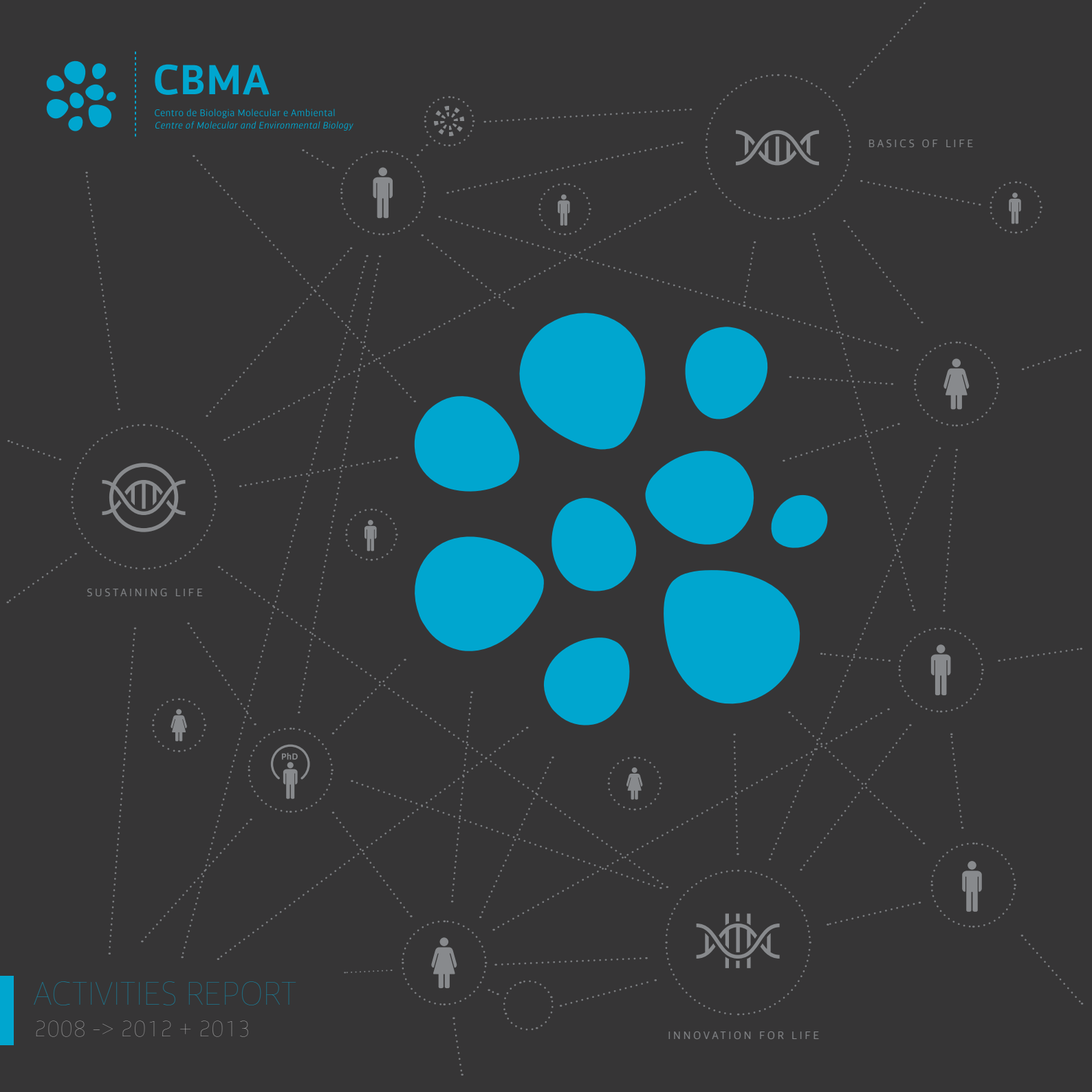
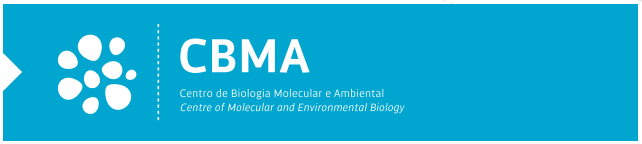
CBMA

Centro de Biologia Molecular e Ambiental
Centre of Molecular and Environmental Biology



ACTIVITIES REPORT

2008 -> 2012 + 2013



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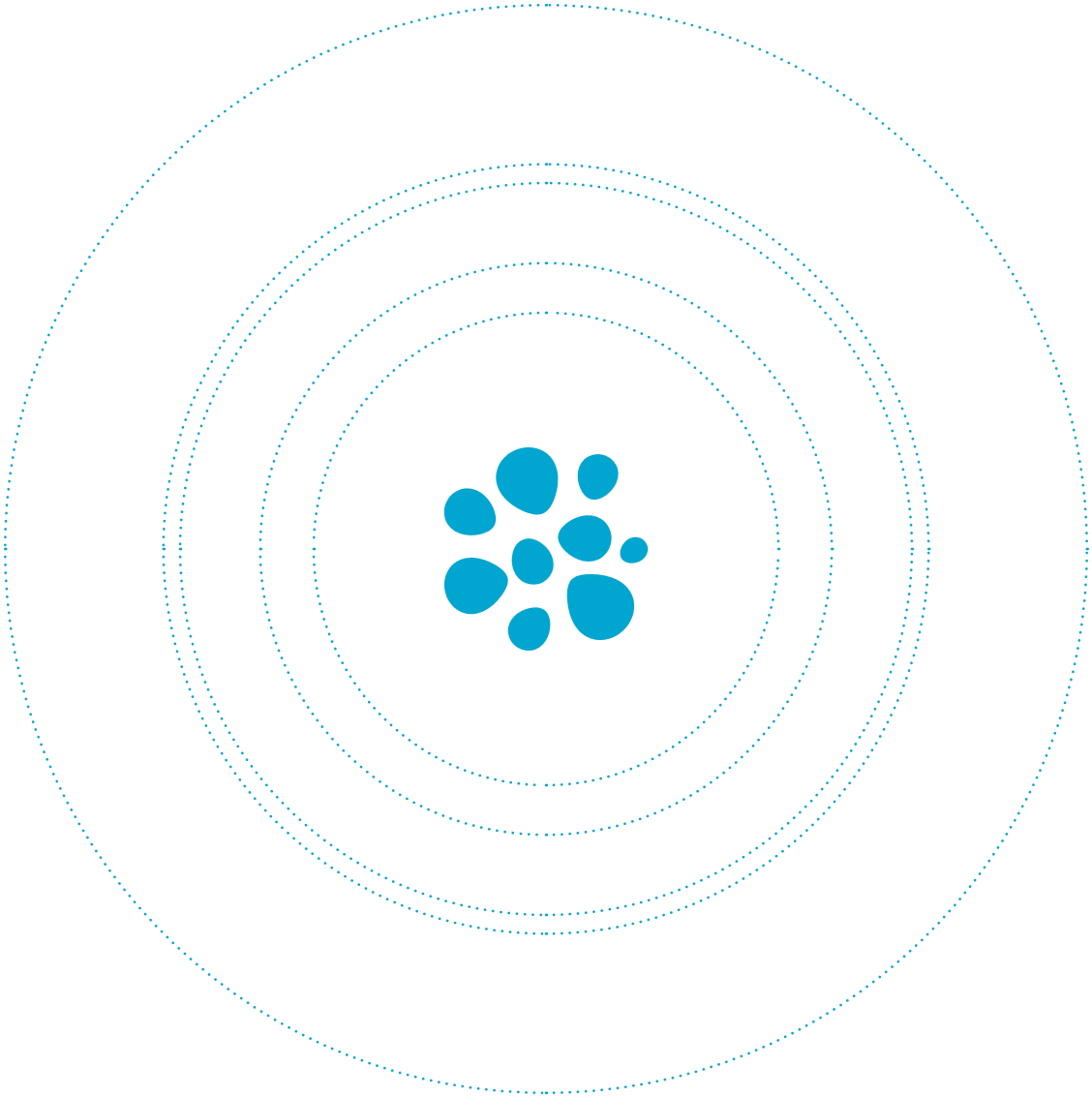


INTRODUCTION

The Centre of Molecular and Environmental Biology / Centro de Biologia Molecular e Ambiental (CBMA) is a Research and Development (R&D) Unit created in 2008, funded by the Portuguese Science & Technology Foundation and hosted at the School of Sciences of the University of Minho.

The mission of CBMA is to promote high quality Research and Advanced Education & Training in Biological Sciences, for the benefit of the societal issues of Biosustainability while serving the community via extension activities that support the development of Science and Technology at the regional, national and international levels.

CBMA drives cutting-edge research through a problem-oriented approach leading to breakthrough innovations, to new tools and to strategies, which have an impact in the Environmental, Biotechnology, Health, Agro-food and Industrial sectors.

By addressing the complexity of biological systems at distinct levels of organization, from molecules to biosphere, and benefiting from the expertise of a cross-disciplinary team, CBMA R&D activities converge towards Integrative Biology.

The study of living organisms and their interaction with the environment implies different scales of approach, from populations, communities, organisms, to a single cell and molecular events. The comprehensive understanding of biodiversity components and ecosystems relies on complementary expertise based on distinct tools and methodologies. Thus, Research Groups organization reflects our scientific expertise and approaches towards different perspectives on biodiversity:

SUSTAINING LIFE
Biodiversity and Functional Ecology

BASICS OF LIFE
Cellular Responses to Environmental Stress

INNOVATION FOR LIFE
Functional Genomics and Nanobiotechnology for Sustainable Living

Further information
www.cbma.bio.uminho.pt

Vision

CBMA vision is to tackle the societal challenges of the 21st century regarding Pressure on Natural Resources and Global Climate Change, while addressing questions that affect Human Health and Wellbeing.

Our scientific focus is on biodiversity, and encompasses research on natural, experimental and human environments to better understand behavior and interactions between different aspects of the living systems, and their responses to global change.

Strategy

Achieving a sustainable balance between human needs and the environment is one of the major challenges facing society. CBMA´s strategy is oriented towards creating cutting-edge knowledge that will foster a biosustainable society.

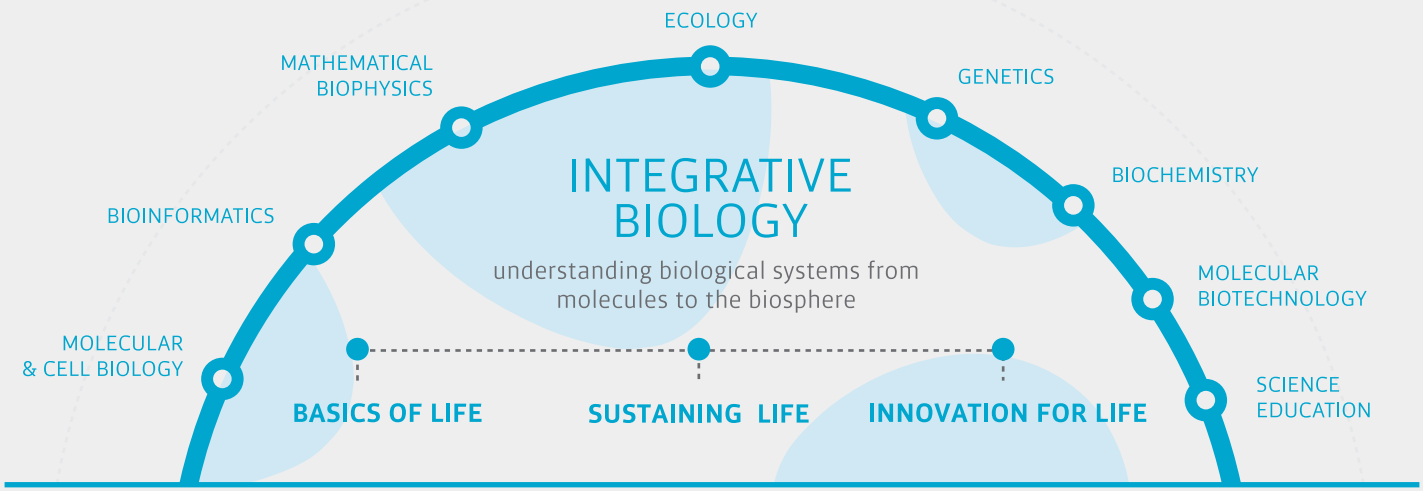
The team´s interdisciplinarity enables the study of biodiversity to uncover novel molecular targets and cellular pathways, to assess, model and predict organism and ecosystem responses to environmental changes. Furthermore, acquired knowledge on biodiversity is also exploited to create green processes and bioproducts.

CBMA established strategic partnerships sharing a vested interest in Biosustainability: the Institute of Science and Innovation for Biosustainability, the Landscape Laboratory and the Quiaios Field Station. Through them, CBMA stimulates excellence in science while enriching critical mass and promoting multidisciplinary team work, translating knowledge into innovation, reinforcing internationalization and expanding networking.

