



DOCTORAL INPHINIT FELLOWSHIPS PROGRAMME – INCOMING FRAME INFORMATION CALL 2022

The doctoral fellowship programme INPHINIT "la Caixa" is devoted to attracting talented Early-Stage Researchers—of any nationality—who wish to pursue doctoral studies in Spanish or Portuguese territory. Sponsored by "la Caixa" Foundation, it is aimed at supporting the best scientific talent and fostering innovative and high-quality research in Spain and Portugal by recruiting outstanding international students and offering them an attractive and competitive environment for conducting research of excellence.

The doctoral INPHINIT fellowships offer a highly competitive salary and complementary opportunities for training on transferrable skills through annual training sessions, temporary stays in industry, incentives upon completion of the thesis, among other elements that make these fellowships some of the most attractive and complete in Europe.

The INCOMING doctoral INPHINIT offers 35 fellowships to pursue PhD studies in research centres accredited with the Spanish Seal of Excellence Severo Ochoa, María de Maeztu or Health Institute Carlos III and Portuguese units accredited as "excellent" according to the evaluation of the Fundação de Ciência e Tecnologia.

STEM disciplines (life sciences and health, experimental sciences, physics, chemistry and mathematics).

Maximum duration: 3 years.

Total maximum allocation: €122,592.

Training programme in transversal skills.

To know more about the call please visit:

<https://fundacionlacaixa.org/en/inphinit-doctoral-fellowships-incoming>

CIIMAR is one of the host organizations of INPHINIT Incoming and will offer **up to 10 research projects** to be carried out in a multidisciplinary and international research team. The offers are described as follows:



DESCRIPTION OF PhD POSITION OFFERS AT CIIMAR

“Naturally diabetic”? Insights from Cetacea evolution

Area of Knowledge: LIFE SCIENCES

Research project/Research group:

Mammals occupy a large and diverse array of ecological niches and habitats, spanning land, air and water. Such diversification entailed the emergence of novel phenotypic traits mirrored in mammalian genomes: with processes of gene selection, duplication and inactivation and loss triggering evolutionary adaptations and novelties. Within mammals, cetaceans exhibit remarkable adaptations associated with the constraints of a fully aquatic lifestyle. With the dawn of next-generation sequencing technologies and the growth of available genomic data, the genomic underpinnings of cetacean biology are currently being disclosed: from observable morphology to less intuitive behavioural traits, or even basic physiological processes. Overall, episodes of gene selection and loss have been thoroughly documented in the literature, accounting for sensorial adaptations, skin remodelling, limb refitting, hypoxic stress adaptations among others (doi:10.1016/j.tree.2014.04.001; doi:10.1093/molbev/msz068; doi:10.3390/genes10020121).

Recent physiological and genomic data also suggested a distinct reorganization of energy production and consumption in Cetacea, notably in toothed-whales (Odontoceti); possibly related with the high-protein and low-carbohydrate dietary constraints (doi: 10.1126/sciadv.aaw6671). In fact, dolphins exhibit an overall low glycolytic activity and exploit fatty acids, and not glucose, as fuel for muscle and sperm energetics (doi:10.1016/j.cub.2021.05.062); counterintuitively, healthy dolphins display extremely high circulating levels of glucose, denoting an “healthy diabetic” state.

Thus, the present proposal expects to address cetacean energy metabolism and homeostasis, in light of cetacean-specific physiological and metabolic requirements. The proposal is in line with the host laboratory current research interests addressing genome evolution and phenotypic diversification, notably in mammalian lineages such as the iconic Cetacea.

Job position description:

The work proposal will entail an eclectic program with a strong focus on Bioinformatics (e.g. gene mining, gene annotation, phylogenetics, selection, network analysis) in combination with Molecular Biology (e.g. next generation sequencing technologies) and Cell Biology techniques (e.g. cell-based cellular assays or knock-out model analysis).

Briefly, using comparative genomic approaches, the gene composition of target genetic pathways (e.g. lipid and sugar metabolism) will be deduced. Gene functionality and conservation status will be initially addressed by combining gene sampling, synteny, phylogenetic (Maximum Likelihood and Bayesian approaches) and selection analyses (e.g. PAML, RELAX), as well as annotation tools developed in the host laboratory (e.g. PseudoChecker,



doi:10.1093/nar/gkaa408/5843816). Genomic transcription factor *in silico* profiles will also be sought to account for gene expression changes.

