

SEE INSIDE FOR INFORMATION ON  
THE **MaCuMBA** MARINE MICROBIOME  
CONFERENCE IN JUNE 2016



# MaCuMBA

**MaCuMBA** is a four-year research project that aims to uncover the untold diversity of marine microbes using cultivation-dependent strategies. This joint venture of 22 partner institutions from 11 EU countries is led by the Royal Netherlands Institute for Sea Research (NIOZ), and has a budget of more than €12 million, of which €9 million is funded by the EC Seventh Framework Programme.

# project news

[www.macumbaproject.eu](http://www.macumbaproject.eu)

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## MaCuMBA presents The Marine Microbiome



Prof Lucas Stal, **MaCuMBA** Project Coordinator

As **MaCuMBA** enters its final months and prepares for an ambitious grand finale event in 'The Marine Microbiome-Discovery & Innovation'; coordinator Lucas Stal reflects on the significance of The Marine Microbiome, the vast store of potential represented by marine microorganisms,

and the importance of bringing the worlds of science and industry together.

The 'Marine Microbiome – Discovery & Innovation' is a unique event taking place from 27-30 June 2016 in Berlin-Adlershof in Germany. It marks the end of **MaCuMBA** ([www.macumbaproject.eu](http://www.macumbaproject.eu)), by all accounts a highly successful four-year project funded by the European Union in which 22 partners from 11 different European countries participated.

**MaCuMBA** in many ways ventured into the unknown, exploring new worlds in our waters to see what treasures might lie in the vast microbiome beneath. The breadth of the project itself could hardly be overstated. A microbiome is defined as the totality of microorganisms and their collective genetic material in a certain environment; in this case the sea (the ocean, the seas, estuaries, bays, and their coasts, including the sediments and the deep biosphere, as well as the microorganisms that live on or inside other organisms, such as fish, sponges, corals, sea grass, algae). Microorganisms include all organisms that are too small to be seen with the naked eye and which are in general single celled (although in exceptional cases microorganisms may

also be multicellular and others may grow to sizes that can be seen by the naked eye). Microorganisms belong to any of the three domains of life: Bacteria, Archaea (together also known as 'prokaryotes') and Eukarya (to which all macroorganisms also belong). Viruses are not considered organisms since they do not multiply outside an organism, but are nevertheless considered as part of the microbiome because they are biological entities.

Although microorganisms and viruses are known to the general public as the cause of disease and putrefaction, the vast majority of microorganisms fulfil important roles in ecosystem function, without which (our human) life would not be possible. Microorganisms encompass an untold genetic diversity that has been generated throughout almost 4 billion years of evolution, most of which is unknown to man. Recent discoveries of new pharmaceuticals, bioactive compounds, remediation activities, and potential bioenergy generation, give promise of nigh on infinite applications.

The goal of **MaCuMBA** was to increase the rate of discovery, isolation and culturing of hitherto unknown microorganisms and screen them for potential biotechnological applications. No mean feat it must be said!

The 'Marine Microbiome – Discovery & Innovation' ties all these threads together in an original conference format that, to my knowledge, has not been attempted before. This meeting brings the worlds of industry and science face-to-face in a format designed to facilitate the sharing of experiences. The latest discoveries and innovations from the academic world can be shared with industry with the aim of generating new commercial opportunities.

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Likewise the industry can share with academia the challenges and opportunities for viable commercialisation, in this area, explore emerging needs and avenues for future innovation.

The one-day Industry Conference (28 June 2016) is composed of a half-day plenary where "The Marine Microbiome" and **MaCuMBA** will be presented to an audience of entrepreneurs, policy makers, scientists, press, and other interested public. Throughout the afternoon a plethora of different activities will take place, including round table discussions, moderated panel discussions, an industry exhibition showcasing the hard- and software developed by **MaCuMBA**, as well as pre-organised one-to-one meetings between participants.