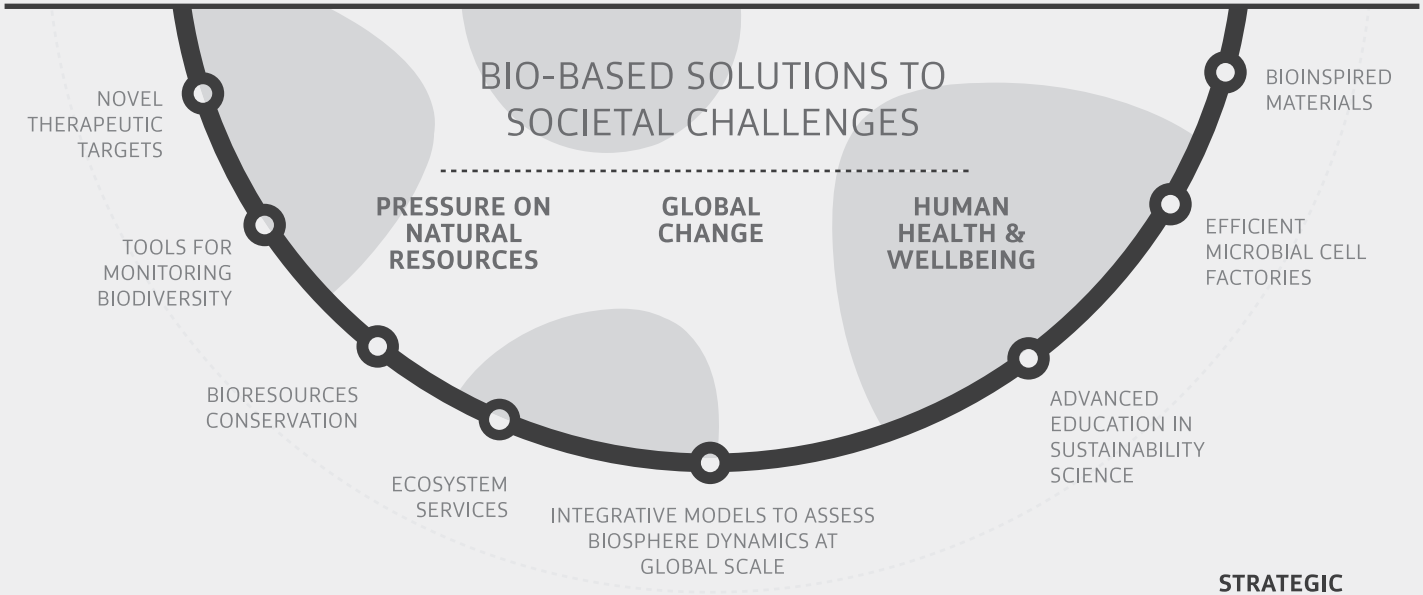
In close association with national and international experts, as well as in the context of our strategic partnerships, CBMA will contribute to improve and develop advanced models that integrate the physical, chemical, biological and social sciences, and also human components of the Earth system, to address Biosustainability issues.

Scientific Strategy

RESEARCH & DEVELOPMENT



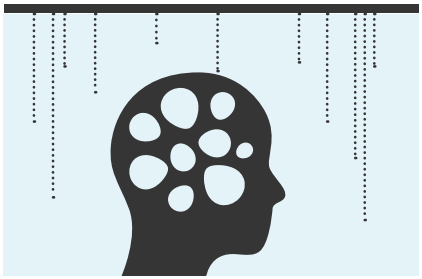
BIOSUSTAINABILITY



STRATEGIC PARTNERSHIPS

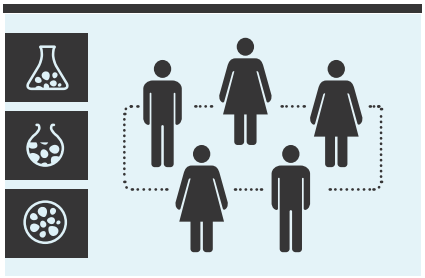
Objectives

To promote the advancement of science on Biosustainability we defined the following strategic objectives.



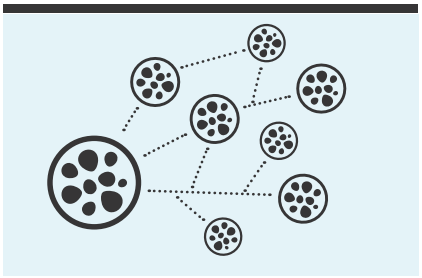
Advance scientific knowledge on Biosustainability

Integrated and multiscale biological research at the population, community, organism and cellular levels is critical to understand the impact of global change on biodiversity. By blending theoretical and experimental Biology, we aim to create models to predict the behaviour of living systems. Our research will contribute to understand ecosystems processes, to define molecular targets associated with environmental changes, and to generate innovative processes.



A resourceful and skilled team

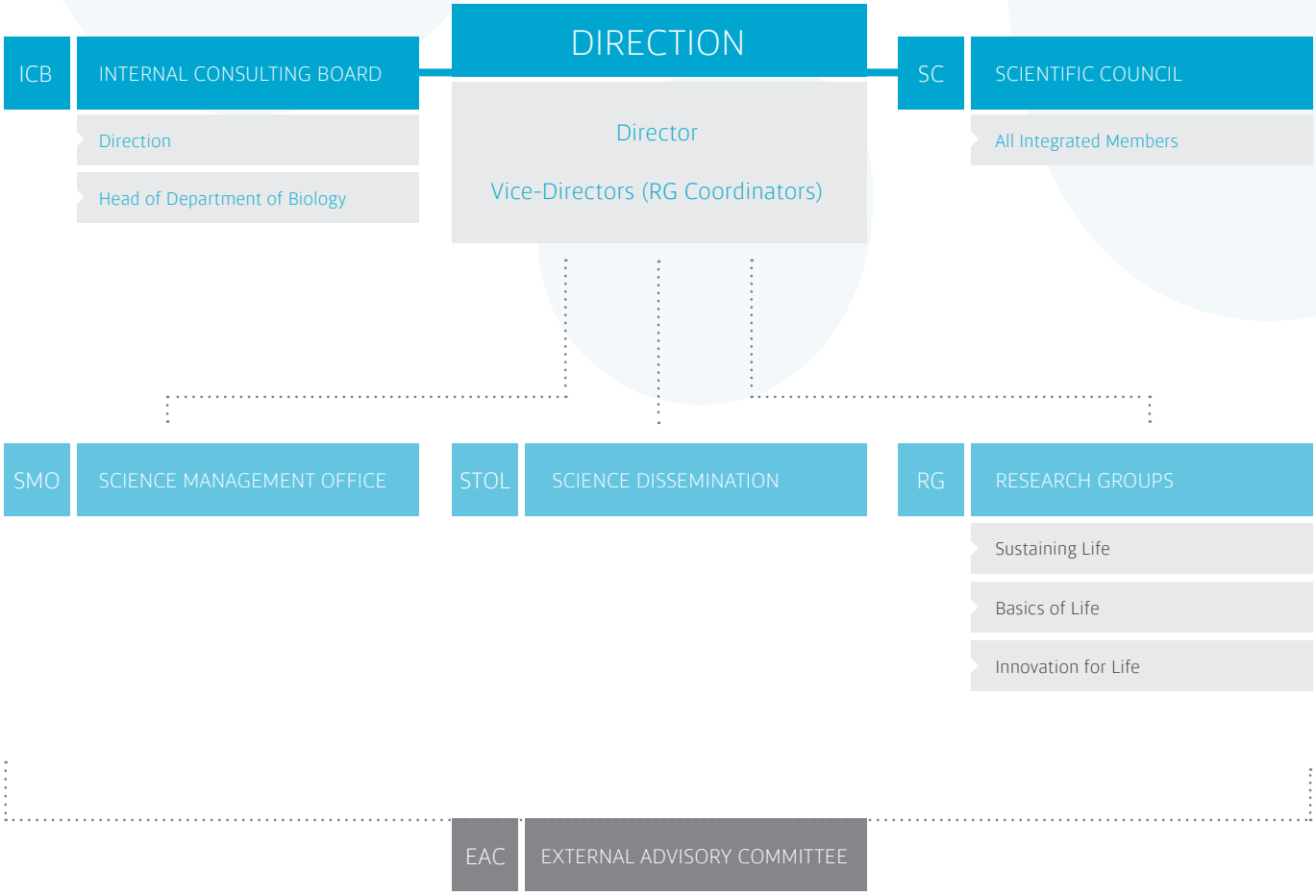
A creative and motivated team, well enrolled with researchers and students, is fundamental to ensure the CBMA mission accomplishment. We cultivate an environment conducive to internal synergies, and stimulate a culture of distinction, where the critical spirit and proactivity are rewarded. CBMA promotes the exchange of PhD students and researchers with outstanding institutions with complementary expertise, to improve skills and share knowledge and resources. The Centre fosters the training and education of a new generation of young scientists committed to pursuing a PhD in Biological Sciences.



Communicate and transfer knowledge

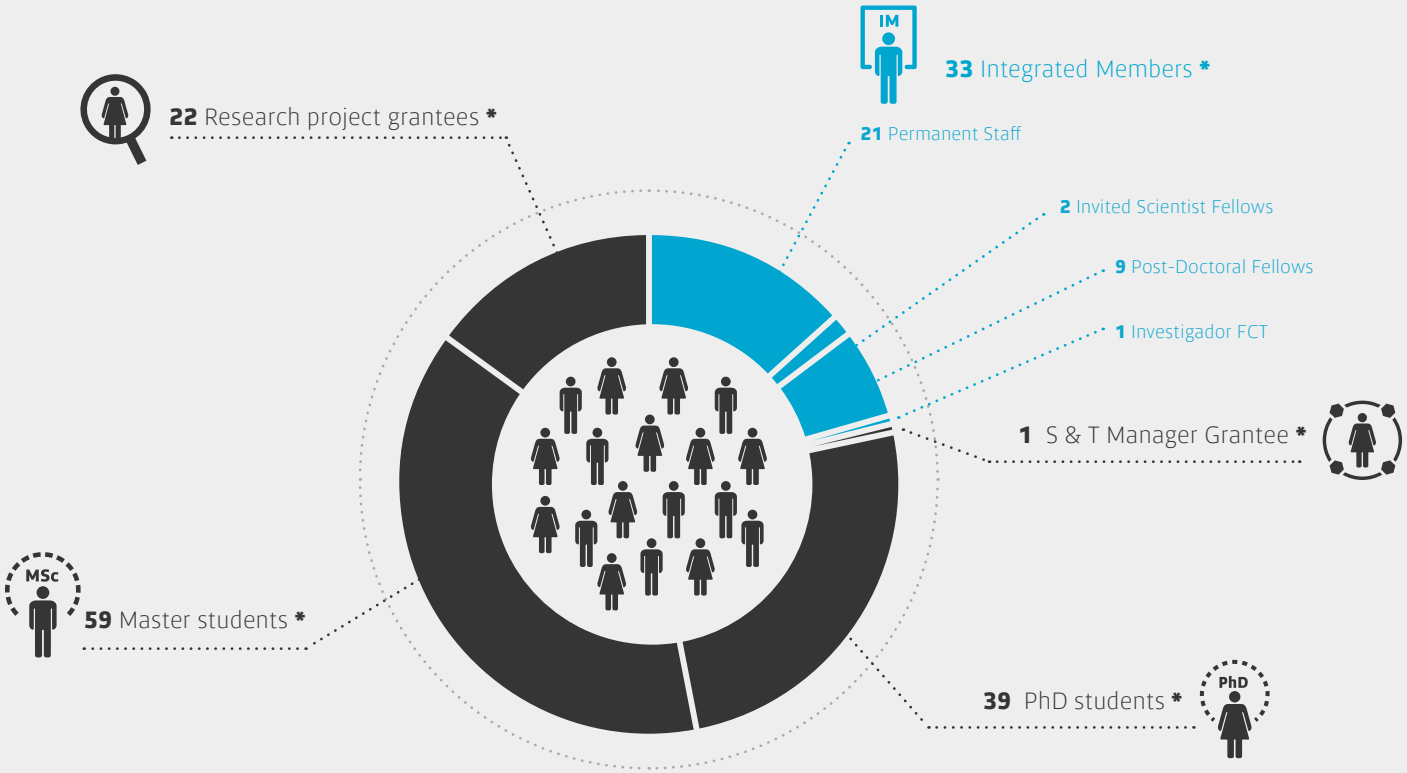
CBMA is committed to translate knowledge to society by promoting scientific and technical services, and research contracts, registering patents and their licensing, and nesting start-ups with the involvement of students and integrated members (IM). Furthermore, using creative strategies, the Science Through Our Lives (STOL) team establishes a cultural, scientific and educational agenda to generate fruitful links between the academy and society, and between teaching and research.

