Guilhem Doulcier | Researcher

Ecology, Evolution and Applied Mathematics
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Employment

Postodoctoral Researcher **2021-2024**
Macquarie University *Sydney, Australia*
Research on the topic of Major Evolutionary Transitions. Based between the Theory and Method in Biosciences group (Sydney, Australia) and the Max Plank Institute for Evolutionary Biology (Plön, Germany). Part of an interdisciplinary team including Pierrick Bourrat (Philosopher, Macquarie University), Katrin Hammerschmidt (Evolutionary Microbiologist, Kiel University), Peter Takacs (Philosopher, University of Sydney).

Visiting Scholar **2020-2021**
University of Sydney *Sydney, Australia*
Invited by Pierrick Bourrat and Paul Griffith in the Theory and Method in Biosciences group to work on interdisciplianry problems in evolutionary biology and philosophy of science.

Postdoctoral Researcher **2019-2020**
Max Plank Institute for Evolutionary Biology *Plön, Germany*
Four months research position on Bayesian inference for experimental evolution, in the Theoretical Biology Department.

Consultant and Developer **2016-2018**
Millidrop Instrument SAS *Paris, France*
Hired by the Millidrop Instrument startup as a consultant and developer to build data analysis software for their flagship "Millidrop Analyzer".

Doctoral candidate **2016-2019**
Université Paris Sciences et Lettres *Paris, France*
Three years PhD position titled "Evolution of Collective-level Darwinian Properties" following a 2016 research project. Supervised by Paul B. Rainey (ESPCI Paris/MPI Plön), Silvia De Monte (IBENS) and Amaury Lambert (Sorbone University/Collège de France). Completed on the 2nd of December, 2019.

Laboratory Rotation and Internships

- **2016**: Studying collective heredity: theoretical foundations and practical solutions (*Paris, France*)
  In ESPCI Paris, Six months research project involving the modeling of the emergence of Darwinian characteristic at the collective level and the development of a signal processing and visualization pipeline for the high throughput phenotype analyzer developed by the

Millidrop start-up. Project supervised by Paul B Rainey (ESPCI Paris), Silvia De Monte (ENS) and Amaury Lambert (Collège de France).

- **2015**: Structure of natural bipartite networks (*Christchurch, New-Zealand*)
  In the University of Canterbury. Six months research project combining theoretical tools development, implementation, and application about the structure of plant-pollinator networks and their consequences. Project supervised by Daniel Stouffer.
- **2014-2015**: Impact of climate change and land use on meta-communities (*Montpellier, France*)
  In the Institut des Sciences de l'Évolution de Montpellier. Five months research project combining spatiotemporal modeling and data analysis, supervised by Sonia Kéfi and Vincent Devictor, about the impact of environmental and climatic variation on metacommunity composition.
- **2014**: Automatic taxonomic affiliation in viral metagenomic data (*Tucson, United-States*)
  In the University of Arizona. Five months research project supervised by Matthew Sullivan, about the automatic classification of the vast amount of viral sequence data gathered by the TARA expedition.
- **2013** Adaptive Evolution of Cell Adhesion in Microbes (*Paris, France*)
  In the Institut de Biologie de l'École normale supérieure. Two months research project on the evolution of multicellularity using adaptive dynamics. Supervised by Silvia De Monte

Education

Thèse de doctorat (PhD) **2016–2019**
Paris Sciences et Lettres University *Paris, France*
Ph.D in the interdisciplinary *Origins of Life* program (PSL University).

M2 Mathématiques et applications (MSc) **2015–2016**
Université Pierre et Marie Curie *Paris, France*
Master degree in applied mathematics (Biology Modeling curriculum).

Diplôme de l'École normale supérieure **2012–2016**
École normale supérieure *Paris, France*
Major in Biology, Minor in environmental sciences.

M1 Écologie-Biodiversité-Évolution **2013–2014**
École normale supérieure *Paris, France*
First year of a master degree in Ecology, Biodiversity and Evolution.

Licence de Biologie (BSc) **2012–2013**
École normale supérieure *Paris, France*
Bachelor Degree in Life Science

Classe préparatoire aux grandes écoles **2010–2012**
Lycée Joffre *Montpellier, France*
"Biologie Chimie Physique et Sciences de la Terre" section.

Baccalauréat scientifque, spécialité physique chimie **2007–2010**
Lycée André Chamson *Le Vigan, France*

High-school national diploma in science, physics and chemistry specialization.