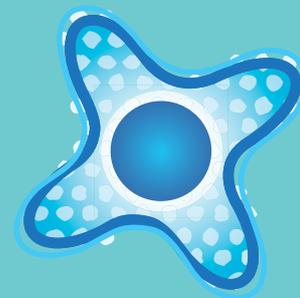
During the two-day Open Science Conference (29-30 June 2016) internationally renowned scientists will present their latest discoveries and innovations related to The Marine Microbiome in invited and contributed oral talks and poster presentations. Both events are connected by a networking

dinner on the evening of Tuesday, 28 June. Not only is this event exciting in terms of content but I must say that its venue is rather special too! Berlin-Adlershof is without a doubt one of Europe's leading Science and Technology parks; comprising ten research institutes, six science departments of the Humboldt University, and about 1,000 businesses! Having the 'Marine Microbiome – Discovery & Innovation' take place at the heart of all these activities was an obvious decision.

'The Marine Microbiome – Discovery & Innovation' will kick off with a welcome reception on the evening of Monday, 27 June. I am very much looking forward to seeing you all there and to sharing a memorable week of great science, innovative industry and good friends!

*Best wishes,  
Lucas*

## Under the Microscope: Marine Microorganisms in the news



### **Climate change will irreversibly force key ocean bacteria into overdrive**

Researchers at USC and Woods Hole Oceanographic Institute tested how *Trichodesmium*, a cyanobacteria that consumes CO<sub>2</sub> and pumps out crucial nitrogen for the rest of the marine food web, would behave under the high-CO<sub>2</sub> conditions projected for 2100.

[news.usc.edu/85742/climate-change-will-irreversibly-force-key-ocean-bacteria-into-overdrive](https://news.usc.edu/85742/climate-change-will-irreversibly-force-key-ocean-bacteria-into-overdrive)

### **Tiny Giants photographic art exhibition**

Bigelow Laboratory and Colby College present: Tiny Giants exhibit. The invisible world of marine microbes revealed through a photographic art exhibit.

[tinygiants.bigelow.org](http://tinygiants.bigelow.org)

To read about the context of the exhibition:

[bangordailynews.com/community/bigelow-laboratory-and-colby-college-present-tiny-giants-exhibit](http://bangordailynews.com/community/bigelow-laboratory-and-colby-college-present-tiny-giants-exhibit)

### **An assessment of US microbiome research.**

Taking stock of previously funded microbiome research can help to identify common themes, under-represented areas and research priorities to consider moving forward.

[nature.com/articles/nmicrobiol201515](http://nature.com/articles/nmicrobiol201515)

### **Building the Microbial Hitchhikers Guide to the Solar System**

We all know that Microbes are fond of extreme environments and now NASA aims to study the microbial freeloaders that might attempt to hitch a ride into space.

[blogs.discovermagazine.com/d-brief/2015/10/07/e-mist-microbial-hitchhikers/#.VpeKAvmLS70](http://blogs.discovermagazine.com/d-brief/2015/10/07/e-mist-microbial-hitchhikers/#.VpeKAvmLS70)