Next, *in silico* (e.g. homology modelling), *in vitro* and cell-based functional analysis, coupled to RNAseq transcriptomic profiles, will be used for selected genes/proteins to gain insight into the functional conservation/divergence of specific metabolic pathways or modules. To this aim, cetacean fibroblast cell-lines will be implemented. In addition to *in silico*, *in vitro* and cell-based assays, further functional profiles will be sought using mice models, notably regarding gene inactivation events: drivers evolutionary change and prevalent in mammalian lineages, markedly in cetaceans.

This layered strategy will allow a comprehensive stepwise analysis of the energy production and consumption patterns in cetaceans. Also, it will comparatively address cryptic metabolic strategies underpinning radical adaptations to novel environments, as depicted by the land-to-water transition operated by cetaceans 50 million years ago in the Eocene epoch.

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“Recombinant endophytic bacteria for the control of red palm weevil”

Area of Knowledge: LIFE SCIENCES

Research project/ Research Group:

This project deals with the development of novel strategies for the control of the Red Palm Weevil (RPW), *Rhynchophorus ferrugineus* (Olivier, 1970) (Coleoptera: Curculionidae), an invasive exotic species that is widely considered the most damaging insect pest of ornamental and economically-important palms globally and a severe threat to the biodiversity and ecosystem in palm plantations. This weevil causes significant economic losses due to the drastic effects of borer larvae on palm trees used as a food source. We hypothesise that inoculating palm plants with engineered endophytic bacteria expressing anti-RPW molecules could provide systemic protection against RPW. First, we will obtain a laboratory colony of RPW to ensure high-quality research insects' availability for bioassay experiments. For the identification of anti-RPW molecules, larvae will be exposed to Coleopteran-specific *Bacillus thuringiensis* toxins and recombinant *Escherichia coli* expressing double stranded RNA of essential RPW genes (i.e. RNAi by feeding). Genetically amenable endophytic *Bacillus cereus* (Bc)/*Bt* strains will be isolated from palm parts preferred by RPW larvae using a combination of microbial culturing, biochemical and genetic methods. Inoculation/re-isolation experiments will detect best palm seedlings' colonisers among true endophytes. The anti-RPW molecules will be inserted into the genome of endophytic Bc/Bt strains replacing the RNase III locus through a gene replacement system based on a vector thermosensitive for replication in Gram positive hosts. Recombinant marker-less anti-RPW endophytic bacteria will be obtained after two rounds of recombination that cause the loss of all vector sequences but the anti-RPW cassette. Palm seedlings inoculated with recombinant anti-RPW endophytes will be evaluated for systemic control of RPW larvae under greenhouse conditions (i.e. potted plant bioassays). We anticipate the obtainment of a potential anti-RPW microbial biopesticide.

Job position description:

The candidate will base his work on different disciplines, particularly entomology, molecular biology, biochemistry and microbiology. Some experience with recombinant DNA technology will be essential for gene cloning and bacterial genome editing. The candidate main research activities will be: 1) the maintenance of red palm weevil (RPW) colonies; 2) cloning, expression and purification of Coleopteran-specific Bt toxins; 3) Cloning of essential insect genes in dual opposing T7 promoters plasmid for double-stranded RNA synthesis; 4) insect exposure and bioassays tests of potential anti-RPW molecules; 5) isolation and characterization of genetically amenable endophytic *Bacillus cereus* / *Bacillus thuringiensis* strains from palm tissues; 6)



endophytic bacterial genome editing; 7) potted-plant (palm plantlets) bioassays; 8) presentation of the results through scientific articles, international conferences and a thesis dissertation.

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“Overtopping and Sea-level rise risk mitigation of Portuguese coastal defence structures under Climate Change Scenarios - OVERSEAS”

Area of Knowledge: PHYSICAL SCIENCES, MATHEMATICS AND ENGINEERING

Research project/ Research Group description:

