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 23 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

Issue 5 | NOVEMBER 2013

Welcome to the fifth newsletter of the MaCuMBA project. In this issue: Interview with WP6 leader Professor Francisco Rodriguez-Valera P.1-2 Under the Microscope: Marine Microorganisms in the News P.2 Culture Club: Meet the scientists making MaCuMBA possible P.3 Report on the first MaCuMBA General Assembly in Roscoff, France, by MaCuMBA Coordinator Lucas Stal P.4-5 Petri Dish Profile: SeaBioTech P.6-7 Metagenomics Course: Universidad Miguel Hernández, Alicante, Spain, 9-13 December 2013 P.8 MaCuMBA Project Video Now Available P.8

Professor Francisco Rodriguez-Valera is leader of MaCuMBA Work Package 6 (WP6), *Sequencing, genomic and metagenomic libraries and (meta) genome analyses.* He is Professor of Microbiology at the Universidad Miguel Hernandez, Spain.

Prof Francisco Rodriguez-Valera

What is the aim of MaCuMBA WP6 and how will it contribute to the overall objectives of the MaCuMBA project?

WP6 uses genomics and metagenomics to improve our ability to obtain pure cultures of individual marine microbes and to increase our understanding of their biology prior to and after retrieving them in pure culture. Sequencing nucleic acids is the fastest and highest yield method presently available for acquiring information about microbes. We will use these technologies to advance our knowledge of the main microbial characters that play a role in the functions of the ocean ecosystem. Learning how to use these organisms will help us to improve the sustainability of both the ocean ecosystem and the European economy through biotechnological processes.

How can you tell whether the genes of a microorganism are of potential biotechnological interest?

The genomes of bacteria or archaea provide more valuable insights about their lifestyles and overall biology than the genomes of any other living entity. The degree of similarity of a gene to other known useful genes is very important when considering its biotechnological potential.

High similarity will mean that resulting products might be too similar to others already available and therefore not promising. The best combination is for genes to have enough similarity to establish a promising function but enough unique characteristics to provide novelty.

How does genetic sequencing work and which methods are being used as part of MaCuMBA?

Genetic sequencing is a field that is constantly evolving and improving. Traditional methods required lots of DNA and could only sequence DNA cloned in *Escherichia coli (E. coli)* or amplified by polymerase chain reactions (PCR), where a piece of DNA is amplified to generate thousands to millions of copies of that particular DNA sequence. Second generation methods including those provided by companies such as 454 Sequencing or Illumina can amplify individual DNA molecules and do not require cloning.

The most recent advances in third generation methods can now sequence individual DNA molecules without any amplification. The methods being used as part of **MaCuMBA** are continuously being reevaluated. For now we mostly use the Illumina platform, but other options might be preferred in the future.

Why is a project such as MaCuMBA important?

The work carried out by the **MaCuMBA** project will increase the time and effort invested in getting new microbes in pure culture. This kind of research is restricted by the high risk that it implies, in spite of the high gain that it provides once significant new microbes are obtained as pure cultures, so projects such as **MaCuMBA** are important.

What do you think is the biggest benefit genetic sequencing will provide to society in the future?

It will improve our understanding of the language of life.

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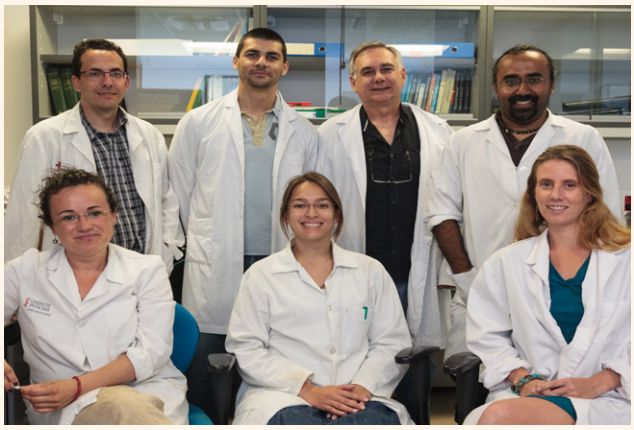

Prof Rodriguez-Valera's Research Group

Your research group was recently involved in the discovery of the smallest aquatic bacterium ever described [see side bar]. Can you describe the contribution of your group to this research and explain the significance of the results?