MaCuMBA  PRESENTS

## MARINE MICROBIOME DISCOVERY & INNOVATION

BERLIN ADLERSHOF - CITY OF SCIENCE TECHNOLOGY & MEDIA 27-30 JUNE 2016

### PROGRAMME

## Welcome Reception

**Monday, 27 June 2016, 18:00-21:00**

## The Marine Microbiome Discovery & Innovation Industry Conference

**Tuesday, 28 June 2016**

### Agenda

**10:00 – 12:30:** Plenary Session featuring:

- Welcome address (T.B.C.)
- Popular talk on Marine Microbiology (T.B.C.)
- Prof. dr. ir. Luuk van der Wielen (Chairman of BioPort Holland Steering Committee; Chairman of Executive Board of BE-Basic Foundation; Professor Biobased Economy, TU Delft, The Netherlands)
- Prof. dr. Lene Lange (Professor BioProcess Engineering, DTU Chemical Engineering, Lyngby, Denmark)
- Dr. Guy Carter (Carter-Bernan Consulting, New City, USA)
- Prof. dr. Himadri Pakrasi (Professor Renewable Energy and Sustainability, Washington University, St. Louis, USA)
- Dr. Silvia Acinas: 'TARA Oceans expedition: past and present' (TARA Oceans, Institute of Marine Sciences, Barcelona, Spain)
- Dr. Jon Kaye (Programme Director, Gordon and Betty Moore Foundation, Marine Microbiology Initiative, Palo Alto, CA, USA)
- Presentation of **MaCuMBA** movie
- Presentation of the book: *'The Marine Microbiome: An Untapped Source of Biodiversity and Biotechnological Potential'*; Lucas J. Stal and Mariana Silvia Cretoiu (editors), Publisher: Springer, Heidelberg, Germany

**12:30 – 13:30:** Lunch and exhibition

**13:30 – 18:00:** Panel discussions, round tables, exhibition, one-to-one meetings

**19:00 – 23:00:** Conference Dinner

### Panel Discussions

#### **Panel Discussion 1: Future use of marine microbial diversity - challenges and solutions.**

This panel will discuss the problems and solutions with regard to intellectual property rights and the implementation of the Nagoya Protocol in Europe and globally with a focus on its application in relation to the use of marine microbial diversity. The legal restrictions which scientists increasingly face in the course of their work investigating marine microorganisms, their ecology and potential biotechnological use may hinder timely developments and innovation in the field. Collaboration between the academic world and that of industry is crucial to paving new avenues for the development of novel, innovative products and bringing these to market. However, despite the efforts of the EU to achieve more efficient collaborations there is still considerable progress to be made.

**Panel Discussion 2: The ocean - a treasure chest for future applications?**

This panel discusses the potential of microorganisms in the ocean to provide new products and services of benefit to human society. What do we expect to find and where (extreme environments, deep sea, symbiosis, or 'just in the water')? How do we move from discovery and bridge the gap to the market? Challenges in this area will be discussed such as difficulties in securing the investment required to determine if a compound is a viable candidate for (clinical) development.

**Round Tables**

**1. Do we need to culture microorganisms in order to use their properties?**

Microorganisms with interesting properties, such as production of bioactive compounds, biofuel or other products; or activities such as for bioremediation, are not always easy to culture in a biotechnological setting or only at prohibitive cost. Once the desired property of a microorganism has been identified, it may be possible to synthesize and produce it chemically or to transform it into a host, which is known for biotechnological production, or there may be other ways to circumvent (mass) culturing of microorganisms while still obtaining the product or service. Or perhaps this is not always possible but we still must consider whether it is necessary to (mass) culture microorganisms.

**2. What is the potential of marine microbiology to deliver products and services to the industry**

What is so special about marine microbiology that it should be distinguished from other disciplines with respect to

biotechnological applications? What specific products and services do we expect from marine microbiology, and once identified, how do we deliver them to the industry? Is there a market for products and services deriving from marine microorganisms interesting enough for industry to develop these products? What are the options to generate tighter connections between academics and industry and what would be the role of politics in this?

**3. What is the future of synthetic microbiology?**

Increasing bioinformatics data has allowed in part for the possibility of synthetic microbiology. Using synthetic microbiology it becomes possible to engineer microorganisms for increased biotechnological performance. It will even become possible to engineer whole new microorganisms that can be used as factories for the production of desired compounds or services. Although synthetic microbiology is still in its infancy, some remarkable results have already been obtained. Will the promises of synthetic microbiology eventually come true?

**4. What are the global effects of legislation on marine biodiscovery?**

Now that the Nagoya Protocol has come into effect and has been translated to European and national legislation, scientists who want to use marine microorganisms or genetic resources need to obey these new rules. However, much is still unresolved or unclear, especially when intending to use samples or microorganisms from developing countries. This might lead to scientists refraining from using such samples or organisms. Would this lead to a collapse of global marine biodiscovery activities? What are the options to be considered?