Teaching

- **2023**: *Kiel University* (*Germany*), I took part in the "experimental evolution" course organised by Katrin Hammerschmidt.
- **2016-2019**: *Département de Biologie - École normale supérieure* (*Paris*), TA position for several lectures including "General computer science and unix" (L3), "Advanced Python programming" (L3) and "Mathematics for Biologists" (L3), "Modelling biological systems" (L3) as well as "Adaptive Dynamics" (M2). Course material: `www.normalesup.org/~doulcier/teaching/`.
- **2017**: *Kalvi Institute for Theoretical Physics,* (*Santa Barbara, CA*), I was a TA in the summer school "Eco-evolutionary dynamics of microbial community" as part of the Santa Barbara Research School for Quantitative Biology.
- **2013-2015**: *Groupe de travail mathématiques et biologie - École normale supérieure* (*Paris*), I gave the presentation about unsupervised classification in the "Mathematics and Biology" (2013) student work-group, I co-organized the "Game theory" workshop (2014). I also gave a lecture about the mathematics behind ecological niches (2015) and functional equations (2016).

Supervision

- **2021-2022** — Secondary supervisor of Agathe Chave, Studying the emergence of Darwinian properties at the collective level: modeling plasmid communities inside of cells (MSc. Biology department of ENS)

Fundings

- **2016** : *Origines et conditions d'apparition de la vie program - Paris Sciences et Lettres Research University*, I obtained a three years PhD funding.
- **2016** : *Concours de l'École doctorale Science du Végétal - Université Paris-Saclay*. I obtained a three years PhD funding which I turned down.

Scientific Communication

- Speaker — **Mathematical Models in Ecology and Evolution 2024**, Vienna (Austria). Invited in a symposium.
- Workshop Organisation — **Evolutionary transitions in Individuality 2023**, Plön (Germany).
- Speaker — **Ecology and Evolution: New perspectives and societal challenges, SFE 2022**, Metz (France).
- Speaker — **Mathematical Models In Ecology and Evolution 2022**, Reading (UK).
- Symposium Organisation and Speaker — **Philosophy of Science Association 2022**, Pittsburgh (USA).
- Speaker — **Paradox of the Organism Revisited**, 2022, Washington DC (USA).
- Speaker — **Mathematical Models In Ecology and Evolution 2019**, Lyon (France).
- Poster — **Gordon Research Conference on Microbial Population Biology 2019**, Andover (NH, USA).
- Speaker — **MPI workshop: Breathing Life into Chemistry**, 2019, Plön (Germany).
- Speaker — **MPI workshop: Evolutionary emergence of life cycles**, 2018, Plön (Germany).
- Speaker — **Evolution 2018**, Montpellier (France).
- Poster — **Evolution of Diversity Workshop**, Les Houches, 2018 (France).

- Speaker — **Models In Ecology and Evolution, 2017**, Montpellier (France).

Publications

Links are available on my ORCID profile: 0000-0003-3720-9089.

Published as Preprints

1. **Evolutionary dynamics of nascent multicellular lineages.** — Guilhem Doulcier, Philippe Remigi, Daniel Rexin, Paul B. Rainey. *BioRxiv* preprint.
2. **Why there are so many definitions of fitness in models.** — Daniel J. Smith, Guilhem Doulcier, Peter Takacs, Pierrick Bourrat, Joanna Masel. *Ecoevorxiv*, 2024.
3. **Individuality Through Ecology.** — Pierrick Bourrat, Peter Takacs, Guilhem Doulcier, Matthew C. Nitschke, Andrew J. Black, Katrin Hammerschmidt, Paul B. Rainey. *OSF* preprint, 2023.