The rising anthropogenic pressures in littoral areas combined with the foreseen risks triggered by climate change effects threaten many coastal areas, populations, infrastructures, assets and key socio-economic activities in Portugal. However, most existing coastal defence structures have been designed over the past decades without including both climate change effects and the long-term analysis of risks related to sea-level rise, sea-storms and overtopping, which in turn may lead to severe coastal flooding events, erosion, among other extreme phenomena. This project aims to make a throughout analysis of existing northern Portuguese coastal defence structures, combining both numerical and physical modelling approaches, to quantify future scenarios of overtopping and morphodynamic response. This will result in a benchmark data set of case studies, which will then be used to develop a coastal risk mitigation plan at a regional scale. Such plan will identify the needs and will promote solutions to increase coastal resilience against climate change under uncertain scenarios of sea-level rise. Adaptation pathways will be defined. Additionally, the risk plan will enable the definition and optimisation of interventions, maintenance and monitoring actions to enhance the safety of the northern Portuguese Coast. Moreover, this plan represents a contribution to analyse the possibility of transforming existing hard coastal defence structures into green-grey solutions, by combining them with eco-friendly novel approaches, including nature-based ones. The risks will be validated with recent extreme events. This research aligns with the Marine Energy Group track-record of more than 200 publications on this topic and related fields of maritime engineering over the past 5 years and a vast set of practical cases studies performed for local and national governmental authorities and private stakeholders acting on the integrated coastal zone management of the Portuguese territory.

Job position description:

The proposed research project results in a risk plan for coastal defence structures that looks for enhanced climate change adaptation and resilience, while providing adaptation pathways and future action plans to optimise the technical-economic resources spent annually on the Portuguese Coast preservation. Hence the work starts by creating a detailed data basis on the existing relevant structures, categorizing them by type of structure, risk level for overtopping, risk level for local sediment transport and coastal erosion, importance for nearby infrastructures and activities, such as harbours and maritime traffic, among other aspects. For each case and location, a set of climate change scenarios focused on combined effects of sea-level rise and



extreme sea-states will be created, including potential changes in local current-wave climate, waves’ direction, heights and periods. Then the data basis will be evaluated for such scenarios in terms of overtopping phenomena, to understand the efficiency of currently existing structures to endure the added effects caused by the referred scenarios. The coastal defence structures will then be categorized according to their sea-level rise and overtopping resilience, in order to define the new risk category based on expected climate change scenarios. Based on its risk category and action strategy will be created based on updated design, maintenance, operation, monitoring and intervention actions, including the combination with alternative nature-base solutions, as well as the risk mitigation measures to reduce local erosion. For each benchmark case study, the outlined strategy will compiled into a risk plan, which includes present and estimated probabilities of overtopping depending on the considered climate change scenarios. This research uses state-of-the-art risk and reliability analysis (doi: 10.1680/jmaen.2019.20, 10.1016/j.coastaleng.2020.103671) to develop a solid risk management of the northern Portuguese Coast.

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“Adaptation genomics under climate-change scenarios”

Area of Knowledge: LIFE SCIENCES

Research project/ Research Group description:

Freshwater ecosystems are at great risk and with unprecedented threats to the biodiversity they support. Climate change is intensifying these trends, with future scenarios predicting an exacerbation of drought conditions in all Mediterranean areas where many watercourses already dry up in summer, challenging the adaptation and survival of freshwater organisms and acting as additional selective stress forces. This is especially true for freshwater mussels (*Bivalvia*, *Unionida*) one of the most threatened groups of animals on Earth.

In this project we will use three freshwater mussel (FM) species, selected based on their higher (*Potomida littoralis* and *Unio tumidiformis*) and lower (*Unio delphinus*) drought tolerances and sampled along a latitudinal and temperature gradient, allowing the impact of natural selection to be contrasted across areas with very different ecological conditions, where populations will presumably contain functionally important polymorphisms adapted to variation in the environment.

The aims of this proposal are to 1) assess genomic changes and responses associated with climatic adaptations 2) evaluate if adaptation is the factor that can mitigate the impact of climate regime variation 3) expand our understanding of neutral vs. adaptive genes. To identify the molecular kernel and functional pathways potentially involved in environmental stress response, we will sequence their genomes, dramatically increasing the very limited existing FM genome resources but also allowing to identify FM candidate genes and functional pathways potentially involved in environmental stress response. Also, RNA-sequencing at the population level will provide the transcriptome profiles, as well as identification of the gene regions that have been affected by selection.

The Aquatic Ecology and Evolution Research Group (AEE) integrates multi-disciplinary approaches to study different levels of organization of aquatic biodiversity: from the genome to organism level, populations, communities and ecosystems. AEE group aims to unravel the patterns and processes driving diversity in aquatic systems, also working towards increasing public awareness and participation on biodiversity and conservation research.