**The Marine Microbiome Discovery & Innovation Open Science Conference**

**Wednesday, 29 June 2016**

**Session 1: The diversity of the oceanic microbiome**

Much debate still persists regarding the extent of the microbial diversity of the oceanic microbiome. This applies to all three domains of life: Eukarya, Bacteria and Archaea. How many species really exist? How are they distributed in the ocean? How many new species are there and where can they be found? Can we find new species with

interesting values in extreme marine environments, the deep sea or the deep-sea sediments? Or would the most interesting microbes be symbiotic with marine animals, plants or other microorganisms? This session attempts to give an overview of the present knowledge in relation to these questions.

### Invited speakers:



#### Prof. Jörg Overmann

*DSMZ-German Collection of Microorganisms and Cell Cultures, Braunschweig, Germany*

Prof. Overmann received his PhD from the University of Konstanz. After a postdoc at UBC, Vancouver, and the Habilitation at the ICBM,

Oldenburg, he became Professor of Microbiology at the LMU München. Since 2010 he is Director of the Leibniz-Institut DSMZ and Professor of Microbiology at the TU Braunschweig. Prof. Overmann has published over 150 articles, received the Ph.D. award of the VAAM, and was Inaugural Douglas Leigh Lecturer of the Waksman Foundation for Microbiology in 2013. He is member elect of the review panel of the German Science Foundation, and serves in Editorial Boards and several scientific advisory boards.



#### Prof. Peer Bork

*Senior group leader, Joint Head of Unit, and Strategic Head of Bioinformatics, EMBL Heidelberg, Germany*

Prof. Bork is senior group leader and joint head of the Structural and Computational Biology unit at EMBL, a European research

organisation where he also serves as strategic head of bioinformatics. In addition, he holds an appointment at the Max-Delbrück-Center for Molecular Medicine in Berlin. Prof. Bork received his PhD in Biochemistry (1990) and his Habilitation in Theoretical Biophysics (1995). He works in various areas of computational and systems biology with a focus on function prediction, comparative analysis and data integration. In addition to an outstanding academic career he has also co-founded five successful biotech companies, two of which went public.

## Session 2: Novel (meta)genomic approaches in marine microbiology

Next Generation (high throughput) Sequencing (NGS) presents unprecedented possibilities for uncovering the marine microbiome. It allows for the reconstruction of metabolic pathways and uncovering of metabolic networks. Metagenomic (including transcriptomics, proteomics, metabolomics) techniques will infer novel functions and it may inform strategies for how to isolate and grow novel marine microbes. These techniques are so precise they allow for investigation even on a single cell level. Metagenomics can be used as an approach for targeted isolation of microorganisms with interesting properties. It can also uncover the diversity and distribution of secondary metabolites. Cloning and expression of genes in the (meta) genomes can be used to find novel products. This session will discuss state-of-the-art techniques in this field and present an outlook on the possibilities and impossibilities of these approaches to understand the function of the marine microbiome and how to mine it for novel applications.

### Invited speakers:



#### Prof. Fergal O'Gara

*BIOMERIT Research Centre, School of Microbiology, National University of Ireland, Cork, Ireland*

Prof. O'Gara is Director of the Biomerit Research Programme at UCC. He is also Emeritus Professor of Microbiology at the University and is

Distinguished Research Fellow at Biomedical Science at



#### Dr. Tanja Woyke

*DOE Joint Genome Institute, Walnut Creek, CA, USA*

Dr. Woyke joined the DOE Joint Genome Institute (JGI) in 2004 after receiving her PhD from the Eberhard Karls University of Tübingen, Germany.

Since 2009 she has been heading

the Microbial Genomics Programme at the JGI and she holds appointments as Adjunct Scientist at the Bigelow Laboratory for Ocean Sciences and as Adjunct Associate Professor in the School of Natural Sciences at the University of California, Merced. Her research is focused on metagenomics and single-cell genomics to study 'microbial dark matter', and including the development of functionally targeted single-cell approaches.