ORGANIZATION

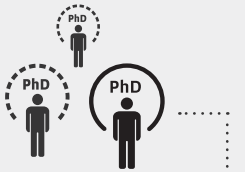


FACTS AND FIGURES

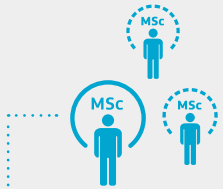
TEAM



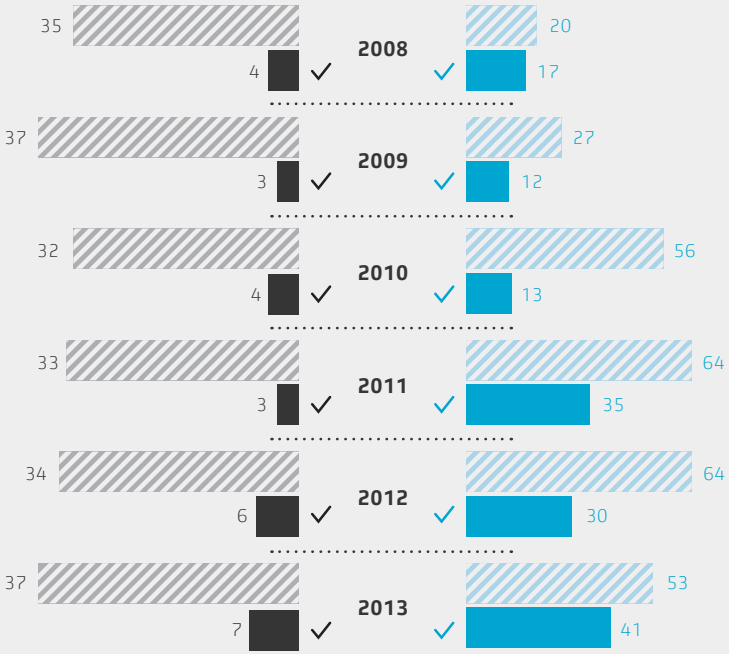
* 2014



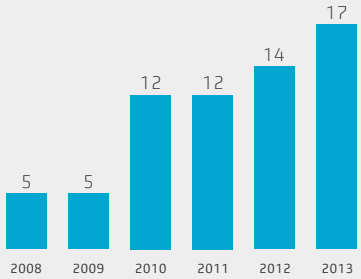
PhD Students



MSc Students



RESEARCH PROJECT GRANTEES



FACTS AND FIGURES

PUBLICATIONS

Total Publications 2008-13

> 269 Peer-review articles

> 2778 Total citations

> 17.1 Average citations per paper (this average considers a paper's maturation time of three years; includes CBMA papers until 2010 and the corresponding total citations to date)

Publications in 2013

52 Peer-review articles

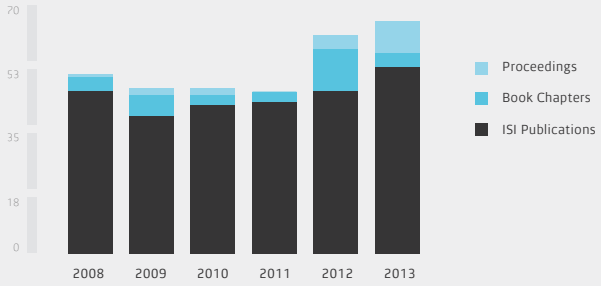
4 Book chapters

9 Proceeding articles

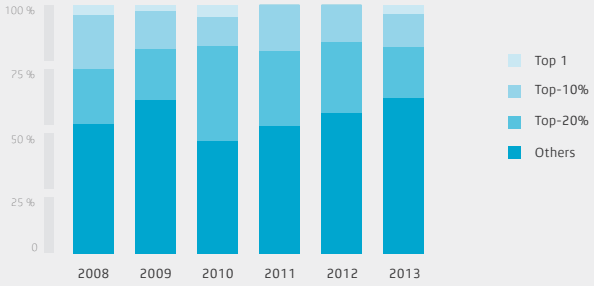
17.3 Average number of papers per research group

1.86 Average number of papers per Integrated Member

Total publications 2008-13

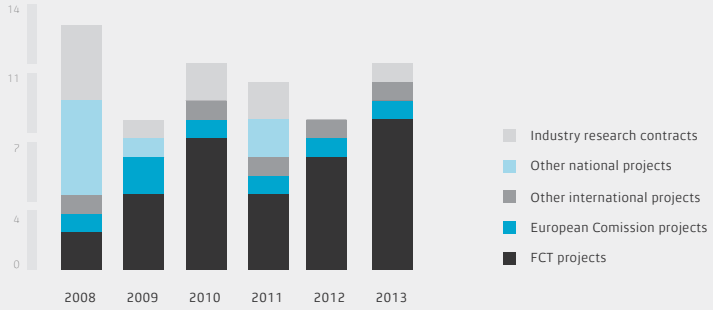


Top 1, Top-10% and Top-20% ISI Publications in 2008-13



COMPETITIVE FUNDING

From 2008-13 CBMA contracted 50 research projects from national and international funding agencies, and established 10 national and international industry research contracts. The full list of projects is given in the Research Outputs Section.



ADVANCED TRAINING

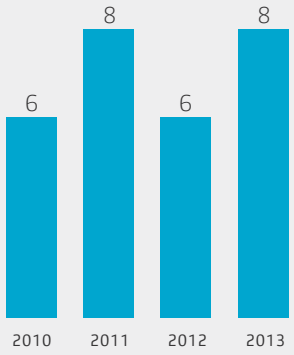
PhD Program in Molecular and Environmental Biology

CBMA is responsible for the organization and management of the PhD Program in Molecular and Environmental Biology. The Program corresponds to 240 ECTS (4 years), divided in 42 ECTS for the PhD Course and 198 ECTS for the Thesis. The Course includes international advanced courses, seminars, lectures, tutorials and round-table discussions.

Masters Degree Programme

CBMA is responsible for the organization and management of the Master Course in Molecular Genetics and of the Master Course in Ecology. Furthermore, and in collaboration with other Departments at the University of Minho, CBMA is also enrolled in the Master Course of Biophysics and Bionanosystems, the Master Course in Applied Biochemistry and the Master Course in Bioinformatics.

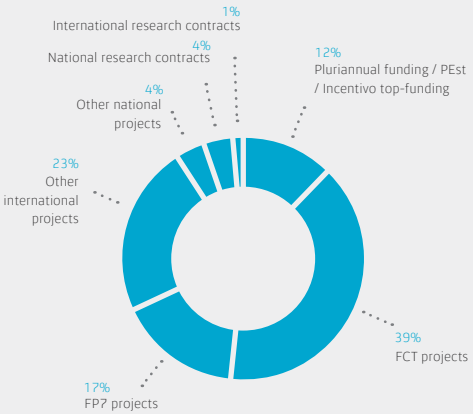
ADVANCED COURSES



BUDGET

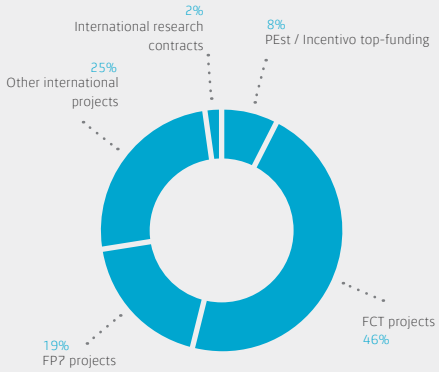
FUNDING IN 2008 – 13

5499 k€



OVERALL BUDGET 2013

597 k€



HIGHLIGHTS (2008 > 2012)

PUBLICATIONS

- CBMA has a ratio of 8.75 publications per integrated member
- 7 papers were published in top 1 journals, 38 papers were published in top-10% journals and 70 papers were published in top-20% journals
- CBMA has published in top journals: Nature, PNAS, Plos Computational Biology, Physics Review Letters, FEMS Microbiology Reviews, Journal of Cell Biology, Freshwater Biology, Global Ecology and Biogeography, Journal of Controlled Release, Biomacromolecules

INTERNATIONALIZATION

- 321 invited speakers visited CBMA (average of 2 seminars/week)
- Participation in 4 international projects (funding agencies: EEA Grants, LIFE+, Atlantic Area, CAPES)
- Participation in 6 EC projects (NMP, KBBE, SME, MC-reintegration Grant, MC-ITN)
- Organization of 28 international advanced courses involving 41 outstanding invited professors/researchers
- Half of publications result from international collaborations
- 41 Participations as invited lectures in international meetings/ seminars.
- Participation in 122 international conferences: 76 oral and 143 panel presentations
- Opponents in 13 PhD theses abroad (U. Leuven, U. Goteborg, Delft U. Technology, U. Valladolid, U. Santiago Compostela, U. Vigo, U. Salamanca, U. Complutense Madrid, U. Malta, U. Mangalore).

ABILITY TO ATTRACT COMPETITIVE FUNDING

- More than 40% of the funding is obtained from international calls
- 88% of total funding was obtained through competive projects
- CBMA was awarded with FCT "Incentivo" top-up funding due to its ability to attract competitive funding
- CBMA secured relevant contracts with companies
- CBMA raised 7.3 € per 1.0 € provided as basal funding by FCT

INTERNATIONAL NETWORKING

- Glycopharm Marie Curie ITN (www.glycopharm.eu/)
- Consortium Campus do Mar (http://campusdomar.es)
- International Barcode of Life (www.ibol.org) - Portugal delegate and member of the Scientific Steering Committee
- Fish Barcode of Life (www.fishbol.org): Deputy-Chair and currently Chair of the European Regional Working Group
- CYTED - Diagnóstico Molecular de las Micosis Sistémicas y Oportunistas (www.micomol-cyted.org)

INNOVATION

- 1 national and 3 international patents
- Creation of the spin-off Nanodelivery, Lda., headquartered at CBMA
- 2 R&D contracts with international companies
- 5 specialized services contracts with national companies

- 7 contracts with national institutions
- 1 Business Environment PhD

EXTERNAL RECOGNITION AND PRIZES

- Jorge M. Pacheco, 2008, Helen C Levitt Visiting Professor to the Mayo Clinic, Rochester, USA.
- Jorge M. Pacheco, 2009, member of the Portuguese Academy of Sciences
- Pedro Gomes, Green Project Awards, 2010, honourable mention in Research and Development to SafeSea project
- Andreia Gomes and Margarida Casal, 2010, 1st prize of SpinUM, to the mentors team of Nanodelivery, Lda.
- Sandra Paiva and Magarida Casal, 2011, Nature Cell Biology Poster Prize, "Ubiquitin and ubiquitin-like modifiers: from functional modules to systems biology"

SCIENCE DISSEMINATION ACTIVITIES

- STOL - Science Through Our Lives https://www.facebook.com/STOLisfun is a project that was born on September 2011, from the brainstorming of CBMA researchers, aware of the importance of science communication in the present society. Its mission is to think Science with consciousness and to communicate/ disseminate knowledge to everyone, including the general public or specific groups of people with particular interests and/ or peculiar needs. STOL was idealized as a cultural, scientific and educational project with two fundamental visions: to create fruitful links between university and society and to narrow the bridges between teaching and research.

ORGANIZATION OF SCIENTIFIC EVENTS

- XVI Meeting of the Iberian Limnological Association. Guimarães, Portugal, 2-6 July 2012.
- ECOPLAST - International Workshop on Biopolymers Based on Renewable Resources: from Synthesis to Applications. Braga, Portugal, 1 June 2011.
- 2nd Conference of the European Consortium for the Barcode of Life (ECBOL2). Braga, Portugal, 2-4 June 2010.
- 2nd Workshop of the European Regional Working Group of the Fish Barcode of Life Initiative (FISH-BOL). Braga, Portugal, 1 June 2010.
- XXXV Meeting from the Portuguese Genetics Society. Braga, Portugal, 31May-2 June 2010.
- 26th Small Meeting on Yeast Transport and Energetics. Braga, Portugal, September 6-9, 2008.
- 1st Workshop of the Research Network Barcoding Aquatic Life – Portugal. Lisboa, Portugal, 26 July 2008.

MAIN ACHIEVEMENTS

CBMA´s team greatly values the study of biodiversity. Our commitment translates into efforts to understand the role of biodiversity in complex biological processes, from cellular and molecular levels to communities and ecosystems, surpassing the actual knowledge of each of these fields.

Modelling complex systems is necessary to make valuable predictions to support decision-making. The development of mathematical tools to model the behaviour of human society around decisions on the exploitation of public goods was assessed through Evolutionary Game Theory, which predicted that the temptation to forgo the public good mostly wins over collective cooperative action **[1]**. Cooperation is promoted by the diversity, as the number and size of the Public Goods Game increases. Results help to explain cooperation, and provide instrumental clues on the self-organization of social communities and their economical implications.