Job position description:

We seek motivated, enthusiastic and hardworking candidates who are attracted to address scientific problems with rigor and creativity. The candidate is expected to work in an independent but collaborative way.

The candidate should have a complete graduate degree in natural sciences, biology, genetics or closely related field before start date, and a strong interest in bioinformatics.



The work will focus intensively on bioinformatics, thus learning shell script will be mandatory. Prior knowledge of this or other programming languages (e.g. R, python, perl, ...) is a plus. The project will mainly use existing samples, but there will be opportunities for fieldwork to support project objectives or/if the candidate is willing to participate on them. Also, the candidate is expected to be involved in some molecular laboratory work (DNA/RNA extractions for NGS sequencing).

This proposal is closely related to the recently funded project Freshwater Bivalves at the edge: Adaptation genomics under climate-change scenarios (PTDC/CTA-AMB/3065/2020). Thus, the PhD candidate will not only join a multidisciplinary team of young motivated researchers in the wide field of Aquatic Ecology and Evolution at CIMAR but will also benefit and be integrated in the extended network of collaborations of the team and the project that includes research Institutes from other national (CIBIO/InBio, UM, IPB and UTAD) and international (IUCN, France, Italy, Sweden and Canada) institutions.

From this proposal we expect to obtain novel insights into the processes by which freshwater species with broad geographical ranges can/might adapt to local environmental conditions and gain a clearer understanding of the evolutionary history of these imperiled organisms with eventual pay-offs in future management actions devoted to the conservation of these extraordinary organisms.

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"Evaluation of nature based solutions for estuarine areas recovery"

Area of Knowledge: LIFE SCIENCES

Research project/ Research Group description:

Nature Based Solutions (NBS) are defined as "living solutions" inspired by nature to address various societal challenges in a resource-efficient and adaptable manner, while delivering simultaneously economic, social, and environmental benefits. NBS have been used for several years to improve water quality, reducing the release of organic matter and nutrients into water bodies. However, there is still little information about the capability of NBS, namely salt marshes in estuarine areas, to reduce common and emergent pollutants on water quality. This research project aims to evaluate how NBS can reduce environmental pollution, achieving sustainable development together with restoring biodiversity in line with the current European green deal. The ecological functions and ecosystem services that these NBs provide as solutions to reduce anthropogenic pressures on marine and freshwater ecosystems will be also assessed, contributing for the "zero-pollution" European target. The project will have a major impact on enhancing the use of sustainable NBS for coastal and estuarine management plans. The application of NBS will become increasingly imperative in the coming years due to the economic costs of conventional water treatment and the need to recover ecosystems health.

ECOBIOTEC aims to contribute to the advance of marine and environmental science from a multidisciplinary point of view, coupling fundamental ecology and ecosystems function research with biotechnology tools for ecosystems recovery. We are also interested in the diverse services and societal benefits that marine and estuarine ecosystems provide, namely in exploring native microorganisms or plant-microorganisms associations for environmental cleaning/recovery through nature-based solutions.

The research team includes Marisa Almeida, expertise in bio and phytoremediation, using it as biotechnology tools for recovery and remediation of aquatic environments contaminated with different pollutants; Sandra Ramos expertise estuarine ecology, with special emphasis on impacts of human activities, including marine ecosystem services and new approaches for environmental assessments; and Ana Paula Mucha, expertise in the development of biotechnological tools for ecosystems recover, based on the ability of autochthonous microorganisms and plants to remove contaminants, through bioremediation and phytoremediation processes.

Job position description:

A holistic assessment of a NBS will be carried out, covering the continuum from the riverine until the coastal sections of estuarine environments. The NBS selected will be an estuarine saltmarsh



in the Lima river. The Lima River Estuary (41.41°N; 08.48°W (WGS84)) is the end member of an international watershed located in NW Portugal, an urban-industrialized water body with a large salt marsh area (267ha). This saltmarsh system through which river water impacted by wastewater passes on will be surveyed. The performance of the saltmarsh system for reducing aquatic pollutants will be evaluated by assessing inputs from the river basis located upstream of the saltmarsh (which includes local contamination sources as small strings that drain into the estuary) and monitoring water quality going through the NBS. Different families of pollutants (e.g., common water quality parameters (nutrients, organic matter, pathogens), metals, endocrine disruptors, pharmaceuticals) will be selected and determined in water, sediments and salt marsh plants collected seasonally. Data will allow to evaluate salt marsh role, a natural NBS, in water quality enhancement.

