

RAFAEL CARLOS REDING ROMAN

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Contact: reding@stanford.edu
Code: https://git.teknik.io/rc_reding/ and
<https://github.com/rc-reding/papers>

APPOINTMENTS

2020 – PRESENT POSTDOCTORAL RESEARCH FELLOW. Department of Genetics, Stanford School of Medicine (USA).

I) Development of milifluidics device for SARS-CoV-2 detection, combining LAMP to detect the virus in saliva samples and measuring detection using impedance readings. II) Molecular profiling of exosomes from SARS-CoV-2 patients using Smart-seq3.

Sponsor: Prof Lars Steinmetz.

2018 – 2020 BIOLOGY & SOFTWARE ENGINEER. BioDynamic Devices, Exeter (UK).

Co-developed a computer-vision spectrophotometer as part of the ERC Proof-of-Concept grant '*Microbiological fluorescence observatory for antibiotic resistance tracking*' (€149,249), where I was named researcher co-investigator. Here I developed early prototype of the device (breadboard circuitry, software, and biological assays) and later pre-commercial specifications. The startup company  BioDynamic Devices emerged from this project to seek commercialisation of the device. A patent is now pending for the device  (PCT/GB2020/050321).

2016 – 2020 ASSOCIATE RESEARCH FELLOW. Living Systems Institute, University of Exeter, (UK).

Designed data mining algorithms and mathematical models to study the adaptation to antibiotics in *Escherichia coli* and, particularly, the regulation of the multi-drug efflux pump AcrAB-TolC. I cross-referenced phenotypic data with whole-genome sequencing and quantitative PCR datasets to track the emergence and fate of mutations in the aforementioned bacterium. Drafted manuscripts for publications (10, plus thesis) and presentations for international conferences (11).

Supervisors: Prof Robert Beardmore, Prof Ivana Gudelj.

EDUCATION

2016 PhD IN BIOLOGICAL SCIENCES, University of Exeter, UK.

Thesis: *Ecological conditions leading to the sweep of antibiotic resistance genes in the model-type bacterium Escherichia coli*.  <https://hdl.handle.net/10871/19693>

Supervisor: Prof Robert Beardmore.

Degree award date: 15th February 2016.

2010 BSC IN BIOLOGY, University of Málaga, Spain.

PATENTS

2020  PCT/GB2020/050321 (PENDING) – Light Modulation (LiMo®) technology for the spatiotemporal analysis of biological samples: A high-throughput computer-vision device to incubate and measure the growth of microbial cultures in microtitre plates, with software-enabled optimisation of lighting conditions to increase detection sensitivity.
Contribution: Designed early prototype, developed and implemented API and python libraries, and designed the experimental protocols.

ASSOCIATED SOFTWARE

 https://git.teknik.io/rc_reding/ Server-side software, communication stack (socket), hardware control library (threading, pigpio, w1thermsensor, picamera), and stand-alone data analysis pipeline (numpy, scipy, opencv, multiprocessing) implemented as a python package (limoControl) under LGPL v2.1 license.

PUBLICATION LIST

PEER-REVIEWED JOURNALS

- 2021** Carlos Reding, Pablo Catalán, Gunther Jansen, Tobias Bergmiller, Philip Rosenstiel, Hinrich Schulenberg, Robert Beardmore. The Antibiotic Dosage of Fastest Resistance Evolution: gene amplifications underpinning the inverted-U. *Mol. Biol. Evol.*, msab025.
Contribution: Designed and performed experiments, analysed phenotypic and genomic data, wrote the manuscript.
- 2017** C. Reding-Roman, S. Duxbury, M. Hewlett, F. Gori, I. Gudelj and R. Beardmore. The unconstrained evolution of fast and efficient antibiotic-resistant bacterial genomes. *Nat. Ecol. Evol.* 1, 0050.
Contribution: Designed and performed experiments, analysed phenotypic and genomic data, wrote the manuscript.
- 2015** A. Fuentes-Hernandez, J. Plucain, F. Gori, R. Peña-Miller, C. Reding, G. Jansen, H. Schulenberg, I. Gudelj, and R. Beardmore. Using a Sequential Regimen to Eliminate Bacteria at Sub-Lethal Antibiotic Dosages. *PLoS Biol.* 13(4):e1002104.
Contribution: Calibration of optical density vs cell number, replicated experiments in Figures 4 and 5.
- 2014** R. Peña-Miller, A. Fuentes-Hernandez, C. Reding, I. Gudelj and R. Beardmore. Testing the optimality properties of a dual antibiotic treatment in a two-locus, two-allele model. *J. R. Soc. Interface*, 11:20131035.
Contribution: Evolutionary experiment to validate theoretical prediction when one drug (erythromycin) is used, analysed data.

PREPRINTS ARCHIVE

- 2021** Carlos Reding. Neighbours can modulate drug diffusion and change antimicrobial sensitivity of specific bacteria. (**undergoing peer-review in Biophysical Journal**).  bioRxiv 422780.
- 2021** Carlos Reding. Improving fitness estimates in populations with density-dependent growth (**undergoing peer-review in Microbiology Spectrum**).  bioRxiv 810259.
- 2021** Carlos Reding⁺, Mark Hewlett⁺, Tobias Bergmiller, Ivana Gudelj, Robert Beardmore. Imaging Fisher travelling waves in antibiograms: emergence of antibiotic-resistance patterns (**undergoing peer-review in Antibiotics**).  bioRxiv 806232.
Contribution: Co-developed device, wrote image analysis algorithm, performed experiments, data analysis, and wrote manuscript.
- 2020** Robert Beardmore, Mark Hewlett, Rafael Peña-Miller, Carlos Reding, Ivana Gudelj, Justin Meyer. Canonical trade-offs subverted by mutations with dual benefits.  bioRxiv 818492.
Contributions: Supervise and assist M. Hewlett in the quantitative analysis and graphic representation of evolutionary datasets.
- 2020** Pablo Catalán, Carlos Reding, Jessica Blair, Ivana Gudelj, Jon Iredell, R. Beardmore. Clinical Antibiotic Resistance Patterns Across 70 Countries.  bioRxiv 2020.12.04.411504v1.
Contributions: Proposed research question and hypothesis, and designed part of the analysis pipeline.
- 2020** Pablo Catalán⁺, Carlos Reding⁺, Robert Beardmore. Antibiotic resistance phenotypes exhibit diminishing returns in the chromosomal copy number of a scalable efflux operon.  Preprint.
Contributions: Performed evolutionary experiments, developed mathematical model, analysis of phenotypic and genomic data.