We have studied the deep chlorophyll maximum in the Mediterranean for some years now. This is a region of the water column, located at a depth of about 50m, where the conditions are ideal for photosynthetic microbes due to the perfect combination of light intensity, availability of inorganic nutrients and absence of UV light. This marine habitat is very rich in types of microbes and relatively stable at different locations. We have found about 4% of the microbe population in this area is made up of low gc actinobacteria, which have extremely small cells and genomes. Aquatic actinobacteria are very different from those found in soil or sediment, which are characterised by the opposite features (large cells and genomes).

Publications

The research group led by Professor Rodríguez-Valera, working in collaboration with researchers at the Cavanilles Institute of Biodiversity and Evolutionary Biology, has discovered the smallest aquatic bacterium ever described worldwide. The research results, published recently in the journal Nature Scientific Reports, are important both for the discovery of a whole new group of bacteria with different genetic characteristics, and the possible ecological significance of this group of bacteria.

Research Report: Rohit Ghai, Carolina Megumi Mizuno, Antonio Picazo, Antonio Camacho & Francisco Rodríguez-Valera. "Metagenomics uncovers a new group of low GC and ultra-small marine Actinobacteria." Nature Scientific Reports 3, Article #: 2471. Available from:

http://www.nature.com/srep/2013/130820/srep02471/full/srep02471.html

Press Release: http://www.alphagalileo.org/ViewItem.aspx?ItemId=134547&CultureCode=en

Under the Microscope: Marine Microorganisms in the news

Can bacteria combat oil spill disasters?
Teams of international scientists have decrypted the effectiveness of two types of bacteria, which could be used in the future to help combat oil spill disasters. **Shortened URL: bit.ly/1aoRnRM**

Insight into the hidden world of what lives within our frozen oceans
Far from frozen oceans being devoid of life, underneath the sea ice a community of microscopic algae and bacteria thrive and has been the focus of major research by scientists at the University of Essex. **Shortened URL: bit.ly/14R9JZK**

Unexpected interaction between ocean currents and bacteria
For the first time, researchers have successfully demonstrated an interaction between ocean currents and bacteria: The unexpected interaction leads to the production of vast amounts of nitrogen gas in the Pacific Ocean. **Shortened URL: bit.ly/190Z1pT**

Tracking microbes in the Southern Ocean
By collecting water samples up to six kilometres deep, UNSW researchers have shown for the first time the impact of ocean currents on the distribution and abundance of marine micro-organisms. **Shortened URL: bit.ly/190wznr**

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Culture Club: Meet the scientists making MaCuMBA possible

Catarina Cúcio

PhD student
Institute for Biodiversity and Ecosystem Dynamics (IBED)
University of Amsterdam (UvA), the Netherlands

Catarina Cúcio is a PhD student in the Aquatic Microbiology group at the Institute for Biodiversity and Ecosystem Dynamics (IBED) of the University of Amsterdam (UvA) under the supervision of Prof Gerard Muyzer. She has a degree in Biology from the Universidade Lusófona de Humanidades e Tecnologias in Lisbon, Portugal, and a MSc in Marine Biology from the University of Algarve, Portugal. During her MSc programme, Catarina worked with microbial communities associated with Cnidarians and marine sediments, and developed skills in molecular, bioinformatic and microbiological techniques.

Her present research within the **MaCuMBA** project is focused on the characterisation of the seagrass microbiome and the interactions between bacteria and the plant. This topic will be the basis of several tasks, including the isolation of previously uncultured microorganisms and the meta-omic analysis of the microbiome.

Cherel Balkema

Project Assistant
Department of Biological Oceanography, Texel
Royal Netherlands Institute for Sea Research (NIOZ),
the Netherlands

Cherel studied Biology and Medical Laboratory Science with a specialisation in Molecular Biology at the University of Applied Sciences in Leiden, the Netherlands. As a part of her Bachelor programme she completed a 10 month internship at Woods Hole Oceanographic Institution, USA, during which she first became interested in marine microbes. As part of the **MaCuMBA** project she is involved in WP3: Improving culture efficiency of already isolated and cultured microorganisms. Currently she is working on better and new media for phytoplankton in combination with various different growth conditions.