Such instruments are mandatory to support choices on ecosystems restoration, species conservation or natural resources exploitation, concurrently with methods as the one developed to disentangle the contribution of species richness and replacement to beta-diversity at small and large scales (e.g. gradients of species invasion and Mediterranean climatic gradient) **[2]**. Alongside, in freshwaters, we showed that positive diversity effects on key ecosystem process (organic matter turnover) were due to complementarity and selection mechanisms **[3]**. Biodiversity effects were modulated by the environmental context because variability of ecosystem processes decreased with increasing biodiversity, mainly under stress **[4]**. Results provide compelling arguments for conserving biodiversity to increase ecosystem stability in a changing world.

Studies on biodiversity are presently boosted through the incorporation of molecular tools in ecology. Our team made a representative contribution to the biodiversity assessment of a wide range of populations (yeasts, aquatic fungi, crustacea and fishes) using DNA barcoding, genetic and genomic approaches. These were applied in monitoring fish population dynamics under climate change and high exploitation, evidencing intra-species genetic differences over space and time **[5]**, and showed that Effective Population Size of specific exploited fish populations is at the minimum threshold to maintain their genetic diversity and evolutionary potential. These major breakthroughs have huge impact in the sustainable management and conservation of fisheries. Furthermore, our team **[6]** produced a core system for molecular identification (DNA barcodes) of marine fish species from Portugal, that constitutes a key public resource for researchers and end-users, with multiple applications, including fisheries control and management and species traceability in fish food products. Similar molecular tools are presently being applied with equal success to improve the current limited state of art on the role of microbial biodiversity in freshwater ecosystems functioning **[3]**.

In the same line, aCGH analysis of the wild type *Saccharomyces cerevisiae* revealed high genomic variability of sub-telomeric regions and Ty-element insertion sites, which are suggested as the main source of biodiversity in the yeast genome **[7]**. Biodiversity assessment and population genetics of yeasts were further used to link vineyard ecosystems to fermentation biotechnology. Most genetic variation among yeast populations occurred in vineyards with higher diversity of grape varieties, which was the main driver of *S. cerevisiae* population structure **[8]**. Assessing yeast biodiversity is extremely important when addressing human commensals. Among the *Candida* species causing bloodstream infections, *C. parapsilosis* is one of the most frequent. We identified new microsatellite *loci* able to distinguish strains, revealing a valuable tool in epidemiology to answer questions of strain relatedness and determine pathways of transmission **[9]**. These data highlights the usefulness of yeast as a model system to elucidate how natural selection shapes genomes and their function. Furthermore, HTP techniques were applied to characterize microbial biodiversity, monitor bioprocesses and enabled the identification of pathways associated with bioactive compounds of economic interest in *Pseudomonas aeruginosa* **[10]**. The genomes of two *P. aeruginosa* clinical isolates with different antibiotic susceptibilities were sequenced and annotated, providing clues on infection *loci* associated with constitution of their accessory genomes **[10]**.

Yeast is also an excellent model to elucidate many mammalian molecular processes. Our work reinforced its use to elucidate the molecular mechanisms of apoptosis. We found that mammalian proteins involved in mitochondrial membrane permeabilization and cytochrome c release are functionally conserved in yeast **[11]**. On the other hand, we found a novel process contributing to apoptotic cell death in yeast associated with the release of the vacuolar protease Pep4p, the yeast cathepsin D orthologue **[12]**, that we later described in mammalian cells. Moreover, processes associated with yeast plasma membrane are crucial for overall cellular regulation and adaptation in response to environmental changes. Our work unveiled structural/functional features and turnover processes of key transporters involved in the uptake of non-fermentable carbon sources, such as lactate. We showed that addition of glucose to lactic acid grown cells rapidly triggers repression of lactate transporter, and its loss of activity is subjected to phosphorylation, ubiquitylation and endocytosis, followed by vacuolar degradation **[13]**. Moreover we identified Rod1p, which serves as a relay between glucose signaling and endocytosis **[14]**, and provided the first molecular insights into the mechanism of arrestin-related protein activation in response to intracellular signaling. All these are major breakthroughs, revealing novel putative targets for therapeutic intervention in cancer and other human pathologies, and fuelling innovation in biotechnology.

1 Santos FC, Santos Marta D, Pacheco JM. (2008). **Social diversity promotes the emergence of cooperation in public goods games.** Nature 454: 213-216. DOI: 10.1038/nature06940

2. Carvalho JC, Cardoso P, Gomes P. (2012). **Determining the relative roles of species turnover and species richness differences in generating beta-diversity patterns**. Global Ecology and Biogeography, 21: 760-771. DOI: 10.1111/j.1466-8238.2011.00694.x

3. Fernandes I, Pascoal C, Cássio F. (2011). **Intraspecific traits change biodiversity effects on ecosystem functioning under metal stress**. Oecologia, 166: 1019-28. DOI: 10.1007/s00442-011-1930-3

4. Pascoal C, Cassio F, Nikolcheva L, Barlocher F. (2010). **Realized fungal diversity increases functional stability of leaf litter decomposition under zinc stress**. Microbial Ecology, 59: 84-93. DOI: 10.1007/s00248-009-9567-z

5. Riccioni G, Landi M, Ferrara G, Milano I, Cariani A, Zane L, Sella M, Barbujani G, Tinti F. (2010). **Spatio-temporal population structuring and genetic diversity retention in depleted Atlantic Bluefin tuna of the Mediterranean Sea.** Proceedings of the National Academy of Sciences USA, 107: 2102-2107. DOI: 10.1073/pnas.0908281107

6. Costa FO, Landi M, Martins R, Costa MH, Costa ME, Carneiro M, Alves MJ, Steinke D, Carvalho GR. (2012). **A ranking system for reference libraries of DNA barcodes: Application to marine fish species from Portugal.** PLoS ONE, 7: e35858. DOI: 10.1371/journal.pone.0035858

7. Eiriz MF, Carreto L, Gomes AC, Pereira PM, Schuller D, Santos MAS. (2008). **Comparative genomics of yeast strains isolated from diverse ecological niches unveils important genome diversity.** BMC Genomics, 9: 524. DOI:10.1186/1471-2164-9-524

8. Schuller D, Cardoso F, Sousa S, Gomes P, Gomes AC, Santos MAS, Casal M. (2012). **Genetic diversity and population structure of *Saccharomyces cerevisiae* strains isolated from different grape varieties and winemaking regions.** PLoS One, 7: e32507. DOI: 10.1371/jornal.pone.0032507. DOI: 10.1371/journal.pone.0032507

9. Sabino R, Sampaio P, Rosado L, Stevens DA, Clemons KV, Pais C. (2010). **New polymorphic microsatellite markers able to distinguish among *Candida parapsilosis sensu stricto* isolates.** Journal of Clinical Microbiology, 48: 1677-1682. DOI:10.1128/JCM.02151-09

10. Soares-Castro P, Marques D, Demyanchuk S, Faustino A, Santos PM. (2011). **Draft genome sequences of two *Pseudomonas aeruginosa* clinical isolates with different antibiotic susceptibilities.** Journal of Bacteriology, 193: 5573. DOI: 10.1128/JB.05446-11

11. Pereira C, Silva RD, Saraiva L, Johansson B, Sousa MJ, Côrte-Real M. (2008). **Mitochondria dependent apoptosis in yeast.** Biochimica et Biophysica Acta - Molecular Cell Research, Special Issue: Apoptosis in Yeast, 1783: 1286-1302. DOI: 10.1016/j.bbamcr.2008.03.010

12. Pereira C, Chaves S, Alves S, Salin B, Camougrand N, Manon S, Sousa MJ, Corte-Real M. (2010). **Mitochondrial degradation in acetic acid-induced yeast apoptosis: the role of Pep4 and the ADP/ATP carrier.** Molecular Microbiology, 76: 1398-1410. DOI: 10.1111/j.1365-2958.2010.07122

13. Paiva S, Vieira N, Nondier I, Haguenauer-Tsapis R, Casal M, Urban-Grimal D. (2009). **Glucose-induces ubiquitylation and endocytosis of the yeast Jen1 transporter: role of ubiquitin-K63 chains.** Journal of Biological Chemistry, 284: 19228-19236. DOI: 10.1074/jbc.M109.008318

14. Becuwe M, Vieira N, Lara D, Gomes-Rezende J, Soares-Cunha C, Haguenauer-Tsapis R, Vincent O, Casal M, Paiva S, Léon S. (2012). **A molecular switch on an arrestin-like protein relays glucose signaling to transporter endocytosis.** Journal of Cell Biology, 196: 247-55. DOI: 10.1083/jcb.201109113

RESEARCH GROUPS

SUSTAINING LIFE

BIODIVERSITY AND FUNCTIONAL ECOLOGY

The Biodiversity and Functional Ecology research group develops theoretical, empirical and observational approaches to understand the role of biodiversity in ecosystem functioning and to propose actions towards ecological sustainability under the ongoing global climate change.

The research group joins expertise on marine and freshwater biology, ecology, ecotoxicology, microbiology, genetics, and mathematics. The application of diversified tools (e.g. omics and modelling) to address questions on the ecology and biodiversity of wild populations allows the design of strategies for the management and conservation of ecosystems and populations.

The research group develops complementary research in Molecular and Functional Ecology, Modelling and Conservation Biology to:

1. Develop new tools for assessing and monitoring ecosystems' biodiversity

The group strives to reveal the biological and ecological basis of the diversity of natural populations and species over space and time. Several projects with a large taxonomic scope, including aquatic fungi, marine macroinvertebrates and fishes, have been developed to assess i) molecular biodiversity - DNA barcoding related research, ii) phylogeography at regional and global scales, and iii) population genetics.

2. Assess impacts of biodiversity on ecosystem processes under global change

The high rates of species extinctions have motivated our research to ascertain how increasingly fewer species are able to maintain ecological processes. The research group has used aquatic detritus food-webs as a model system to address the relationships between biodiversity and ecosystem functioning. Impacts of biodiversity loss have being addressed across multitrophic levels, through a range of spatial and temporal scales and along gradients of anthropogenic and climate stress. Particular attention has been given to global warming as well as to the effects of priority and emerging contaminants at the community, population and cellular level. Addressing impacts within and across different levels of biological organization pave the way to identify sensitive organisms, potential biomarkers, and to elucidate the action mechanism of contaminants in aquatic organisms, ultimately contributing to ecological risk assessment.

3. Apply modeling to describe the dynamics of complex ecological processes

A unifying approach, inspired by mathematical methods and techniques, was developed to study the dynamics of ecological processes and to understand the evolution of cooperation. Similar mathematical techniques have been employed to deal with the problem of avoiding dangerous climate change outcomes, viewed as a tragedy of the commons.

Main scientific achievements 2008-12

Research was conducted on biodiversity and functional ecology to promote the conservation of species/ecosystems and the sustainable use of natural resources. Results showed the suitability of DNA barcodes for the identification of a wide range of organisms (fungi, crustacea, fishes) and contributed to i) create a comprehensive reference library of DNA barcodes of marine specimens **[S1]**; ii) improve tools to assist fisheries management in EU **[S2]**; and iii) improve monitoring tools for quality assessment following the EU Water Framework Directive.

The RG used aquatic detritus foodwebs to address how different components of biodiversity affect ecosystem functioning **[S3]**. Data showed that biodiversity helps to buffer environmental variability and to maintain ecological processes, because different species, phenotypes or genotypes respond differently to environmental changes leading to functional compensations **[S4]**. We found that anthropogenic stressors, such as metals **[S5]**, nanoparticles **[S6]** and eutrophication **[S7]**, are threatening biodiversity and functional ecosystem integrity. Exposure to multiple stressors led to synergistic, additive or antagonistic effects: effects of metals in mixtures were mainly additive **[S5]**, but warming potentiated metal toxicity **[S8]**. Survival of aquatic organisms in metal-stressed environments was associated with their ability to initiate an efficient antioxidant defense system and to undergo programmed cell death **[S9]**.

Modeling of complex population dynamical processes was applied to i) disentangle the contribution of species richness and replacement to beta-diversity at small and large scales **[S10]**, ii) understand the evolution of cooperation at different levels of biological organization **[S11,S12]**, iii) solve problems of collective action as those related to Greenhouse Gas Emissions **[S13]**, iv) predict the comparative performance of bottom-up vs top-down approaches in managing the Climate Change problem, and v) characterize the spatio-temporal layout of urban areas to identify (and even predict) areas requiring the most proximate planning and regulation.