**Thursday 30 June 2016**

### Session 3: Marine systems microbial ecology

Marine microbial systems should be studied as functional entities formed by the microbial diversity and the biogeochemical cycles they encompass. In this systems ecology approach the network of different microorganisms, and the way they communicate, can be studied by using meta-omics (metabolomics) and numerical modelling. This session aims at bringing together the newest developments in systems microbial ecology.

#### Invited speakers:



**Dr. Gerard Muyzer**  
*Microbial Systems Ecology, Department of Aquatic Microbiology, Institute for Biodiversity and Ecosystem Dynamics, University of Amsterdam, The Netherlands*

Prof. Muyzer's research interests are diversity and ecophysiology of bacteria that play a role in the sulfur cycle of freshwater, marine and

extreme environments. Within his research he is using a

### Session 4: Novel cultivation approaches of marine microbes

Hitherto only a small number of marine microorganisms have been brought into culture. It is of great importance to increase the number of marine microorganisms in culture because it is the only way to understand their nature, their function in the marine microbiome, and their properties, including potential pharmaceutical or biotechnological applications. Culturing the uncultured and the "unculturable" is **MaCuMBA's** motto as we seek to make progress after several decades of focus on cultivation-independent techniques. In this session we will discuss the state-of-the-art of isolations and culturing techniques and approaches, including co-cultivation of microorganisms and microbial consortia, use of environmental signals and cell-to-cell communication, and mimicking natural conditions.

#### Invited speakers:



**Prof. Gwenaëlle LeBlay**  
*Laboratory of Microbiology of Extreme Environments, University of East Brittany, Brest, France*

During the 16 years Prof. LeBlay spent in different laboratories in Europe (Switzerland, Germany, France) and Canada, she has acquired strong expertise in microbial physiology and ecology in different

systems biology approach including different meta-omics techniques. For more information, see [www.muyzer.eu](http://www.muyzer.eu).



**Dr. Anne Dekas**  
*Department of Earth System Science, Stanford University, CA, USA*

Dr. Dekas is a geomicrobiologist interested in how microbial life affects the chemistry and climate of our planet today and throughout time.

She obtained her PhD in Geobiology at the California Institute of Technology in 2013, and her BA in Earth and Planetary Sciences at Harvard University in 2004. She joined the Earth System Science Department at Stanford University as an assistant professor in September 2015.

ecosystems. She recently directed her research to work on the culture of microorganisms from marine extreme environments. She is currently working on the development of immobilised microbial communities from deep sea ecosystems to study microbial population dynamics during continuous cultures in bioreactors.



**Prof. Slava Epstein**  
*Northeastern University, College of Science, Boston, USA*

For the past 15 years, Prof. Epstein's lab has been working on one of the most intriguing biological phenomena: why 99% of microbial diversity has gone missing from the lab. The basic and applied potential of this microbial "dark matter" is unprecedented, and so his lab has focused on, developed and continues to practice innovative approaches to sample and study this pool of unexplored species. These approaches led to many new ideas about why uncultivated species remain uncultivated.

Registration for this event is now open with the deadline for abstract submission fixed at 9 May 2016. For more information about this event and to register, please visit: [www.macumbaproject.eu](http://www.macumbaproject.eu)

## MaCuMBA Culture Collections

The overarching objective of **MaCuMBA** is to develop strategies to cultivate the uncultured majority of marine microorganisms. This work is still ongoing but great successes have already been achieved. Key strains isolated as a result of **MaCuMBA** activities are housed in four major collections belonging to partners of the **MaCuMBA** project.

### 1. Deutsche Sammlung von Mikroorganismen und Zellkulturen GmbH (DSMZ)

The address to access the DSMZ **MaCuMBA** project page is: [www.dsmz.de/research/microorganisms/projects/macumba-collection.html](http://www.dsmz.de/research/microorganisms/projects/macumba-collection.html)

The DSMZ collection can be searched for a number of criteria including:

- DSM number
- Key word
- Microorganism type

All visitors can see a minimal data set of individual cultures. Full details of all stored data for the available cultures are visible only to project partners or a defined group of customers. After authentication, project members are enabled to retrieve the detailed information and order the strain.