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The First MaCuMBA General Assembly in Roscoff, France

Dear MaCuMBA Colleagues,

MaCuMBA held its first General Assembly (GA) on 23-24 September 2013 in Roscoff, France, 11 months after the kick-off meeting in Amsterdam which marked the start of the project. The GA was combined with separate progress meetings of the work packages (on 25 September) and a 2-day local sampling event combined with joint laboratory work (on 26-27 September) as well as a Steering Committee meeting (on 24 September). At the GA in Roscoff MaCuMBA was officially 14 months old and during these first months the partner organisations appointed personnel, received the necessary equipment and started up the work.

The GA was exceptionally well attended with approximately 80 participants. Only one of the **MaCuMBA** beneficiaries did not attend. It was wonderful to see so many colleagues and friends again and to meet new ones.

The location in Roscoff was well chosen for the GA and its satellite meetings and the weather was perfect! It was warm, sunny and dry, which, as locals assured me, is unusual for Roscoff and even more so for the time of the year. Lucky us! Roscoff is situated at the most western edge of Brittany, reaching far into the Atlantic Ocean. This situation also made Roscoff a wonderful place for sampling the marine environment. The Station Biologique de Roscoff (SBR) is exceptionally well equipped for a meeting such as ours, with a nice lecture hall and its own hotels that accommodated all of the participants and a restaurant where we had wonderful lunches as well as the conference dinner. Roscoff has a wide choice

of restaurants that were still open (because it was the end of the tourist season) and were visited in smaller groups for the other dinners.

I would like to thank the Roscoff team for a wonderful and smooth organisation of this meeting. A job well done! While organising the scientific part of this GA, the Steering Committee decided that instead of having a boring repetition of aims, deliverables and milestones, and administrative stuff, which would be less interesting for most of the participants, we would have a scientific meeting where the people who are actually involved in the research would present their results. These were introduced by short overviews by the work package leaders on the progress they have made. The 21 original scientific presentations were all of a very high level and quality and, considering the short time the project is running, showed a remarkable set of new data and results.

It was pleasant to note that there were no major issues on the financial and administrative side. Work Package 9 did an extremely good job making **MaCuMBA** known to the public and publishing newsletters and much more on dissemination and the planning

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of the exploitation. We all felt that our **MaCuMBA** intranet on Basecamp works extremely well as a platform where we can exchange our information and data in a protected environment. It was felt that all partners in **MaCuMBA** should increase their efforts to provide more information and text for future newsletters. The presentations in the GA demonstrated that there is so much more that we can present to a wider public and to stakeholders.

Most of the work package meetings were much shorter than anticipated. On the one hand this showed that the work progresses well and that no major flaws or problems were identified. On the other hand, it could also be seen as a missed chance to discuss in more depth the work and exchange ideas. This will need some attention in the next GA and perhaps work package leaders may call for additional meetings.

The sampling exercise was attended by a much smaller group of people (approximately 20). Although we still need to evaluate this event, I have heard a lot of good remarks about this. Many colleagues went out and collected material from which they will isolate microorganisms, and in the lab various techniques (microcopy, flow cytometer and cell sorting) were demonstrated and their use for isolation and growing of microorganisms discussed.

I was pleasantly surprised by the visit of Prof Joël Querelou to the conference dinner. Joël was at the birthplace of **MaCuMBA** when he retired and it was he who proposed the acronym.

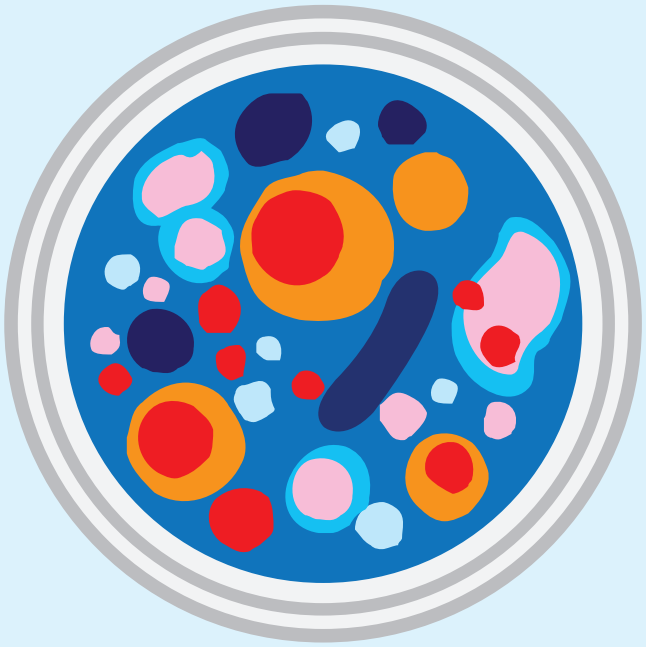
The next GA assembly will be held in Huelva, Spain, from 22-24 September 2014 and will be locally organised by Pharmamar, possibly with an extra two days for sampling. I am already looking forward to it. There will be lots of new results and data to be presented at a wonderful venue. Sunny weather guaranteed!