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S2. Riccioni G, Landi M, Ferrara G, Milano I, Cariani A, Zane L, Sella M, Barbujani G, Tinti F. (2010). **Spatio-temporal population structuring and genetic diversity retention in depleted Atlantic Bluefin tuna of the Mediterranean Sea.** Proceedings of the National Academy of Sciences USA, 107: 2102-2107. DOI: 10.1073/pnas.0908281107

S3. Reiss J, Bailey RA, Cassio F, Woodward G, Pascoal C. (2010). **Assessing the contribution of microrganisms and macrofauna to biodiversity–ecosystem functioning relationships in freshwater microcosms.** Advances in Ecological Research, 43: 151-176. DOI: 10.1016/S0065-2504(10)43004-4

S4. Fernandes I, Pascoal C, Cássio F. (2011). **Intraspecific traits change biodiversity effects on ecosystem functioning under metal stress.** Oecologia, 166: 1019-28. DOI: 10.1007/s00442-011-1930-3

S5. Duarte S, Pascoal C, Alves A, Correia A, Cássio F. (2008). **Copper and zinc mixtures induce shifts in microbial communities and reduce leaf litter decomposition in streams.** Freshwater Biology, 53: 91-102. DOI: 10.1111/j.1365-2427.2007.01869.x

S6. Pradhan A, Seena S, Pascoal C, Cássio F. (2011). **Can metal nanoparticles be a threat to microbial decomposers of plant litter in streams?**. Microbial ecology, 62: 58-68. DOI: 10.1007/s00248-011-9861-4

S7. Duarte S, Pascoal C, Garabetian F, Cássio F, Charcosset JY. (2009). **Microbial decomposer communities are mainly structured by trophic status in circumneutral and alkaline streams.** Applied and Environmental Microbiology, 75: 6211-6221. DOI: 10.1128/AEM.00971-09

S8. Batista D, Pascoal C, Cássio F. (2012). **Impacts of warming on freshwater decomposers along a gradient of cadmium stress.** Environmental Pollution, 169: 35-41. DOI: 10.1016/j.envpol.2012-05.021

S9. Azevedo MM, Almeida B, Ludovico P, Cássio F. (2009). **Metal stress induces programmed cell death in aquatic fungi.** Aquatic Toxicology, 92: 264-270. DOI: 10.1016/j.aquatox.2009.02.010

S10. Carvalho JC, Cardoso P, Gomes P. (2012). **Determining the relative roles of species turnover and species richness differences in generating beta-diversity patterns.** Global Ecology and Biogeography, 21: 760-771. DOI: 10.1111/j.1466-8238.2011.00694.x

S11. Pacheco JM, Pinheiro FL, Santos FC. (2009). **Population structure induces a symmetry breaking favoring the emergence of cooperation.** PLoS-Computational Biology 5(12) e1000596. DOI: 10.1371/journal.pcbi.1000596

S12. Santos FC, Santos MD, Pacheco JM. (2008). **Social diversity promotes the emergence of cooperation in public goods games.** Nature 454: 213-216. DOI: 10.1038/nature06940

S13. Santos FC, Pacheco JM. (2011). **Risk of collective failure provides an escape from the tragedy of the commons.** Proceedings of the National Academy of Sciences (USA) 108: 10421-10425. DOI: 10.1073/pnas.1015648108

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- Tânia Sofia Marcos Lopes

BASICS OF LIFE

CELLULAR RESPONSES TO ENVIRONMENTAL STRESS

The research activities span from molecules to cells and whole organisms. The group possesses a solid know-how on physiology, biochemistry and molecular biology, with applications in the fields of biotechnology and biomedicine.

The team exploits cutting-edge technologies established for the budding yeast *Saccharomyces cerevisiae* to investigate and characterize molecular and cellular targets of toxic compounds, and integrates this information to uncover novel functional networks and pathways in key biological processes, which are evolutionary conserved. Thus, we could also translate our findings to different biological models, contributing to the understanding of mechanisms underlying the functioning of higher eukaryotic cells.

Our main focus is on:

1. Plasma membrane transporters: using methodologies based on radioactive labelled substrates to measure kinetics and energetics, computer-assisted modelling tools to study structure-function, and protein-tagging tools to assess trafficking and turnover in order to understand signalling pathways controlling membrane structure and cell differentiation in response to environmental changes, including stress imposed by drugs.

2. Apoptosis signalling: using complementary models (mammalian and yeast cells, isolated organelles and yeast cells heterologously expressing human/mammalian-specific apoptotic regulators and signalling proteins) and biochemical approaches, as well as flow cytometry, advanced microscopy and omic´s tools, to unveil novel

components of the cell death machinery and signalling pathways in response to different stimuli.

3. Fungal pathogens, pathogenesis and host response: developing new molecular tools for diagnosis and identification of fungal pathogens based on GeneScan fragment analysis, as well as using in vitro mammalian cell cultures and in vivo animal infection models to identify and characterize virulence factors and molecular mechanisms involved in antifungal responses.

Main scientific achievements 2008-12

The RG contributed significantly to highlight several signaling and regulatory pathways of cellular processes triggered by biotic and abiotic stressors, with special focus on plasma membrane (PM) transporters, programmed cell death (PCD) and host-fungus adaptive responses.

Understanding the complex PCD regulatory network has been another key research topic of the RG. We identified common features between mitochondria death pathways in yeast and mammals, contributing to the recognition that PCD is highly conserved. We also heterologously (co-)expressed the pro-apoptotic mammalian Bax to elucidate the regulatory PCD network of higher eukaryotes **[B1]**. We also used the yeast model to uncover NH4+ as an ageing determinant **[B2]** and identify the role of ceramide metabolism in apoptosis through the modulation of mitochondrial permeabilization **[B3]**. Furthermore, we found that the vacuolar release of the yeast cathepsin D also regulates PCD, leading to the proposal of a novel role for this protease in colorectal carcinoma (CRC), and exploited this model in studies of signaling pathways involved in carcinogenesis and resistance to therapy **[B4]**.

The characterization of plasma membrane (PM) transporters has been an internationally recognized key research theme of the RG in the last 25 years. PM proteins intervene on how the cell interacts with its surroundings, including sensing, adhesion, signaling and solute uptake, which allow the cell to respond to distinct environmental cues. We achieved important milestones in this field, including the characterization of PM lactate transporters in different yeast species **[B5]** and in breast cancer cell lines **[B6]**. PM proteins are tightly regulated and are rapidly targeted for vacuolar degradation, which depends on phosphorylation, ubiquitylation and endocytosis **[B7]**. Recently, we showed the activation of arrestin-related proteins is involved in the mediation of intracellular signaling **[B8]**.

The ability of the yeast *C. albicans* to escape/adjust to host defences depends on its dynamic interactions with the host, in which virulence factors like proteolytic enzymes or cell wall determinants were claimed to play a significant role. We showed that secreted aspartyl proteinases have a limited role in the murine hematogenously disseminated infection but are important for other types of infections **[B9]**. Furthermore, we revealed for the first time that continuous interaction with the host leads to decreased strain virulence in the murine model of disseminated candidiasis **[B10]**, which is modulated by the cell wall integrity signaling pathway. Our recent results suggest a complex regulation, by RLM1, of cell wall determinants and virulence factors, providing the possibility to exploit these pathways and their interplay to unravel fungal adaptive processes.

Overall, we characterized PM proteins, PCD regulators and virulence factors that are attractive molecular targets to develop novel therapeutics for Human pathologies associated with cell death dysfunctions and infectious diseases, as well as to improve yeast bio-based industrial processes. The knowledge generated will contribute to uncover signaling/regulatory pathways of cellular events triggered by biotic and abiotic stressors.

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B8. Becuwe M, Vieira N, Lara D, Gomes-Rezende J, Soares-Cunha C, Haguenauer-Tsapis R, Vincent O, Casal M, Paiva S, Léon S. (2012). **A molecular switch on an arrestin-like protein relays glucose signaling to transporter endocytosis.** Journal of Cell Biology, 196: 247-55. DOI: 10.1083/jcb.201109113

B9. Sabino R, Verissimo C, Brandao J, Alves C, Parada H, Rosado L, Paixao E, Videira Z, Tendeiro T, Sampaio P, Pais C. (2010). **Epidemiology of candidemia in oncology patients: a 6-year survey in a Portuguese central hospital.** Medical Mycology, 48: 346-354. DOI: 10.3109/13693780903161216

B10. Sampaio P, Santos M, Correia A, Amaral FE, Chavez-Galarza J, Costa-de-Oliveira S, Castro AG, Pedrosa J, Pais C. (2010). **Virulence attenuation of *Candida albicans* genetic variants isolated from a patient with a recurrent bloodstream infection.** Plos One, 5: e10155. DOI: 10.1371/journal.pone.0010155

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INNOVATION FOR LIFE

FUNCTIONAL GENOMICS AND NANOBIOTECHNOLOGY FOR SUSTAINABLE LIVING

The group INNOVATION FOR LIFE - Functional Genomics and Nanobiotechnology for Sustainable Living uses molecular biotechnology and applied microbiology, omics and bioinformatics tools in synthetic biology approaches to re-design natural biological systems (or parts of) and to promote a knowledge-based society.

Our scientific expertise is focused on:

1. Optimization of high throughput methods to exploit microbial resources for industrial applications;
2. Genetic engineering for bioprocess optimization;
3. Development of bio inspired nanostructured materials.

High-throughput methodologies have been developed and implemented to characterize biological collections for posterior prediction of biotechnologically useful traits. Microorganisms with unique metabolic features of industrial interest (e.g. for production of chemical building blocks) have been identified.

Several biotechnology R&D topics with application potential have also been explored. Efficient, biosustainable metabolic engineering of yeast has been another focus of our work, creating the possibility of using these modified microorganisms to transform biowaste or industrial bioproducts in added value materials for biodiesel or bioethanol industries, for example.

A lot of effort has been put in the design and scaled up production of protein-based polymers, with varying features in terms of physical-chemical properties. Bioactive peptides and growth factors (BMPs, antimicrobial peptides) have similarly been efficiently produced. Protein polymers were validated per se or processed into nanostructured materials by self-assembly, electrospinning and solvent-cast technologies. These polymers and derived structures have an immense potential for application in biomedicine and will continue to be a strong area of work in 2015-2020.

Main scientific achievements 2008-12

The team has been working intensively on characterizing and exploring bacteria and yeast biodiversity, in order to harness natural genetic and phenotypic variability. High-throughput, non-invasive methods were established for phenometabolomic characterization of *S. cerevisiae* strains collected in the wild and from estabilished collections **[I1]**. This methodology allowed the creation of a relational database describing the pheno-metabolomic landscape of this species. This data can be used for predicting biotechnologically useful traits **[I2,I3]**. Development of tools for efficient, biosustainable metabolic engineering of yeast have been a focus of our work.

The strain *Pseudomonas sp.* M1 is able to biotransform an unusually high range of organic compounds (e.g. recalcitrant solvents, terpenoids and PAHs) with biotechnological potential **[I4]**. We identified a genomic island involved in sensing and biotransformation of terpenoids using high throughput methods. Terpenoids of natural origin are important as fragrances and flavors due to their organoleptic properties but may also be converted into chemical building-blocks.

Pseudomonas aeruginosa is a known opportunistic pathogen and with reported increasing resistance to antibiotics. A library of clinical isolates of *P. aeruginosa* was created and the mobilome component of the genome was characterized, providing new insights into the understanding of persistence and virulence during human infection **[I5]**.

An assortment of protein-based polymers, with varying features in terms of physical-chemical properties, were produced at levels of grams per liter. Using the same set up, bioactive human growth factors was also efficiently produced **[I6,I7,I8]**. Production of silk-elastin copolymers was scaled up to industrial level in a 500L fermentor anticipating its translation into industry **[I9]**. Protein polymers were processed into new structured materials by self-assembly, electrospinning and solvent-cast technologies **[I10]** for regenerative medicine.

Several of the group's main achievements relate to technology or tools that are being transferred to the economic domain in the form of services, patent applications and spin-off companies **[I1,I2,I8,I11,I12,I13,I14]**. Enzymes were enhanced by genetically engineering, with direct application in wool fibre modification (WO 2010/001356). Other work directly related with functionalization of different bioinspired materials for biomedical applications has since been successfully carried out. Furthermore, the development of lipidic nanovehicles composed of DODAB and monoolein **[I12]** was recognized for its potential application in human gene therapy, which led to the genesis of spin-off Nanodelivery, supported by national and international patents (PN 104158, W0/2010/029035 A2).