Research will also include the study of ecological functions, and biotic and abiotic processes involved in the removal of contaminants in natural NBS, namely in estuarine salt marshes, identifying the role of sediments, plants and microorganisms in these processes. Such knowledge will be used to assess the ecosystem service bioremediation provided by the Lima estuary salt marsh, following the ecosystem-service cascade approach.

The knowledge regarding their role will allow to identify potential key players in the enhancement of salt marsh performances. Finally, a framework will be developed integrating all the knowledge acquired to support and help in the decision making of conservation and management plans of estuarine environments.

Team Leader:

EcoBioTec – supervision team Marisa Almeida, Sandra Ramos, Ana Paula Mucha

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“Bio-based sustainable strategies to improve health and disease resistance in farmed animals”

Area of Knowledge: LIFE SCIENCES

Research project/ Research Group:

Unsuitable farming conditions can lead to antibiotic overuse as prophylactic and therapeutic treatments, being a major cause for the emergence and widespread of antimicrobial resistance. Therefore, alternative and sustainable infection management strategies are urgently needed.

Nutrition can have significant health implications for animals and, particularly in fish, best practices on diet formulation are of major importance, as feeds probably represent the leading expenditure to the aquaculture industry. The term functional or fortified feed is used to describe feeds with added benefits beyond the animal's essential nutritional requirements, being both health status and growth expected to be improved. Therefore, a shift away from chemotherapeutic and antibiotic treatments would be possible.

An activated immune system has specific nutrient requirements and in this context, research in physiology and nutrition of functional ingredients/additives in health and disease of humans and other animals increased in recent years. In particular, functional AA could be an advantage to fine-tune dietary formulations in order to develop sustainable nutritional strategies to increase disease resistance in farmed animals.

The present research project intends to contribute to this endeavour with innovative and sustainable strategies to improve fish immunity and resistance to pathogens. A multidisciplinary approach, using up to date methodologies, will be used to investigate further valorization of algae and halophyte fractions by upgrading to pure high value bioactive compounds and formulation of bioactive products (i.e. functional feeds).

This proposal will join projects AQUACOMBINE, IMMUNAA and ATLANTIDA, which were conceived to develop novel dietary formulations able to avoid the colonization and spread of pathogenic microorganisms, including multi-resistant microorganisms, among farmed animals and the subsequent spread to human beings through the food chain.

Job position description:

The main objective of this research project is to develop sustainable functional feeds to improve fish immunity (i.e. systemic and mucosal defence mechanisms) and resistance to pathogens, as



well as the synergistic effects of nutrition and vaccination in a way to improve vaccine efficiency against bacterial and viral pathogens. In particular, it is intended to:

i) develop in vitro methodologies and assays to evaluate the suitability of bioactive compounds as health promoting additives;

ii) study the effects of diets supplemented with functional additives on mucosal (i.e. skin, gills, gut) and systemic (i.e. blood, head-kidney, spleen) immunity and resistance to pathogen infection;

iii) explore the potential of functional additives to improve vaccine efficiency. In this case, only bioactive compounds with some potential effect on enhancing both neutrophils and macrophages trafficking and proliferation will be studied. Therefore, it is hypothesized that bioactive compounds could act similarly to adjuvants categorised as signal 1 facilitators by influencing the fate of the vaccine antigen in time, place, and concentration, ultimately improving its immune-availability, which are required for activation of specific T and B lymphocytes.

During the course of the project, the PhD candidate will acquire technical skills on cell culture, flow cytometry, proteomics, transcriptomics, microbiology and in vivo animal experimentation. There will be room to participate in advanced courses whenever needed.

The PhD candidate will join a multidisciplinary team (i.e. biologists, biochemists, vets) of young motivated researchers in the field of nutritional immunology. The team has an extended network of collaborations including both academic and industrial sectors. Besides Portugal, most important collaborations are settled in Spain, Norway and France. Therefore, the PhD candidate will benefit from project secondments.

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“Population genomics of *Laminaria hyperborea*: an habitat forming species impacted by climate change.”