Kind regards,
Lucas

Petri Dish Profile: SeaBioTech

Prof Brian McNeil

Continuing our series of Petri Dish Profiles of other European-funded projects related to the study of marine microorganisms, Prof Brian McNeil from Strathclyde University, Scotland, tells us about the SeaBioTech project, which aims to convert the huge potential of underdeveloped marine biotechnology into novel bioactive industrial products.



What are the aims of the SeaBioTech project?

The main aim of SeaBioTech is to develop methods to more effectively convert the potential of marine biotechnology into new industrial products for the pharmaceutical, cosmetic, functional food and industrial chemistry sectors. We will do this through close collaboration between the eight industry partners and six research centres.

What are the main barriers to successful industrial exploitation of marine biodiversity for companies more accustomed to terrestrial biotechnology?

Often it is simply lack of knowledge and experience in cultivation, scale-up and production of the desired metabolic products within small biotech companies as the marine isolate moves through the different stages of process development. Some marine microbes which make interesting products also require unusual cultivation conditions when compared to the "usual" terrestrial industrial microorganisms. For example, very high incubation temperatures, high salt content, unusual pH.

Another factor is that large biotech companies have mostly abandoned trying to find new industrial products from natural isolates, so those bio companies with great experience of industrialising microbial isolates are not really doing this on the scale they were previously. Within our consortium we have a number of groups who have great expertise in metabolic engineering, so one approach we will be using to address some of these barriers will be to move the ability to make a desired product from the originally isolated marine microorganism into a well known and simple to culture microbe, such as *E.coli*. The biotechnology industry is far more familiar with cultivation of such industry workhorses.

What milestones has the project achieved so far?

The programme has achieved all the milestones for its first year as originally outlined. In fact, I would say we have achieved far more than that! For example, in terms of initial screening we have tested 106 marine isolates using 28 assays looking for either therapeutic or biotechnological activity, and we have found 33 postive hits so far with 24 of those

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dereplicated. This is a very exciting start indeed. In addition, the 14 partners are all working together as a very effective team, as shown during our recent 1st Annual Meeting at the Hellenic Marine Research Centre, Greece. We have also held a number of successful events aimed at increasing the interest of the public, especially schools, in marine biotechnology. We think it is essential for the public to be interested and committed to understanding the pressing need for sustainable exploitation of marine resources now and for the future.

How will SeaBioTech standardise the sampling process for collecting microorganisms from unique and previously untapped habitats?

With guidance from our industry partners we are formulating standard protocols for the preparation, testing, cultivation and storage of all microorganisms generated within the project and their metabolites. All of these protocols and isolate/metabolite details will be captured in a new central database being developed at Strathclyde. The materials are also being stored there in a central repository. At the project end there will be public access to this repository.

SeaBioTech aims to harmonise the legal process related to marine bioprospecting, biodiscovery and marine biotechnology for commercial purposes, what are the main legal issues related to these areas?

SeaBioTech, working with other EU-FP7 marine biodiversity projects, PharmaSea, BlueGenics and Micro B3, aims to contribute to the rapidly evolving legal areas of access and benefit sharing arrangements associated with the exploitation of marine natural resources. We will help to develop legal agreements compatible with the Convention on Biological Diversity and reflecting the Nagoya Protocol. We hope the joint efforts of the consortia will form an important example for future marine programmes aimed at sustainable, fair exploitation of the sea's resources worldwide, while respecting the environment, and making sure all stakeholders enjoy a fair share in any benefits arising from this process.