POSTERS & CONFERENCES

- MAY 2021** Presentation at “Bug Club”, held in the Department of Biology at Stanford University. Invited by Prof Ami Bhatt, MD and Prof Sharon Long.
- OCT. 2019** Department of Environmental Systems Science, ETH Zürich, Switzerland. Invited talk hosted by Prof Martin Ackermann. Zürich, Switzerland.
- SEPT. 2018** Wesmead Hospital, Sydney, Australia. Invited talk hosted by Prof Jonathan Iredell.

- MARCH 2018** Florey Institute Seminar Series. University of Sheffield, UK (Invited talk).
- SEPT. 2017** Mathematical Challenges from Life Sciences. University of Warwick, UK (Contributed talk).
- MAY 2017** Applied Bioinformatics & Public Health Microbiology. Wellcome Genome Campus, Hinxton, UK (poster).
- DEC. 2015** Third International Biannual Evolution & Cancer Conference (IBECC): Evolutionary Tradeoffs & Clinical Consequences. University of California San Francisco, USA (Contributed talk).
- APRIL 2015** Modelling Biological Evolution. University of Leicester, UK.
- JUNE 2014** BioDynamics Workshop, College of Engineering Mathematics and Physical Sciences. University of Exeter, UK (Contributed talk).
- MAY 2014** Systems Biology of Drug Resistance Evolution, Centre for Genomic Sciences, UNAM. Cuernavaca, Mexico (Contributed talk).
- SEPT. 2005** XI Congress of the Spanish Society of Neuroscience, University of Málaga, Málaga, Spain (poster).

GRANTS, AWARDS & RECOGNITIONS

SUCCESSES

- 2018** ERC Proof-of-Concept Grant ‘Microbiological fluorescence observatory for antibiotic resistance tracking’ with **me as researcher co-investigator**, with Profs Ivana Gudelj and Robert Beardmore as principal investigators (€149,249).
- 2017** University of Exeter Above & Beyond Recognition for Impact with the project ‘Lab in a Bag’ (£250).
- 2015** London Mathematical Society Travel Grant for Early Career Researchers (£102).

NEAR-SUCCESSES — THAT'S LIFE...

- 2018** BBSRC Discovery Fellowship Ecological mechanisms that control antibiotic sensitivity during polymicrobial infections, with Profs Simon Foster and Michael Brockhurst at University of Sheffield (UK, £375,000). **Score:** Excellent/Very Good/Very Good... but not funded.

TEACHING EXPERIENCE

UNIVERSITY OF EXETER

- 2011 – 2015** Demonstrator in the **undergraduate** courses Modern Theories of Evolution, Evolution & Informatics, Fundamental Principles, Research Skills & Bioethics (also *graduate teaching assistant*), and Genetics (also *statistics tutor*).
- 2012 – 2013** Demonstrator and graduate teaching assistant in the **postgraduate** course MSc Sequence Analysis & Structural Bioinformatics.
- 2012** Instructor in the **Global Challenges Workshop** held at the University of Exeter (UK) to introduce 1st-year undergraduate students how bioscience research addresses current problems in society.

LEADERSHIP ACTIVITIES

UNIVERSITY OF EXETER

- 2011 – 2015** Supervision of undergraduate students during their final-year project, including: Budget management, laboratory training and supervision, data analysis training and discussion of results.
- 2013** Member of the organising committee of the conference  **Quantitative Evolutionary Dynamics** held in Teignmouth (UK) bringing together speakers from Harvard, Cambridge, Oxford, and ETH Zürich—among others.

OUTREACH

- 2021 Designed a 3D printed 96-well pin replicator for a project led by Dr Magdalena Strinrück from IST Austria, where school children used pH indicator dyes to create droplet-pixelated, pH art.
- 2015 – 2017 Outreach activities in City of Stoke-on-Trent Sixth Form College in the UK (how many bacteria grow in peas, antibiotic properties of garlic, vinegar and lemon juice, and how to build a hawk-eye system with a smartphone).
- 2016 Co-organiser of the First NorthWest Science Summer School held at Staffordshire University (Stoke-On-Trent, UK).

ACADEMIC ACTIVITIES & MEMBERSHIPS

2021 – PRESENT Member of the **Biophysical Society**.

2020 – PRESENT Member of the **American Society for Microbiology**.

2020 – PRESENT Member of the **Society of Mathematical Biology**.

2020 Peer reviewer for the **Economic and Social Research Council (ESRC)**, UK.

REFERENCES

References in on-line form, **please contact them only if shortlisted**.

Prof Robert Beardmore,
Living Systems Institute,
University of Exeter (UK),
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Prof Pietro Cicuta,
Cavendish Laboratory,
University of Cambridge (UK)
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Assistant Prof. Pablo Catalan,
Department of Mathematics,
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