Area of knowledge: LIFE SCIENCES

Research project/ Research Group description:

The PhD project is part of the FUTUREMARES project (<https://www.futuremares.eu>; H2020 n°869300). The global objective of FUTUREMARES is to examine the relations between climate change, marine biodiversity and ecosystem services. FUTUREMARES is focused on the improvement of three Nature Based Solutions (NBS): 1) effective restoration; 2) effective conservation; 3) sustainable harvesting in different marine communities, such as marine forests. Sublittoral marine seaweeds forests are characterized by key ecological roles with important socio-economic implications. Seaweed forests are biodiversity-rich communities supporting complex food webs. They provide physical coastal protections and they were recently recognized as important carbon sinks. In this context, their conservation and restoration are a cost-effective nature-based solution to buffer the biodiversity crisis and the impact of climate change. Yet, these communities are themselves under strong pressures (e.g. climate change, habitat destruction) and there are still critical knowledge gaps regarding their eco-evolution. FUTUREMARES is contributing to fill these gaps by implementing a multidisciplinary approach from field and experimental ecology to ecological modeling and population genomics.

The PhD student will be involved in the Benthic Ecology team (CIIMAR) led by Dr. Arenas (principal supervisor) and she/he will be co-supervised by Dr. Ledoux from the Evolutionary Genomics and Bioinformatics team (CIIMAR). This guarantees access to the resources needed to successfully achieve the PhD work (e.g. local ecological knowledge, sampling, molecular and bioinformatics resources; see Job Position Description). Besides, the PhD will be integrated to the FUTUREMARES research consortium composed by international researchers from more than 30 research institutes in different European countries, guarantying stimulating interactions and productive working environment.

Job position description:

The main objective of PhD is to shed new light on the eco-evolution of *Laminaria hyperborea* a cold adapted kelp species impacted by climate change, with a key role as habitat-forming species in seaweed forests from the North Eastern Atlantic. This work is part of the Task 3.2 (led by Dr. Arenas) and Task 3.3 of the FUTUREMARES project. The student will develop a multidisciplinary approach integrating field ecology and population genomics.

The student should have a master in Marine/Biological sciences. We expect the student to have good skills in population genetics, bioinformatics and evolutionary biology and interests for conservation and restoration ecology. Experience in scientific scuba-diving will be a plus. She/he



should not be afraid to share her/his working time between molecular biology (DNA/RNA extractions), bioinformatics (analyses of RADseq dataset) and field work (sampling).

The PhD will be divided in 3 objectives that may be refined depending on the student’s will. Basically, these objectives are to: 1) infer the scales and drivers of connectivity among populations; 2) decipher population by environment interactions; 3) link ecological and evolutionary processes acting within populations. To reach these objectives, the student will characterize the patterns of genetic diversity and structure at different spatial and temporal scales using genotyping by sequencing. Thanks to the international consortium of the FUTUREMARES project, we aim to sample the North Eastern European coast from Norway to the Portugal.

The student will be based at CIIMAR, a leading research and advanced training institution of the University of Porto (Portugal). CIIMAR features facilities for research, knowledge transfer, and Technology Platforms (e.g. Access to ecosystems, Animal experimentation and Bioinformatics). It includes international researchers and PhD students offering a highly stimulating working environment.

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“Transgenerational inheritance of adversity: from chemical exposure to epigenetic effects”

Area of Knowledge: LIFE SCIENCES

Research project/ Research Group description:

Endocrine disrupting chemicals unmistakably impact an array of signaling pathways, in addition to the reproductive tract. One of such is lipid homeostasis. Although a multitude of factors are known to influence obesity, the exact cause(s) is still unclear. Yet, none of the proposed factors seems to explain the rise in the obesity rates in such a short period of time. An emerging hypothesis suggests that human exposure to certain chemicals, particularly in utero, may alter the body weight-control mechanisms, leading to obesity later in adulthood. Many synthetic chemicals are known to produce weight gain.

Thus, several key questions emerge: What is the taxonomic scope of lipid homeostasis perturbation by environmental chemicals? Are the observed effects transgenerational as has been suggested in mammalian models? What is the role of epigenetic modifications? To what extent obesogens impact ecological relevant endpoints?

We set to address these questions here using a combination of tools and representative aquatic animal species from a broad phylogenetic sampling, i.e., teleosts, molluscs and crustacea.