I1. Schuller D, Cardoso F, Sousa S, Gomes P, Gomes AC, Santos MAS, Casal M. (2012). **Genetic diversity and population structure of *Saccharomyces cerevisiae* strains isolated from different grape varieties and winemaking regions.** PLoS One, 7: e32507. DOI: 10.1371/journal.pone.0032507

I2. Oliveira VA, Vicente MA, Fietto LG, Castro IM, Coutrim MX, Schuller D, Casal M, Santos JO, Araújo LD, Silva PHA, Brandão RL. (2008). **Biochemical and molecular characterization of *Saccharomyces cerevisiae* strains obtained from sugar-cane juice fermentations and their impact in cachaça production.** Applied and Environmental Microbiology, 74: 693-701. DOI: 10.1128/AEM.01729-07

I3. Eiriz MF, Carreto L, Gomes AC, Pereira PM, Schuller D, Santos MAS . (2008). **Comparative genomics of yeast strains isolated from diverse ecological niches unveils important genome diversity.** BMC Genomics, 9: 524. DOI: 10.1186/1471-2164-9-524

I4. Santos PM, Sá-Correia I. (2009). **Adaptation to beta-myrcene catabolism in *Pseudomonas sp.* M1: an expression proteomics analysis.** Proteomics, 9: 5101-5111. DOI: 10.1002/pmic.200900325

I5. Soares-Castro, P, Marques, D, Demyanchuk, S, Faustino, A, Santos, PM. (2011). **Draft genome sequences of two *Pseudomonas aeruginosa* clinical isolates with different antibiotic susceptibilities.** Journal of Bacteriology, 193: 5573. DOI: 10.1128/JB.05446-11

I6. Bessa P, Machado R, Nürnberger S, Dopler D, Banerjee A, Cunha AM, Rodríguez-Cabello C, Redl H, van Griensven M, Reis RL, Casal M. (2010). **Thermoresponsive self-assembled elastin-based nanoparticles for delivery of BMPs.** Journal of Controlled Release, 142: 312–318. DOI: 10.1016/j.jconrel.2009.11.003

I7. Bessa PC, Balmayor ER, Azevedo HS, Nürnberger S, Casal M, van Griensven M, Reis RL, Redl H. (2010). **Silk fibroin microparticles as carriers for delivery of human recombinant BMPs. Physical characterization and drug release.** Journal of Tissue Engineering and Regenerative Medicine, 4: 349-355. DOI: 10.1002/term.245

I8. Bessa PC, Casal M, Reis RL. (2008). **Bone morphogenetic proteins in tissue engineering: the road from laboratory to the clinic, part II (BMP delivery).** Journal of Tissue Engineering and Regenerative Medicine, 2: 81-96. DOI: 10.1002/term.74

I9. Collins T, Azevedo-Silva J, da Costa A, Branca F, Machado R, Casal M. (2013). **Batch production of a silk-elastin-like protein in *E. coli* BL21(DE3): key stress factors and parameters for optimisation.** Microbial Cell Factories, 12, 21.

I10. Machado R , da Costa A, Sencadas V, Garcia-Arévalo C, Costa CM, Padrão J, Gomes A, Lanceros-Méndez S, Rodríguez-Cabello JC, Casal M. (2013) **Electrospun silk-elastin-like fibre mats for tissue engineering applications.** Biomedical Materials, 8, 065009. DOI: 10.1088/1748-6041/8/6/065009

I11. Vasconcelos A, Gomes AC, Cavaco-Paulo A. (2012). **Novel silk fibroin/elastin wound dressings.** Acta biomaterialia, 8: 3049-60. DOI: 10.1016/j.actbio.2012.04.035

I12. Silva JPN, Oliveira ACN, Casal MPPA, Gomes AC, Coutinho PJG, Coutinho OP, Oliveira MECDR. (2011). **DODAB:monoolein-based lipoplexes as non-viral vectors for transfection of mammalian cells.** Biochimica et Biophysica Acta - Biomembranes, 1808: 2440-9. DOI: 10.1016/j.bbamem.2011.07.002

I13. Araújo R, Silva C, Machado R, Casal M, Cunha AM, Rodriguez-Cabello C, Cavaco-Paulo A. (2009). **Proteolytic enzyme engineering: a tool for wool.** Biomacromolecules, 10: 1655-1661. DOI: 10.1002/term.245

I14. Amaral C, Lucas M, Coutinho J, Crespí AL, Anjos MR, Pais C. (2008). **Microbiological and physicochemical characterization of olive mill wastewaters from a continuous olive mill in northeastern Portugal.** Bioresource Technology, 99: 7215- 7223. DOI: 10.1016/j.biortech.2007.12.058

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- Mário Jorge Faria Barroca
- Rogério Filipe Fernandes Marques

RESEARCH OUTPUTS

PhD THESES AWARDED

> 2013

Arunava Pradhan. Impacts of nanoparticles to microbes and invertebrates : from community responses to cellular targets.

Dário Alexandre Martins Trindade. Contribution of the adenine nucleotide carrier, porin, and sphingolipid metabolism to mitochondria membrane permeabilization in *Saccharomyces cerevisiae*.

Fábio Oliveira. First molecular and biochemical characterization of the extracellular matrix of *Saccharomyces cerevisiae*.

Filipa Alexandra Barroso Pereira. Metabolic engineering of transport and core pentose metabolism in *Saccharomyces cerevisiae*.

Isabel Fernandes. Responses of aquatic decomposers to resource availability and increased temperature.

Joana Margarida Sá Pessoa da Graça Santos. Structural functional studies of plasma membrane carboxylate transporters in yeasts.

Rute Alexandra Pais Costa. Forest avifauna as a bioindicator of heavy metal pollution.

> 2012

Alexandra Correia. Role of secreted aspartyl proteases in *Candida albicans* virulence, host immune response and immunoprotection in murine disseminated candidiasis.

Marta D. Santos. Evolutionary dynamics of collective action in structured populations.

Paula M. Fernandéz. Ecological segregation inferred using chemical tracers and contamination assessment of five toothed whales in the Northwest Iberian Peninsula.

Raul Machado. Design, bioproduction and characterization of protein recombinant silk-elastin-based polymers : a new class of nano-biomaterials.

Sara Encarnação. Espaço geográfico e complexidade: modelação do crescimento das áreas construídas na aglomeração de Lisboa.

Yolanda Silva. Involvement of the gene CaRLM1 in *Candida albicans* virulence.

> 2011

Carlos L. Reis. Ab-initio design of bulk materials assembled with silicon clusters.

José C. Carvalho. Biogeography and macroecology of spiders along a gradient of mediterraneity.

Rui D. Silva. Yeast as a model system for the study of Bax regulation by protein kinase C isoforms.

> 2010

Neide Vieira. The transport of carboxylic acids in yeasts : from physiology towards structural-functional characterization of permeases.

Randi Danielsen. Late holocene environmental change at the Quiaios-Tocha coastal plain.

Raquel Sabino. Molecular epidemiology studies of candidiasis in oncological patients and development of new polymorphic microsatellite markers to distinguish *Candida parapsilosis* strains and investigate genetic diversity.

Sven Van Segbroeck. Complex dynamics in adaptive networks.

> 2009

Andreia Pacheco. Baker's yeasts for use in frozen-dough technology: sugar utilization in freeze tolerant *Torulaspora delbrueckii* strains and elucidation of cryo-resistance mechanisms.

Paulo Bessa. Novel biodegradable drug delivery systems for the controlled release of growth factors in bone healing and tissue engineering.

Susana Moreira. Recombinant carbohydrate-binding modules for biomedical applications, Biocompatibility of polysaccharide-based materials.

> 2008

Clara Pereira. Involvement of mitochondrial proteins in yeast apoptosis.

Maria M. Azevedo. Toxicity of metals in aquatic hyphomycetes : cellular targets and defence mechanisms.

Rita Araújo. Molecular biotechnology approaches towards the optimization of enzymes for advanced textile applications.

Sofia Duarte. Biodiversity and activity of microbial decomposers of leaf litter in streams under anthropogenic stress.

PROJECTS

> FCT Projects

PHOSPHOBAX. **Phosphoregulation of Bax-dependent cell death.** FCT-ANR/BEX-BCM/0175/2012 (2013-2016)

BAX. **Regulation of Bax activation by the oncogene PKC epsilon: An approach to eliminate cancer cells.** EXPL/BIM-ONC /0056/2012 (2013-2014)

DIVERSEAQUAFUN. **Molecular profiling of taxonomic, functional and genetic diversity of aquatic fungi along a pollution gradient.** PTDC/AAG-GLO/3896/2012 (2013-2015)

CETSENTI. **Cetaceans as marine ecosystem health sentinels.** RECI/AAG-GLO/0470/2012 (2013-2017)

MITOSIGNAL. **Role of the yeast neutral sphingomyelinase in mitochondria function and iron homeostasis.** PTDC/BBB-BQB/1850/2012 (2013-2016)

FIRETOX. **Toxic effects of wildfires on aquatic systems.** PTDC/AAG-GLO/4176/2012 (2013-2016)

Immunomics-Bcc. **Exploitation of immunogenic proteins of the *Burkholderia cepacia* complex to design new diagnostic and therapeutic strategies.** PTDC/BBB-BIO/1958/2012 (2013-2016)

ACROSS. **Development of antimicrobial spider silk sutures for preventing surgical site infections.** PTDC/BBB-BIO/0827/2012 (2013-2016)

NANOECOTOX. **Impacts of metal nanoparticles to aquatic ecosystems: from community responses to cellular targets.** PTDC/AAC-AMB/121650/2010 (2012-2015)

FRESHBIOFUN. **Biodiversity and the functioning of detritus food-webs in freshwaters.** PTDC/AAC-AMB/117068/2010 (2012-2015)

MYCOFAT. **Metabolic engineering of yeast fatty acids synthesis for biodiesel production.** PTDC/AAC-AMB/120940/2010 (2012-2015)

ECO-IAS. **Ecosystem-level impacts of an invasive alien species.** PTDC/AAC-AMB/116685/2010 (2012-2015)

CANDIDA. **Mechanisms of *Candida glabrata* biofilms tolerance to antifungal agents.** PTDC/SAU-MIC/119069/2010 (2012-2015)

WINE METRICS. **Revealing the volatile molecular feature responsible for the wine like aroma a critical.** PTDC/AGR-ALI/121062/2010 (2012-2015)

BESTBARCODE. **Benthic Estuarine Barcode: Development and application of massively paralelized sequencing for monitoring of estuarine macrobenthic communities.** PTDC/MAR/113435/2009 (2011-2014)

FUNDIVER. **Development of molecular tools for assessing fungal diversity and activity in freshwaters.** PTDC/AAC-AMB/113746/2009 (2011-2014)

ROOT–INT. **Role of a two-component regulatory system in the early interaction between *Sinorhizobium meliloti* and plant root hairs.** PTDC/BIA-MIC/113733/2009 (2011-2014)

Stochastic co-evolutionary dynamics of signaling and cooperation. PTDC/MAT/122897/2010 (2011-2013)

ZYGOSACAR. **Mechanistic insights into acetic acid resistance in food spoilage yeasts: from the experimental model *Saccharomyces cerevisiae* to *Zygosaccharomyces spp*.** PTDC/AGR-ALI/102608/2008 (2010-2013)

PHENOMET. **Integrative pheno-metabolomic and genetic approaches for *Saccharomyces cerevisiae* winemaking yeasts.** PTDC/AGR-ALI/103392/2008 (2010-2013)

BIOMYR. **Towards the metabolic engineering of beta-myrcene pathway of *Pseudomonas sp.* M1: functional genomics and**

structural biochemistry approaches. PTDC/EBB-BIO/104980/2008 (2010-2013)

Patterns and processes of (neutral and adaptive) variation in the honey bee (*Apis mellifera iberiensis*) hybrid zone of the Iberian Peninsula: a population genetics approach integrating population genomics and landscape genetics. PTDC/BIA-BEC/099640/2008 (2010-2013)

METAFISHCODE. **Fish genetic diversity and meta-species phylogeography at global and regional scales: implications for fisheries management.** PTDC/MAR/101795/2008 (2010-2013)

RESCOE. **Risk assessment and ecological sustainability of Cork Oak in Montado ecosystems.** PTDC/BIA-BEC/102834/2008 (2010-2013)

Modeling of Complex Evolutionary processes. PTDC/FIS/70973/2006 (2010-2012)

CHIMERA: **Development of new chimeric proteins to be used in the fabrication of a novel biomaterial for bone regeneration application.** PTDC/EBB-EBI/109093/2008 (2009-2012)

Elucidation of ceramide-induced apoptosis: modulation of Protein Kinase C isoforms. PTDC/BIA-BCM/69448/2006 (2009-2012)

LUSOMARBOL. **Integrating molecular approaches into marine biodiversity research in Portugal: implementing DNA barcoding and investigating phylogeographic patterns.** PTDC/MAR/69892/2006 (2009-2012)

Implementation of a national facility for DNA microarrays:Phase II. PTDC/BIA-BCM/64745/2006 (2009-2012)

MONOLIPO. **Monoolein-Based Lipoplexes: Physiochemical characterization and study of their potential use as non-viral vectors.** PTDC/QUI/69795/2006 (2009-2012)

WARMING. **Predicting the effect of global warming on stream ecosystems.** PTDC/CLI/67180/2006 (2008-2011)

> Other National Projects

BIOZOOM: **Descobrir a Vida para inspirar o futuro!.** Ciência Viva (2013-2014)