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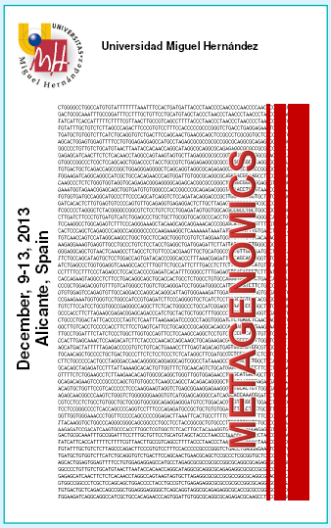
Metagenomics Course: Universidad Miguel Hernández, Alicante, Spain, 9-13 December 2013



The Evolutionary Genomics Group (EGG) of Universidad Miguel Hernández (UMH) in Alicante, Spain, is organising an advanced course on the application of high throughput sequencing technologies to study prokaryotic microbes in their natural environments.

The course will take place at UMH on 9-13 December 2013 and will be taught by members of the EGG and some distinguished scientists invited for the event. The course is intended to provide an overview of both practical and theoretical aspects of postgenomic microbiology in microbial ecology. It will consist of lectures and practical work regarding data analysis, biomass collection and nucleic acid extraction from a marine sample as is required for most metaomic studies. The course will be taught entirely in English and is directed towards students who are interested in microbial ecology and genomics.

Program

Time	Monday	Tuesday	Wednesday	Thursday	Friday
9.00 10.00	Post-Genomic Microbiology Francisco Rodriguez-Valera	Human microbiome Alex Mira	Transcriptomics and Metatranscriptomics (i) Wolfgang Hess	Soil Metagenomics Manuel Fernández López	Sampling Cruise
10.00 11.00	Overview on Meta-omics Francisco Rodriguez-Valera	Human microbiome. Oral Microbiology Alex Mira	Transcriptomics and Metatranscriptomics (ii) Wolfgang Hess	Sediment Metagenomics Henk Bolhuis	
	Coffee 11.00 – 11.30				
11.30 12.30	New Sequencing Technologies Ana-Belen Martin-Cuadrado	Single Cell Genomics Manuel Martinez Garcia	Aquatic Metagenomics Rohit Ghai	Metaviromes Rohit Ghai	
12.30 13.30	Prokaryotic genome assembly and annotation Mario López-Pérez	Metadata, microscopy and imaging Antonio Camacho	Enrichments culture metagenomics Nikole Kimes	CRISPR system Francisco Juan Martinez Mojica	
	Lunch				
16.00 18.00 Coffee	DATA ANALYSIS	DATA ANALYSIS	DATA ANALYSIS	DATA ANALYSIS	

Registration fee (includes attendance to lectures and practical sessions, connection, sampling cruise and coffees):

- Members of MicroGen and MaCuMBA: €50
- Others: €100

How to register: Send the completed registration to Raquel Flores (rflores@umh.es) before November 15th and wait for confirmation. Once you have received this message you will have 10 days to send a copy of the payment. Places will be assigned on a first come first served basis, however participants of the European Commission FP7 MaCuMBA and the Spanish Consolider-Ingenio MICROGEN projects will be given priority.

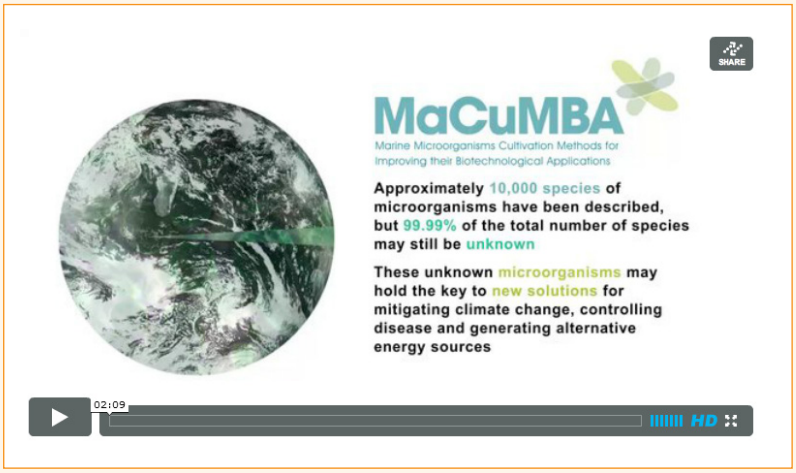
Limited to 30 participants

For more information, visit: http://egg.umh.es/course.html

MaCuMBA Project Video Now Available

A short video providing an introduction to the MaCuMBA project is now online. The video, which aims to raise awareness of the project, can be viewed by visiting the MaCuMBA project website:

www.macumbaproject.eu or via vimeo.com/77120768.



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