many of the SMEs are spin outs from an academic culture. They start with an idea and create a company and they get some money from public funding. If they are successful they are being bought by the big companies, and if they are not they are bankrupt and all the debts are paid by society again. And that needs to change. I think that academics understand this very well. I am a fundamental biologist, really I like the big fundamental questions, but many of the students now don't want that, they want to do something for society. They want to know, "Why is it good that I do this?" And if you tell them if you do this you can help to cure cancer or to make biofuels they become much more interested.

FOG: Yes students want to know why research is done. What is the benefit of exploring the diversity of marine ecosystems? What is the significance? What is the application? Biotechnological applications, medical applications, new products? And the European Commission is completely supporting this. Horizon 2020 is strongly application driven.

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The problem is an understanding for industry of what the marine environment gives to you and what the advantage is
– Marcel Jaspars





MARINE MICR'OMICS FOR BIOTECH APPLICATIONS WORKSHOP

Micro B3 - MaCuMBA - PharmaSea - Industry Expert Workshop

PharmaMar, Colmenar Viejo, Spain
30 - 31 March 2015

This second Industry Expert Workshop under the lead of the Ocean of Tomorrow project **Micro B3** brought together academic and industrial scientists. It aimed to further the exchange of current approaches for the discovery of novel microbial strains, bioactives and engineering of marine-derived biocatalysts with the help of bioinformatics tools. Opportunities and challenges for understanding complex genome data and their application to discover new enzymes and bioactive compounds were discussed.

The workshop opened with a welcome and introduction from Dr Johanna B Wesnigk, who is work package leader for training and dissemination within **Micro B3**, and Simon Munt, of PharmaMar. The coordinators of **Micro B3** (Frank Oliver Glöckner, Jacobs University Bremen), **MaCuMBA** (Lucas Stal, NIOZ, Yerseke) and **PharmaSea** (Marcel Jaspars, University of Aberdeen) then provided brief introductions to their projects.

The main workshop agenda included four focused sessions and a cross-sectoral panel discussion.

SESSION 1: Natural products based on marine biodiversity

Chair: Fernando de la Calle, PharmaMar

This session presented case studies relating to:

- ➔ The current strategy of drug discovery using marine organisms
- ➔ Genomic mining into the universe of microbial biodiversity
- ➔ The designing of unnatural new compounds by genomic manipulation
- ➔ Present & future trends in drug delivery of marine compounds

SESSION 2: Environmental biotechnology through marine microbial knowledge

Chair: Juan Luis Ramos, Bio-Iliberis and Abengoa

Molecular biology tools have first been used to understand the biology of a number of microbes cultivated in the laboratory. Then efforts brought this set of techniques to the study and understanding of microbes inhabiting different environments, and a number of reports proved that all niches explored on Earth are inhabited by microbes. In particular,

metagenomics and meta-proteomics techniques are revealing a wealth of unexpected functions while also explaining the adaptation of microbes to extreme environments. A number of the enzymes from oceanic metagenomic libraries are revealing potentially new applications in industry. This session explored some of these approaches and how enzymes of industrial interest can be retrieved and evolved.

SESSION 3: Bioinformatic tools and methods for innovative blue biotechnology

Chair: Renzo Kottmann, Max Planck Institute for Marine Microbiology

This session featured presentations and discussions regarding new developments in bioinformatics algorithms, tools and standards for the (meta)genomic identification and analysis of unknown genes and biosynthetic gene clusters that are relevant for marine biotechnology. The discussions focused on what is needed to bring bioinformatics closer to biotechnology applications, by accelerating the industrial utilisation of newly developed methods and by filling gaps in the knowledge transfer between academia and industry.

SESSION 4: New strategies for high throughput isolation of novel marine microorganisms

Chair: Lucas Stal, NIOZ

During this session new strategies for the isolation and cultivation of novel marine microorganisms and the importance and problems of their deposition in accessible culture collections were discussed. The session also explored the possibility of using 'omics' approaches for targeted isolation of specific microorganisms based on their predicted biotechnological applications. Issues regarding intellectual property rights and rights to marine genetic resources including microbial cultures, and consequences of implementing the Nagoya Protocol to the Convention on Biological Diversity (CBD) by the EU were also presented for further discussion.

PANEL DISCUSSION: Bioactives of marine origin – opportunities and challenges

Moderator: Marcel Jaspars, co-moderator Johanna Wesnigk

A panel formed by participants from industry and EU project partners discussed opportunities and challenges in the use of bioinformatics and genomics tools for discovering new marine bioactives relevant for pharmaceutical and other biotechnological applications.



WORKSHOP PARTICIPANTS' FEEDBACK



JAUME MIR CEO, Biochemize SL

What was your overall impression of the workshop?

It was very good. It provided a welcome opportunity for participants to gain an updated overview and

detailed knowledge regarding marine microbiology and its industrial potential.

What part of the workshop did you find the most interesting/relevant?

For me, the most interesting and relevant parts of the workshop were the confirmation of a number of new potentially discoverable molecules, the potential for new metabolic routes, and also the increased relevance of the use of computational methods.

Are the overall aims of the Micro B3, PharmaSea and/or MaCuMBA projects relevant to your field of research/work and how might they be beneficial for you (based on your understanding of the projects)?

Yes, new enzymes that may be discovered could be used by us in the development of new biosynthesis routes for known chemical reactions that are currently not optimised.



HELENA VIEIRA Marine Biotech Expert, University of Lisbon

What was your overall impression of the workshop?

The workshop was very useful and good for networking, although some of the presentations were maybe too

technically detailed.

What part of the workshop did you find the most interesting/relevant?

The visit to the PharmaMar premises was fantastic!

Are the overall aims of the Micro B3, PharmaSea and/or MaCuMBA projects relevant to your field of research/work and how might they be beneficial for you (based on your understanding of the projects)?

All of them are relevant for the field of marine biotech in general. MaCuMBA is the one I know the best and its results can certainly contribute to increase the potentially available bioresources for further exploitation and commercial valorisation. PharmaSea will move forward important marine derived molecules and contribute to increase the awareness of marine bioresources for drug discovery. The legal impact of the Micro B3 project and raising researchers awareness to these issues was also important.



MARINE MICROBES RESEARCH UPDATE

**JUNE
2015**

Exploring Synergies between Three EC Flagship
Marine Microorganism Research Projects

Designed and Developed by AquaTT

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www.pharma-sea.eu



The **MaCuMBA** project has received funding from the European Union's Seventh Framework Programme under Grant Agreement No 311975.
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