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AYUDAS RAMÓN Y CAJAL – CONVOCATORIA 2024

Turno General

Área Temática: Ciencias y tecnologías medioambientales
Nombre: ARANDIA GOROSTIDI, NESTOR
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Título: Marine Microbial Ecology and Biogeochemistry: Unraveling Interactions and Nutrient Cycling from Surface Waters to Extreme Environments

Resumen de la Memoria:

In my scientific career, I aimed to understand the ecological and biogeochemical role of marine microbes and how microbial interactions can shape the cycling of different elements in the ocean. In particular, I focus on two main research lines, RS1: The role of microbial interactions, including bacteria and phytoplankton in the cycling of different elements, and RS2: exploring the microbial activity under extreme conditions, such as the high-pressure/low-nutrient conditions of the deep ocean, or the osmotic stress in hypersaline environments, allowing to unveil the known limits of life on Earth.

RS1: During my PhD studies, I analyzed the impact of increasing marine temperatures on microbial metabolism and their interaction with phytoplankton cells. In our first publication, we observed that warming may have a very relevant impact on the growth of the microbial community and that such response of the bacterial community to rising temperatures is intricately linked to the interaction between bacteria and phytoplankton. To further analyze the bacteria-phytoplankton interactions, I started 2 different international collaborations (with Lawrence Livermore National Laboratory in California and UFZ-Leipzig in Germany) to analyze these interactions at the single-cell level using state-of-the-art mass spectrometry techniques. The results of both collaborations showed a very tight trophic interaction between bacteria and phytoplankton through C and N exchange. Thanks to my work during my PhD I published 4 papers as first author, and 5 as co-author, and participated in more than 10 international conference abstracts.

In my first postdoc at the University of Gothenburg, I continued pushing our knowledge about the biogeochemical implication of the bacteria-phytoplankton interaction and its relevance on the C and N cycling of the ocean.

RS2: For my second postdoc at Stanford University, I shifted my focus towards the resilience of marine microbes, primarily bacteria and archaea, to extreme environmental conditions. First, in collaboration with Dr. Anne Dekas, I analyzed the microbial activity of the deep regions of the ocean, up to 4000m depth. In two papers published recently, we observed that the microbial activity in the deepest regions of the ocean is higher than previously reported and that urea seems to be a key substrate sustaining that activity. These studies highlight the importance of the deep ocean on global biogeochemical cycles. During my postdoc at Stanford, I also collaborated on the NASA-funded Oceans across Space and Time (OAST) project. In this project, we aimed to analyze the limits of life in hypersaline environments, analogous to the water masses expected to be found on Mars and Saturn's icy satellite, Enceladus. My participation in OAST resulted in the publication of two papers, one of them in Science Advances as first-author.

Currently, as a postdoctoral researcher at the Marine Science Institute in Barcelona, I am advancing both of my primary research lines. As a Beatriu de Pinós-MSCA fellow, I investigate the impact of viral infections on the interactions between bacteria and phytoplankton. Concurrently, as part of the MINION project and the MACGNET network, I study the activity and metabolism of microbes inhabiting the extreme conditions of groundwater environments.

Resumen del Currículum Vitae:

Since the start of my scientific career in 2012, my primary motivation has been to explore the role of marine microbes and their interactions in driving oceanic biogeochemical cycles. By combining molecular biology, bioinformatics, and mass spectrometry techniques, I have studied how these interactions influence the cycling of carbon and nitrogen across diverse marine ecosystems, including those in extreme environments. I completed my PhD at the University of Oviedo in 2017, focusing on bacteria-phytoplankton interactions and how rising temperatures from ocean warming influence microbial metabolism and carbon and nitrogen cycling in coastal ecosystems. During my PhD, I conducted international research stays at the Lawrence Livermore National Laboratory (USA) and Helmholtz UFZ-Leipzig (Germany), where I gained expertise in nanoSIMS, a cutting-edge mass spectrometry technique for single-cell analysis. These collaborations resulted in several high-impact publications, including in The ISME Journal. After completing my PhD, I undertook postdoctoral research at the University of Gothenburg (Sweden), supported by the Swedish Research Council, where I investigated the role of diatom-bacteria interactions in carbon export to the deep ocean. In 2018, I joined Stanford University as a Simons Foundation Postdoctoral Fellow, where I focused on quantifying microbial activity in the deep ocean using nanoSIMS. This work expanded into the NASA-funded OAST project, where I developed a new set of mass spectrometry techniques that will allow the detection of microbial life in extreme environments.

In 2022, I was awarded a Beatriu de Pinós-MSCA fellowship to lead my independent research project, VirInt, at ICM-CSIC in Barcelona. This project combines metagenomics, ecological network analysis, and nanoSIMS to investigate how viral infections influence interactions between bacteria and phytoplankton. Concurrently, I contribute to the MAORI project, analyzing the functional basis of marine microbial interactions, and to the MINION project, exploring microbial metabolism in groundwater ecosystems. Throughout my career, I have been PI or collaborator in 8 research projects. I have published 19 peer-reviewed articles, including in PNAS, The ISME Journal, and Science Advances, with over 600 citations and an H-index of 13. My research findings have been presented at over 15 national and international conferences, including invited talks at the Gordon Research Seminar.



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Mentorship is a central aspect of my work. I have supervised four undergraduate students, one MSc thesis, and one PhD student. Currently, I am co-advising another MSc thesis and one PhD student at the ICM-CSIC. Additionally, I actively contribute to the scientific community as an editorial board member for *Frontiers in Marine Science* and *Frontiers in Microbiology*, as an associated editor for *Ocean Microbiology*, and as a reviewer for journals such as *ISME Journal* and *Environmental Microbiology*.