DoIt. D**evelopment and Operation of Translational Research. QREN Projectos mobilizadores.** Project n. 13853 (2011-2014)

CBMA **Post-Graduated Training Programme. Programa de Actividades de Reforço da Capacidade Científica Fundação Calouste Gulbenkian** (2011-2012)

Ciência Viva (2008-2009)

Environment education Plan for the Malcata Natura 2000 site. ICNB (2008-2009)

Natural values GIS database for Malcata Natura 2000. ICNB (2008-2009)

Threaten factors GIS database for Malcata Natura 2000. ICNB (2008-2009)

Evaluation of Malcata Reserve as neutral Carbon protected area. ICNB (2008-2009)

Monitoring of Côa River ictiofauna at Malcata site. ICNB (2008-2009)

> European and International Projects

TRANSPROT. **New insights into structure, function and regulation of transport proteins.** Erasmus Intensive Programme 2013-1-PT1-ERA10-16664-P BRAGA01 (2013-2014)

GLYCOPHARM. **The sugar code: from (bio)chemical concept to clinics.** FP7-PEOPLE-ITN N. 317297 (2012-2016)

TOBEWELL. **Tourism, Wellbeing and Ecosystem Services.** COST ACTION N. ISI204 (2012-2016)

Engineering *S. cerevisiae* for the industrial utilization of bio-diesel glycerol wastes - Ciência sem Fronteiras – CAPES, Brasil (2012-2016)

TRANSBIO. **Biotransformation of by-products from fruit and vegetable processing industry into valuable BIOproducts.** FP7-KBBE N.289603 (2011-2015)

MARPRO. **Conservation of marine protected species in Mainland Portugal.** LIFE09 NAT/PT/00038 (2011-2015)

ECOPLAST. **Research in new biomass-based composites from renewable resources with improved properties for vehicle parts moulding.** FP7-NMP-SME N. 246176 (2010-2014)

FAME. **The future of the Atlantic Marine Environment. Atlantic Area** N.2009 -1/89 (2010-2013)

NANOFOL. **Folate-based nanobiodevices for integrated diagnosis/therapy targeting chronic inflammatory diseases.** FP7 NMP-

LA-2009 N.228827 (2009-2013)

INNOYEAST. **Innovation and Improvement of European Wine Industry Competitiveness by the Research and Development of Native Microencapsulated Wine Yeasts to Produce Quality Wine.** FP7 SME-2008 N.232454 (2009-2011)

Iberoamerican network for the molecular diagnosis of systemic and opportunistic mycoses. CYTED N. P207RT0353 (2008 – 2011)

SAFESEA. **Sustainable local fisheries and promotion of a safe sea for cetaceans.** EEA Grants N.PT0039 (2008-2011)

LUSOAQUABARCODE. **Implementing DNA barcoding into aquatic biodiversity research in Portugal and priming new macrobenthos monitoring tools.** FP7 Marie Curie Reintegration Grants N. PERG02 GA-2007-224890 (2008-2011)

> Industry research contracts

OLEOLEV - **Utilização da vinhaça de cana para produção de biodiesel e antiespumantes, visando a sustentabilidade ambiental através do desenvolvimento de um processo de biorefinaria integrada.** FERMENTEC Ltda. (2013)

Specialized genotyping. Uniferm BmgH (2011)

Ecosystem services assessment: identifying risks & opportunities arising from climate change – Sonae Sierra (2011)

Ecological Quality of the Aveiro Lagoon - Ambieco/Polis Litoral (2010)

Ecological Assessment of streams in North Portugal- Administração da Região Hidrográfica do Norte, IP (ARH) (2010)

Genotypic identification and characterization of yeast mycology collection, IVDP property - Instituto dos Vinhos do Douro e Porto, IP (IVDP) (2009)

Creation of a new baker yeast strain able to grow with industrial efficiency in glycerol from biodiesel. AB/MAURI (2008/09)

Monitoring Program of fauna (bats, otter/ Pyrenean desman, wolf, fish) and biological quality of water in Baixo Sabor Dam. Odebrecht/Bento Pedroso Construções & Lena Construções. (2008)

Monitoring Program of fauna - IC13 Road Alter do Chão, Crato & Portalegre. OPWAY (2008)

Selection of industrial yeasts. Proenol, Lda. (2008)

INTERNATIONAL ADVANCED COURSES

> 2013

Host-fungus interactions and virulence (15-26 April) -> 2nd Edition

Nanoparticles and the immune system: risks and therapeutic opportunities (5-14 June)

Ecotoxicology and environmental risk assessment (17-21 June) -> 2nd Edition

Mammalian and yeast cells as complementary cell models in Programmed Cell Death (17-28 June) -> 4th Edition

Protein degradation and trafficking in health and disease (17-28 June)

Next generation sequencing in environmental monitoring (1-12 July)

Pharmacological development: from organic synthesis to clinical trials (1-12 July) -> 2nd Edition

Cancer therapy: from basic research to clinic (15-26 July)

> 2012

Bionanosystems for biomedical application (30 April-11 May)

Mammalian and yeast cells as complementary cell models in Programmed Cell Death (17-28 June) -> 3rd Edition

Plasma membrane transporters: physiology, genetics and phylogeny (4-16 June) -> 4th Edition

Industrial yeast molecular systems biology (18-29 June)

A primer on taxonomic research and infrastructure for ecologists (9-20 July)

> 2011

Bioinformatics in health science (7-11 February)

Epidemiologia e Diagnostico Molecular de Micoses Oportunistas e Emergentes (7-11 February)

Global change and biodiversity: implications for ecosystems services. (9-13 May)

Molecular nutrition: dietary phytochemicals and age-related disease prevention (23 May - 3 June)

Biopolymers based on renewable resources: from synthesis to applications (6-17 June)

Biomarker discovery using multiplexed proteomic technology (20 June-1 July)

Mammalian and yeast cells as complementary cell models in Programmed Cell Death (4-15 July) -> 2nd Edition

River restoration: principles and practices (4-8 July)

> 2010

Mammalian and Yeast as Complementary Cell Models in Programmed Cell Death (3-14 May)

Methods of DNA Analysis: State of the Art (17-28 May)

Nanotechnologies Applied to Theranostics: from Diagnosis to Disease Therapy (14-23 June)

Plasma Membrane Transporters: Physiology, Genetics and Phylogeny (28 June-3 July) -> 3rd Edition

Industrial Yeast Molecular Systems Biology (12-23 July)

Integrative Assessment of Aquatic Ecosystem Health (14-23 July)

SCIENCE DISSEMINATION

2013

SEMINARS, FORA, DEBATES

Tertulias FNACiência Museu de História Natural no século XXI	FNAC
Tertúlia O futuro da Biologia em Portugal	Biblioteca Geral da Universidade do Minho

ARTICLES/INTERVIEWS IN JOURNALS, MAGAZINES AND BLOGS

"Acasos" felizes entre mentes astutas e bolores esverdeados - A. Nobre	Jornal Correio do Minho
Ponto a Ponto enche a Ciência o Espaço – STOL	Jornal Correio do Minho
Os principais agentes de reciclagem da matéria orgânica nos rios – S. Duarte	Jornal Correio do Minho
A masseira onde não se amassou só pão – M. J. Almeida	Jornal Correio do Minho
As the crisis deepens in Portugal.... – C. Lucas	Euroscientist
A quem pertencem os genes? – M. Casal	Jornal Correio do Minho
Vida no Extremo – T. Collins	Jornal Correio do Minho
Comece a tratar as bactérias por tu – M. J. Almeida	Jornal Correio do Minho
Coluna quinzenal: Aqui há Ciência - STOL	Jornal Diário do Minho
A jornada de Ingold na descoberta dos hifomicetos aquáticos: os principais agentes de reciclagem da matéria orgânica nos rios – S. Duarte	Jornal Correio do Minho
Biologia, Matemática e croché – uma Troika de sucesso – A. Nobre	Jornal Correio do Minho
Comunicar Ciência é trocar por miúdos – A. Nobre	Newsletter FCT – Nº8

TV AND RADIO INTERVIEWS

A personalidade vem no ADN? - M. Casal	Programa Sociedade Civil da RTP 2
Projeto MarPro - J. Vingada	Programa Biosfera RTP2

EXHIBITIONS ORGANIZATION/PARTICIPATION

Exposição Ciência e Arte - Membranas - modelo tridimensional de membrana plasmática.	Museu Nacional Soares dos Reis. Porto
Exposição Ciência e Arte - Ponto a Ponto enche a Ciência o Espaço - Instalação	Museu Nacional Soares dos Reis. Porto
Instalação Ponto a Ponto enche a Ciência o Espaço	Pavilhão do Conhecimento - Ciência Viva, Lisboa

Exposição Ver Arte Prever Ciência	Direção Regional de Cultura do Norte e o Mosteiro de Tibães
Exposição Era uma vez... Ciência para quem gosta de histórias	Pavilhão do Conhecimento - Lisboa
Exposição Microrganismos aos Quadradinhos - cartoons no âmbito da Microbiologia Aplicada	Museu Dom Diogo de Sousa - Braga
IN PARTNERSHIP WITH ECUM	
Noite Europeia dos Investigadores	UMinho
Festa da Ciência	UMinho
Programa Visitas ECUM 2013	UMinho
A Minha Escola de Ciências	Escolas do distrito de Braga e de Viana do Castelo
SCIENTIFIC EDUCATION FOR SCHOOL TEACHERS	
Ciência dos 3 aos 11: Atividades experimentais de Biologia e Ambiente, curso Pri-Sci-Net de Formação de Professores do ensino pré-escolar e do 1º e 2º ciclo do ensino básico. 1ª e 2ª Edição	UMinho
SCIENCE EDUCATION FOR NON GRADUATE STUDENTS	
O DNA vai à Escola	Escola Secundária de Paredes
A citometria de fluxo como ferramenta para o estudo da célula	Escola Secundária de Vila Verde
Ciência para todos - O DNA e a Vida	Colégio Teresiano - Braga
EDUCATIONAL PROJECTS	
Homo numericus	UMinho
BioCientistas de Palmo e Meio	UMinho
À descoberta do mini, do micro e do nano	Centro Cultural Vila Flor Guimarães
Viagem ao País dos Micróbios - Micróbios: Forças do Bem ou do Mal?	Centro Cultural Vila Flor Guimarães
SUMMER SCIENTIFIC ACTIVITIES	
Programa Ciência Viva no Laboratório	UMinho
OTHER ACTIVITIES	
Workshop A terapêutica do doente oncológico: o papel dos profissionais de saude	UMinho
Workshop Crochetar Biologia com dicas da Matemática	Mosteiro de Tibães
Noite Europeia dos Investigadores - Rómulo - Centro Ciência Viva da Universidade de Coimbra	Universidade de Coimbra

2012

SEMINARS, FORA, DEBATES

Tertulias FNACiência Como a Genética nos pode ajudar a compreender a história e evolução humanas Códigos do Direito e da Vida Bactérias do nosso quotidiano: de aliados fiéis a temíveis inimigos O ataque das invasoras	FNAC
Tertúlia XIII Jornadas de Biologia Aplicada Vida Artificial	Café Brasileira, Braga
Workshop LIFE+ MARPRO: Redes de arrojamentos e de reabilitação de animais marinhos	Figueira da Foz
Workshop LusoMarBol: encerramento do projeto	UMINHO
Portas Abertas à Ciência e à Tecnologia As Plantas e a Luz Micróbios que nos rodeiam	UMINHO

ARTICLES/INTERVIEWS IN JOURNALS, MAGAZINES AND BLOGS

Projeto SafeSea	Diário Económico
Projeto Transbio: Criação de Tecnologias Limpas – D. Schuller	Diário do Minho Correio do Minho
A atribuição do Prémio Nobel da Quimica 2012	Ciência Hoje
"Peter Mitchell da Teoria Quimiosmótica? Sim e também de algumas excentricidades..." A. Nobre "Gregor Mendel – Há quem chame pai a outro mas Genética Moderna não pode fazê-lo" A. Nobre	De Rerum Natura

TV AND RADIO INTERVIEWS

Descoberta molécula para atacar doenças como o cancro – S. Paiva	RTP 1
ProjetoTransbio: Criação de Tecnologias Limpas – D. Schuller	Porto Canal Rádio Universitária do Minho

EXHIBITIONS ORGANIZATION/PARTICIPATION

Exposição "Ponto a Ponto Enche a Ciência o Espaço"	UMINHO
Exposição fotográfica "De que é Feita a Ciência"	Braga