The student will be integrated in the EDEC team (<https://www2.ciimar.up.pt/research.php?team=10>). The main aim of EDEC group is to improve environmental risk assessment of endocrine disrupting chemicals (EDCs) and emerging pollutants (EPs) in aquatic ecosystems, developing new methodologies to assess their effects. The group uses a multi-parametric approach that combines molecular biology, modeling and bioinformatics, ecological modeling, biochemical tools, and population relevant endpoints such as embryonic development bioassays, full life-cycle and multi and transgenerational assays. We aim to understand the mechanisms of toxicity of EDCs and EPs, single and in mixtures, and their impact in the aquatic ecosystems. We are particularly interested in understanding the transgenerational effects of EDCs and EPs and the underlying chemical's mode of action (MOA). Linking adverse-effects endpoints of EDCs and EPs with the chemical's mode of action (MOA) is transversal to all themes of the EDEC group.

Job position description:

It has been demonstrated that the obesogenic effects of several EDCs prevail at least up to the F3 generation, following F0 exposure, although the molecular underlying mechanisms remain poorly defined. The reported effects are not circumscribed to mammals and several terrestrial animals show a weight increase over several generations that point to the



involvement of as yet unidentified factors, such as environmental pollutants. Similar effects have been observed in the marine environment. Also, laboratory studies with Amphibian, snails, fish and crustaceans show disruption of lipid metabolism. Collectively, data indicates that obesogens impact lipid metabolism across phyla that have diverged over 600 million years ago.

The student will be involved in the transgenerational studies, and the determination of both apical and biochemical and molecular endpoints using a combination of tools (i.e., next generation sequencing, transcriptomic, proteomic, epigenetic markers such as chromatin accessibility, histone modifications, methylation patterns) to establish a “finger print” of affected pathways that might be evolutionary conserved across phyla and throughout generations, to assess for putative heritable impacts. In parallel, epigenetic markers will be accessed and gain/loss of function will be targeted using crispr cas9.

Overall, this project will contribute to clarify the risk of obesogens considering an ecosystem scale. Given the comparative approach, we expect to identify conserved pathways in representatives of several metazoans and the role of epigenetic factors. The identification of conserved targeted pathways in an informative sampling of metazoans will also contribute to a better understanding of the etiology of obesity in human populations.

Recent reference in the field:

Neuparth et al. 2020. Transgenerational inheritance of chemical-induced signature: a case study with simvastatin. *Environment International* 144, 106020.

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“On the origin and diversity of SARS-CoV-2: genomic assessments and health risks implication of the COVID-19”

Area of Knowledge: LIFE SCIENCES

Research project/ Research Group description:

The COVID-19 outbreak is presumably sourced from a Chinese “wet market”, with the illegal wildlife trade holding a major responsibility of the current pandemic, but arguably debate still grasps on the unproven theory of a human mediated genetic manipulation of such deadly coronavirus, which leaked from a lab in Wuhan, the Chinese city where it was first detected. SARS-CoV-2-like strains have been isolated from two Asian wild mammals, a bat and a pangolin. Given the huge diversity of SARS-CoV viruses and their well-known ability to cross infect multiple species, it is crucial to better characterize the SARS-CoV-2-like diversity spectrum, which could provide key information to understand its origin and molecular features underpin its pathogenic potential, retrieved from the analyses of its genomes. Such knowledge would be fundamental to properly describe the transmission pathway that allowed the infection of humans, the most privileged scenario being that of multiple recombination events among SARS-CoV-2-like strains in (unknown) intermediary hosts. Unsustainable harvesting of wildlife has a direct impact on the propagation of emerging diseases (e.g. HIV, SARS-CoV-1, Ebola and Lassa fever), and wildlifetrade surveys constitute crucial sentinels for the surveillance of future SARS- CoV-2 related outbreaks, which we are currently researching with the funded projects, (i) BUSHRISK and (ii) AFRICoV-Genomic surveillance of SARS-CoV-2(-like) viruses. Moreover, our genomic data analyses allowed to infer the possible role of wild species (e.g. pangolins) in the COVID-19 outbreak (e.g. <https://doi.org/10.1111/conl.12754>) and the role of genomic changes as key players for SARS-CoV-2 pathogenicity (e.g. DOI: 10.1016/j.virusres.2021.198472). Here, we will use state-of-the-art genomic analyses to understand SARS-CoV-2 origin and diversification, which will be key to understand the coronavirus biology and infection potential, by elucidation similarities and differences between SARS-CoV-2 and other coronaviruses, comprehend host–genome interactions, relevant for future strategies to combat coronavirus infections, virulent pathogenicity and identifying targets for drug or vaccine strategy design.