My future research will focus on the emerging role of vitamin-mediated microbial interactions in marine biogeochemistry. My goal is to establish an independent research laboratory to explore microbial interactions and their implications for global nutrient cycles, integrating cutting-edge molecular and analytical techniques with ecological modeling.



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Turno General

Área Temática: Ciencias y tecnologías químicas
Nombre: STASYUK, OLGA
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Título: Computational design of carbon materials for advanced applications
Resumen de la Memoria:

I am currently a Postdoctoral Fellow at the University of Houston, USA, where my research focuses on exploring the concepts of excited-state aromaticity and antiaromaticity for opportunities in organic photochemistry. Prior to this role, I participated in International PhD program "Towards Advanced Functional Materials and Novel Devices". My project focused on electron delocalization, tautomerism, and intermolecular interactions of nucleobases. I earned my PhD from the Warsaw University of Technology (Poland) in 2015. After this, I worked as a postdoctoral fellow at the Institute of Organic Chemistry and Biochemistry in Prague for three years. I studied noncovalent DNA-protein interactions under the guidance of Prof. P. Hobza. I also had the opportunity to collaborate with Prof. M. Swart at the University of Girona, where I worked on the reactivity of transition metal complexes in oxidation reactions. To visit his group, I was awarded two short-term postdoctoral fellowships from the FEBS and HPC-Europa3. From 2019 to 2021, I worked as a Juan de la Cierva-formación postdoctoral researcher at the University of Girona, where I investigated non-covalent complexes of carbon nanostructures. In May 2021, I joined the Crystal Engineering Laboratory of the University of Warsaw, PL, where my work focused on nitrogen-containing organic compounds. I resigned from this position in favour of a postdoctoral position at the University of Girona to continue my research of carbon materials, supported by the REQ2021- Maria Zambrano grant. I worked in the field of computational chemistry, with a focus on the investigation of photoinduced electron transfer processes in covalent and non-covalent complexes of carbon nanostructures.

I have published 46 articles, 2 reviews and 2 book chapters. Among them, 23 as the first author, 11 as the corresponding author. My works have received nearly 1500 times and my h-index is 19. I participated in 6 team research projects, gave 4 invited seminar lectures, and presented my research at 19 scientific conferences (9 oral presentations and 10 posters). I am a Member of the Czech Society for Biochemistry and Molecular Biology. I was an assistant in the organization of two Symposiums for PhD students of International programs, Poland (2013 and 2015) and Amsterdam Density Functional Program workshop at Warsaw University of Technology (2013).

I participated in teaching of undergraduate and graduate students (Experiments in Physical chemistry, Reaction Mechanisms, and Scientific Communication and Technology Transfer). In 2023, I received positive tenure-eligible lecturer report from AQU Catalunya. I mentored three PhD students from Poland during their 3-month visits (within HPC-Europa3) and two Bachelor's Degree Final Projects at the University of Girona.

I took part in international evaluation activities. Since 2020, I am a member of the Examination Committee for the defense of diploma theses, UdG. Since 2021, I am an Editorial board member of Frontiers publisher in Theoretical and Computational Chemistry. I also served as an expert for evaluating research proposals for programs such as BIENVENUE programme (MSCA co-funded, FR), FENG programme (FNP, PL), as well as the Alexander von Humboldt scholarship.

Resumen del Currículum Vitae:

My research interest has been mainly focused on study of electronic structure and noncovalent interactions of biomolecules, and physical interpretation of substituent effects in carbo- and heterocycles. Currently, the main research line is the investigation of ground and excited state properties of carbon nanostructures (fullerenes, fullertubes, nanotubes, nanobelts), and computational design of their host-guest complexes for organic electronics and energy conversion.

As a PhD student, I participated in three projects, where my research was devoted to investigation of substituent effects and non-covalent interactions in nucleobases. The results were presented in 5 first-author articles and 1 review in Chem. Rev. In collaboration with my supervisor, we successfully secured a grant titled "Towards physical interpretation of the substituent effect," where I served as the main researcher responsible for calculations. My contribution to this grant was published in 4 articles and 1 book chapter.

During my postdoctoral stay at the Institute of Organic Chemistry and Biochemistry, Czech Republic, I was involved in a huge interdisciplinary project (Controlling Structure and Function of Biomolecules at the Molecular Scale: Theory meets Experiment). In collaboration with bioinformaticians, I was responsible for development of computational methods for quantitative description of noncovalent interactions in protein-DNA complexes. The results of my work were disseminated by three first-author publications.

My postdoctoral experience at the Institute of Computational Chemistry and Catalysis/University of Girona, Spain started from a prestigious Juan de la Cierva formación fellowship. My work in the DiMoCat group centered on investigation of bonding, aromaticity and chemical reactivity of carbon nanostructures. My results successfully contributed to the group outputs by 11 publications in highly-rated international journals (8 in Q1 journals, 5 as first author). Later, I secured a one-year postdoctoral position at the University of Girona (POSTDOC-UdG2021), focusing on host-guest complexes of carbon nanorings and nanobelts, and then was supported by the grant REQ2021-Maria Zambrano. I worked in the field of computational chemistry and investigated excited state processes in non-covalent complexes of carbon nanostructures.

The proposed research will focus on two types of materials: nanosized concave-convex complexes and low-dimensional carbon materials, both of which have significant applications in sustainable energy, a high-priority global challenge. My ultimate objective is to advance materials chemistry by



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providing computational insights that guide the experimental development of novel materials. Through interdisciplinary approaches and active international collaboration, I plan to lead creative, pioneering projects that contribute to sustainable energy solutions.