IN PARTNERSHIP WITH ECUM

iSci – Interface	UMINHO
Festa da Ciência	UMINHO
Noite dos Investigadores	UMINHO

SCIENTIFIC EDUCATION FOR SCHOOL TEACHERS	
O mundo microbiano que nos rodeia	Ordem dos Biólogos
SCIENCE EDUCATION FOR NON GRADUATE STUDENTS	
Bio-Cientistas de Palmo e Meio	Escolas de 1º ciclo da área de Braga
Somos Pó de Estrelas Nascidos nas estrelas	Colégio D. Diogo de Sousa, Braga
Microbiologia - o grande mundo das coisas pequenas	Colégio Teresiano, Braga
Invenções TOP 10... e a Vida Acontece	Escola Secundária Alberto Sampaio, Braga
EDUCATIONAL PROJECTS	
Feira das Ciências	Museu D. Diogo de Sousa
SUMMER SCIENTIFIC ACTIVITIES	
Campo de Férias AFUM Verão 2012 Micróbios que nos rodeiam e Língua para que te quero	Escolas de 1º ciclo da área de Braga
UMa Biologia no Verão	Ciência Viva
OTHER ACTIVITIES	
Chá sem TEDio	UMINHO
Concurso "Ciência num Click"	Nacional
Projeto de divulgação de ciência "Ciência com Todos"	Nacional
2013 - Ano da Matemática do Planeta Terra "A Matemática dos nossos avós"	Museu da Ciência da Universidade de Coimbra

2011

SEMINARS, FORA, DEBATES	
Tertulias FNACiência Códigos do Direito e da Vida Florestas Terrestres e Florestas Marinhas	FNAC
Portas Abertas à Ciência e Tecnologia As Plantas e a Luz Micróbios que nos rodeiam Língua para que te quero	UMINHO

Workshop Ecoplast Biopolymers based on renewable resources: from synthesis to applications	UMINHO
EcoTertúlia O preço da Biodiversidade	Estaleiro Cultural Velha-a-Branca
ARTICLES/INTERVIEWS IN JOURNALS, MAGAZINES AND BLOGS	
Acasos felizes – das lágrimas há noventa anos ao sorriso sete anos depois... A.Nobre	De Rerum Natura
Escola de Ciências da UMinho organiza passeio ao rio Cávado – C.Pascoal	Ciência PT; Diário do Minho; maisactual.pt; Correia do Minho
Efeitos do aquecimento global estudados na ribeira do Candal – F.Cássio e C.Pascoal	Diário de Coimbra
Ambiente: Investigação antevê efeitos do aquecimento global nos ecossistemas aquáticos - F.Cássio e C.Pascoal	www.lusa.pt
Ecossistemas aquáticos em perigo - F.Cássio e C.Pascoal	Ecossistemas aquáticos em perigo - F.Cássio e C.Pascoal
TV AND RADIO INTERVIEWS	
DNA Barcoding – Filipe Costa	Porto Canal
Divulgação das ações Biologia no Verão 2011 financiadas pela Ciência Viva: Claudia Pascoal, promove atividade no rio Cávado para avaliar a qualidade da água dos rios	Porto Canal
EXHIBITIONS ORGANIZATION/PARTICIPATION	
An ocean field research expedition and field oriented courses - Life project Marpro and Santa Maria Manuela	Festival dos Oceanos, Lisboa
SCIENTIFIC EDUCATION FOR SCHOOL TEACHERS	
O mundo microbiano que nos rodeia – beneficios e ameaças	Lisboa Editora
O mundo microbiano que nos rodeia	Ordem dos Biólogos
Das ervilhas de Mendel à ovelha Dolly: os caminhos da Genética	Professores do Grupo 520
Os sistemas fisiológicos – da teoria à prática	Professores do 2º ciclo do ensino básico
SCIENTIFIC EDUCATION FOR NON GRADUATE STUDENTS	
Bio-Cientistas de Palmo e Meio	Escolas de 1º ciclo da área de Braga
BioConcurso de Fotografia Científica	Academia estudantil em geral
CSI: Ciência sob investigação	Casas da Juventude e C. Municipal Matosinhos
Biotecnologia - uma grande história contada em pequenos retalhos	ES de Barcelos e ES de Ponte de Lima
O papel do poster na divulgação da ciência	Escola EB 2/3 de Lamaçães

PARTNERSHIPS IN EDUCATIVE PROJECTS	
Technical / scientific support on Fundação Ilídio Pinho Project	Escola Secundária de D. Maria II, Braga
Technical / scientific support on projects from the discipline of Área do projecto Biologia (12th grade)	Escola Secundária de Vizela
Evaluation of science projects from several grade students	EB 2,3 Vila Verde
SUMMER SCIENTIFIC ACTIVITIES	
UMa Biologia no Verão	Ciência Viva
O que nos contam os organismos que vivem nos rios sobre a saúde desses ecossistemas?	Ciência Viva

2010

SEMINARS, FORA, DEBATES	
Espécies invasoras e seus impactos no funcionamento dos ecossistemas	Centro de Monitorização e Interpretação Ambiental (CMIA) de Matosinhos
Biodiversidade no Campus da Caparica 2010 Códigos de barras de ADN (DNA barcodes): suas aplicações e perspectivas futuras para o conhecimento da biodiversidade oceânica	Universidade Nova de Lisboa
Programa LimparMar O impacte dos plásticos na fauna marinha	Câmara Municipal Figueira da Foz e Clube Náutico
Importância da biodiversidade	Associação Juvenil de Ciência (AJC), Fundação para a Juventude do Porto
ARTICLES/INTERVIEWS IN JOURNALS, MAGAZINES AND BLOGS	
BioCientistas Palmo e Meio	Correio do Minho e Diário do Minho
TV AND RADIO INTERVIEWS	
A investigação em reabilitação de fauna marinha – J. Vingada	Programa 4 x Ciência. RTP-N
SCIENCE EDUCATION FOR NON GRADUATE STUDENTS	
Biotecnologia - uma grande história contada em pequenos retalhos	ES Entre-os-Rios, ES Alcaides Faria, Barcelos e ES Artur Gonçalves, Torres Novas
BioCientistas de Palmo e Meio	UMINHO
SUMMER SCIENTIFIC ACTIVITIES	
UMa Biologia no Verão	Ciência Viva

Nem tudo o que vem à rede é peixe!	Ciência Viva

2009

SEMINARS, FORA, DEBATES

Darwin à moda D´UMinho De Darwin aos nossos dias: novas perspectivas no estudo da evolução	Braga
Semana da Ciência e da Tecnologia As células, os "blocos de construção"dos organismos Micróbios que nos rodeiam Língua para que te quero Animais aquáticos	UMINHO
Semana da União Europeia Microbiologia e Saúde: passado, presente e futuro	Biblioteca Lúcio Craveiro da Silva, Braga
A Divulgação Científica em Portugal	Museu de Arqueologia D. Diogo de Sousa, Braga

EXHIBITIONS ORGANIZATION/PARTICIPATION

Exposição de cartoons "Darwin 2009: Odisseia da Evolução	Centro Comercial Braga Parque e Museu Dom Diogo de Sousa

SCIENTIFIC EDUCATION FOR SCHOOL TEACHERS

Os Micróbios tão perto de nós	Ordem dos Biólogos

SCIENCE EDUCATION FOR NON GRADUATE STUDENTS

Microbiologia – ubiquidade e aplicação dos microrganismos no campo da saúde Microbiologia: bactérias em toda a parte Microbiologia na produção de iogurtes Organismos geneticamente modificados e alimentos derivados	Escola Secundária Padre Benjamim Salgado, Guimarães
Pilha de combustível microbiana	Escola Secundária Alves Martins, Viseu
O que é o Cancro?	Liceu Sá de Miranda, Braga
A água, um recurso (in)esgotável?	Escola Secundária Carlos Amarante, Braga

SUMMER SCIENTIFIC ACTIVITIES

Como se estudam os oceanos?	Ciência Viva
Vamos espreitar debaixo das pedras: a vida na zona entre marés	Ciência Viva
UMa Biologia no Verão	UMINHO

2008

SEMINARS, FORA, DEBATES

Simpósio Arte & Ciência - Projecto europeu Sentidos da Ciência Hereditariedade no feminino: o valor da maternidade aos olhos da arte.	UMINHO
IV Ciclo de Conferências do Instituto Superior de Ciências da Saúde do Norte O jogo dos genes – no limite da ciência - M. Casal	Edificio da Alfândega, Porto

SCIENTIFIC EDUCATION FOR SCHOOL TEACHERS

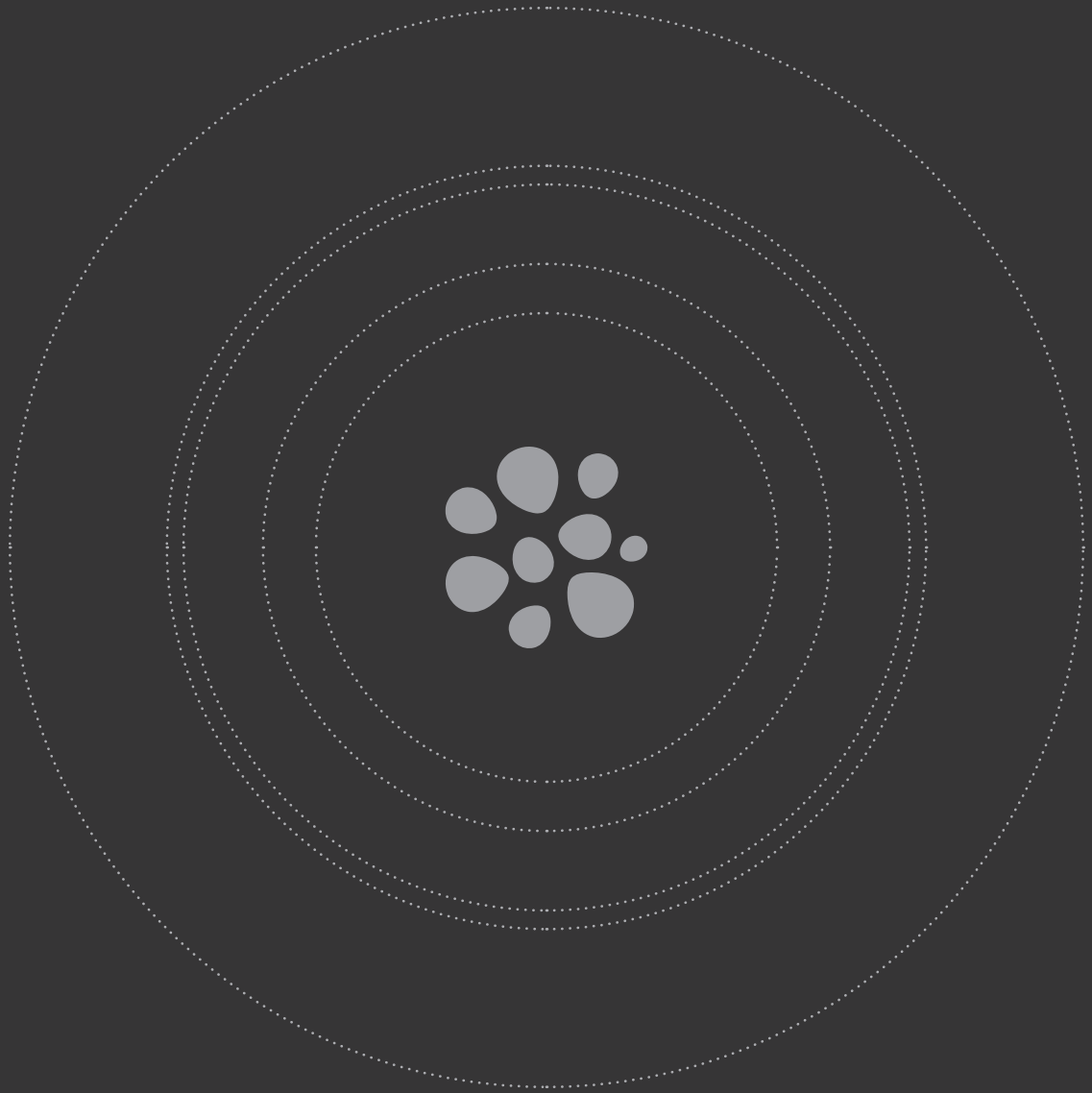
Oficina para Professores Genética Clássica e Molecular – dos conceitos às abordagens práticas	Ordem dos Biólogos

SCIENCE EDUCATION FOR NON GRADUATE STUDENTS

A gestão da água por espécies autóctones e exóticas existentes no monte S. Bento de Pêras (Vizela)	Escola Secundária de Vizela
Evolução e Biodiversidade	Escola EB 2/3 de Celeirós, Braga
Trissomia 21	Externato Infante D.Henrique, Ruílhe, Braga

SUMMER SCIENTIFIC ACTIVITIES

O que nos contam os organismos que vivem nos rios sobre a saúde desses ecossistemas?	Ciência Viva
Censos de pequenos cetáceos e aves marinhas na costa Atlântica Portuguesa	Ciência Viva



Universidade do Minho

FCT
Fundação para a Ciência e a Tecnologia
MINISTÉRIO DA EDUCAÇÃO E CIÊNCIA