Job position description:

The genomic work to be developed will focus on cutting edge Genomic and Bioinformatics analyses, relevant for Biotechnological application and performed at the genome level of the SARS-CoV-2 and its relation with biological interactions of the host human genome (versus other wildlife possible hosts). Detailed surveys based on whole genome searches, synteny, gene network interactions, phylogenetics, recombination, selection, and large-scale data retrieval (host-DNA vs coronavirus-RNA sequencing technologies) and assays (e.g. recombinant and cell-based assays). Relevance for biotechnological potential of the findings will be highly appreciated



and developed along the course of the study. Detailed methodologies could be further evaluated in our recent publications on virus, cancer, antibiotics, gene networking, functional genomics, biotechnological relevance, etc (e.g. DOI: 10.1016/j.virusres.2021.198472, <https://doi.org/10.1016/j.ygeno.2020.08.020>, <https://doi.org/10.3390/antibiotics9110757>, <https://doi.org/10.1016/j.ygeno.2020.03.015>, <https://doi.org/10.1093/gbe/evz111>, <https://doi.org/10.1073/pnas.1819778116>, <https://doi.org/10.1016/j.cub.2019.10.066>).

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<https://www2.ciimar.up.pt/research.php?team=1>



“A novel eco-friendly and cost-efficient scour PROtection for MARine structures - PROMAR”

Area of knowledge: PHYSICAL SCIENCES, MATHEMATICS AND ENGINEERING

Research project/ Research Group description:

Scour at marine bottom-fixed structures is a major cause of instability and collapse. Typically made of rubble-mound material, they are often indispensable to ensure the safety of structures such as monopiles, jackets and GBFs. The cost of the foundation lies between 20 to 35% of the capital expenditures (CAPEX), which adds up to the operational and maintenance expenditures (OPEX) of an offshore investment. Presently, climate change is not systematically considered in the design of scour protections, which may also be a key requirement for marine harvesting technologies, such as wave energy converters, tidal and wind turbines with fixed foundations, since vibrations induced by some converters will enhance scour effects. Rubble-mound material presents considerable levels of uncertainty and there is little to no knowledge on the behaviour of existing solutions under climate change and lifetime extension. Extreme events and lifetime extension contribute to even larger OPEX values, due to re-filling and additional measures for scour reduction. The re-conversion of oil & gas platforms to marine renewable energy units also contributes to enhance the application of rubble-mound solutions under uncertain conditions. In this project, a scour protection based on a novel armour unit is developed through numerical and physical modelling, taking advantage of the wave basin (28x12x1.2m³) and the wave current flume (32x1x1 m³) of FEUP-CIIMAR. New shapes, sizes and materials will be tested to develop a new eco-friendly and cost-effective product, with improved resilience to long lifecycles under climate change forcing, e.g. 25-50 years. The new unit is inspired in nature-based solutions that are newly being developed for breakwaters and similar structures. The project is expected to result in a novel patented scour protection, that contributes to the competitiveness of the PT offshore energy sector, hence being the success following major PT projects as the WINDFLOAT.

Job position description:

Most scour protections used in offshore renewable energy are made of rubble-mound material: a granular filter layer is placed on a flattened seabed and then covered by rock or gravel material. However, the material applied often includes fractions of smaller stones which cannot endure the wave- and current-induced bed shear stresses. This may result in the failure of the protection and further increase of scour phenomena that may lead to foundation's failure. Other solutions (prefab collars, marine sea-grass mats or concrete) often imply the use of non-inert materials to be placed at sea, including plastic components. This variety of solutions present high costs and



may impact marine environments due to the use of non-sustainable materials. Scour protections are hence expensive and the key component most often focused by industry when seeking for optimised cost-benefit ratios. The R&D projects performed so far show a lack of studies focused on efficient solutions under extreme climate conditions. Therefore, there is both a scientific and industrial knowledge-solution gap for scour protections that are efficient but cheap (cost optimised) and resilient to climate change effects. A novel scour protection combining different materials with a dynamic stability concept will be tested and optimised. Three main aspects will be focused to reach the patented design: i) materials used in the armour layer, ii) eco-friendly framing structure for materials disposition, iii) full-probabilistic design to reduce the uncertainty and ensure the dynamic stability of the armour layer. New materials combined with the eco-friendly framing structure will increase the mid- and long-term stability under extreme events and the full-probabilistic design with dynamic stability will optimise the volume of material applied in the protection. These are expected to decrease the OPEX and CAPEX parcels, contributing to the competitiveness of fixed foundations for marine renewable energy structures.

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