### 2. Roscoff Culture Collection (RCC)

The address to access the **MaCuMBA** sub-collection is: <http://roscoff-culture-collection.org/strains/shortlists/projects/macumba>

The RCC collection can be searched for a number of criteria including:

- Taxonomy
- Strain name
- Project name
- Growth temperature
- Geographic location through keywords
- Geographic location through a map

When clicking on the strain of interest detailed information is provided and the strain can be ordered.

To view the location of the **MaCuMBA** Culture Collections on Google Maps, go to: [www.google.com/maps/d/viewer?mid=zYNBjX4QN3E8.kDEUW2RDR2rk](http://www.google.com/maps/d/viewer?mid=zYNBjX4QN3E8.kDEUW2RDR2rk)

### 3. Université de Bretagne Occidentale Culture Collection (UBOCC)

UBOCC is divided into two sub-collections:

- 3.1 UBO-Extremophiles (LM2E):** *Laboratoire de Microbiologie des Environnements Extrêmes*
- 3.2 UBO-Fungi (LUBEM):** *Laboratoire Universitaire de Biodiversité et d'Ecologie Microbienne*

The address to access the UBO **MaCuMBA** sub-collection is: [www.univ-brest.fr/macumba](http://www.univ-brest.fr/macumba)

Log in:

- Username: MaCuMBA
- password: MaCuMBA311975

The UBO collection can be searched for a number of criteria including:

- Taxonomy
- Strain name
- Morphology
- Keywords

When clicking on the strain of interest detailed information is provided

### 4. Culture Collection Yerseke (CCY)

CCY also contains all strains of cyanobacteria deposited at DSMZ.

The CCY collection can be accessed here:

<https://ccy.nioz.nl/>

The CCY collection can be searched for a number of criteria including:

- Name
- Key word
- Microorganism type

When clicking on the strain of interest detailed information is provided.



## MaCuMBA STRAINS

So far **1337** different microorganism strains have been deposited in the **MaCuMBA** Culture Collections. These include samples isolated from diverse locations, from coastal seas to open (bathypelagic) ocean, including (deep sea) sediments and hydrothermal vents.



**1337**  
**STRAINS**

## MaCuMBA STRAIN DOMAINS

**110**  
**Archaea**

Microorganisms which are similar to bacteria in size and simplicity of structure but radically different in molecular organisation. They are now believed to constitute an ancient group which is intermediate between the bacteria and eukaryotes.

**571**  
**Bacteria**

Unicellular microorganisms which have cell walls but lack organelles and an organised nucleus, including some which can cause disease.

**656**  
**Eukaryota**

Organisms consisting of a cell or cells in which the genetic material is DNA in the form of chromosomes contained within a distinct nucleus. Eukaryotes include all living organisms other than the bacteria and archaea.

## MaCuMBA STRAIN CLASSES

1 Clostridia  
1 Deltaproteobacteria  
1 Dictyochophyceae  
1 Eustigmatophyceae  
1 Firmicutes  
1 Holophagae  
1 Mollicutes  
1 Pelagophyceae  
1 Planctomycetes  
1 Thermococci  
1 Ulvophyceae  
2 Bacteroidetes  
2 Deinococci  
2 Pavlovophyceae

2 Thermotogae  
3 Betaproteobacteria  
3 Epsilonproteobacteria  
3 Nephroselmidophyceae  
3 Trebouxiophyceae  
3 Unknown  
4 Chlorophyceae  
4 Coscinodiscophyceae  
4 Mamiellophyceae  
5 Sphingobacteria  
6 Cryptophyceae  
7 Cytophagia  
9 Prasinophyceae  
12 Prymnesiophyceae

13 Flavobacteria  
22 Bacilli  
30 Bacillariophyceae  
31 Halobacteria  
34 Actinobacteria  
36 Syndiniophyceae  
78 Methanococci  
84 Alphaproteobacteria  
88 Proteobacteria  
98 Unknown  
101 Gammaproteobacteria  
105 Cyanobacteria  
183 Fungi  
349 Dinophyceae