Peer Reviewed and Published

1. **Stability of Ecologically Scaffolded Traits During Evolutionary Transitions in Individuality.** — Guilhem Doulcier, Peter Takacs, Katrin Hammerschmidt, Pierrick Bourrat. *Nature Communications*, 2024.
2. **Neutral Diversity in Experimental Metapopulations.** — Guilhem Doulcier, Amaury Lambert. *Theoretical Population Biology*, 2024.
3. **Rapid dissemination of host-metabolism-manipulating transposon-like entities via integrative and conjugative elements.** Elena Colombi, Frederic Bertels, Guilhem Doulcier, Ellen McConnell, Tatyana Pichugina, Kee Hoon Sohn, Christina Straub, Honour McCann, Paul B. Rainey. *PNAS*, 2023.
4. **Evolutionary Transitions in Individuality and Life Cycle Closure.** — Guilhem Doulcier, Peter Takacs, Pierrick Bourrat. *Philosophy of Science*, 2023.
5. **From Fitness-Centered to Trait-Centered Explanations: What Evolutionary Transitions in Individuality Teach Us About Fitness.** — Peter Takacs, Guilhem Doulcier, Pierrick Bourrat. *Pilosophy of Science*, 2023.
6. **Tradeoff breaking model of evolutionary transitions in individuality and the limits of the fitness-decoupling metaphor.** — Pierrick Bourrat*, Guilhem Doulcier*, Caroline J Rose, Paul B Rainey, Katrin Hammerschmidt, *eLife*, 2022. (* These authors contributed equally to this work).
7. **Life history tradeoffs, division of labor and evolutionary transitions in individuality.** — Guilhem Doulcier, Katrin Hammerschmidt, Pierrick Bourrat, 2021. In *Evolution of Multicellularity* edited by Matthew D. Herron, Peter L. Conlin and William C. Ratcliff, CRC Press.
8. **A leader cell triggers end of lag phase in populations of Pseudomonas fluorescens.** — Maxime Ardré, Guilhem Doulcier, Naama Brenner, Paul B. Rainey. *microLife*, 2022.
9. **Taming fitness: Organism-Environment Interdependencies Preclude Long-Term Fitness Forecasting** — Guilhem Doulcier, Peter Takacs, Pierrick Bourrat, *BioEssays*, 2020.
10. **Eco-evolutionary dynamics of nested Darwinian populations and the emergence of community-level heredity** — Guilhem Doulcier, Amaury Lambert, Silvia De Monte, Paul B. Rainey, *eLife*, 2020.
11. **Evolution of Collective-level Darwinian Properties.** Guilhem Doulcier, PhD Thesis, *Uni-*

versité Paris Sciences et Lettres, 2019.

12. **Experimental manipulation of selfish genetic elements links genes to microbial community function** — Steven D. Quistad, Guilhem Doulcier, Paul B. Rainey, *Phil. Trans. R. Soc. B*, 2019.
13. **Aridity leads to shifts in microbial communities and severe implications under a changing climate** — Manuel Delgado-Baquerizo, Guilhem Doulcier, David J. Eldridge, Daniel Stouffer, Fernando T. Maestre, Noah Fierer, Jeff. R. Powell, Thomas C. Jeffries, Brajesh K. Singh, *Land Degradation Development*, 2019.
14. **A General framework to assess species contribution to community changes** — Pierre Gausere*, Guilhem Doulcier*, Vincent Devictor, Sonia Kefi, *Ecological Indicators*, 2019, (* These authors contributed equally to this work).
15. **VConTACT: An IVirus Tool to Classify Double-Stranded DNA Viruses That Infect Archaea and Bacteria** — Benjamin Bolduc, Ho Bin Jang, Guilhem Doulcier, Zhi-Qiang You, Simon Roux, and Matthew B. Sullivan. *PeerJ*, 2017.
16. **The evolution of adhesiveness as a social adaptation** — Thomas Garcia*, Guilhem Doulcier*, Silvia De Monte, *eLife*, 2015, (* These authors contributed equally to this work).
17. **Patterns and ecological drivers of ocean viral communities** — Jennifer R. Brum*, J. Cesar Ignacio-Espinoza*, Simon Roux*, Guilhem Doulcier, Silvia G. Acinas, Adriana Alberti, Samuel Chaffron, Corinne Cruaud, Colomban de Vargas, Josep M. Gasol, Gabriel Gorsky, Ann C. Gregory, Lionel Guidi, Pascal Hingamp, Daniele Iudicone, Fabrice Not, Hiroyuki Ogata, Stéphane Pesant, Bonnie T. Poulos, Sarah M. Schwenck, Sabrina Speich, Celine Dimier, Stefanie Kandels-Lewis, Marc Picheral, Sarah Searson, Tara Oceans Coordinators, Peer Bork, Chris Bowler, Shinichi Sunagawa, Patrick Wincker, Eric Karsenti, Matthew B. Sullivan, *Science*, May 2015. (* These authors contributed equally to this work).

Skills

- **Languages:** French (native speaker), English (fluent).
- **Computer programming:** Python (Numpy, Matplotlib, Pandas), C (HPC with OpenMP).
- **Computer software:** R, Parallel computing with grid engines, Unix tools, GNU/Linux system administration.
- **Web developpment:** HTML/CSS, SQL, Javascript (Data visualisation with D3js).
- Driver's licence

Selected contributions to Free and Open Source software for scientific research

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Links are available on my homepage: www.normalesup.org/∼doulcier

- **Matpopmod** (2021-ongoing, Python): Analysis of Matrix Population Models (beta).
- **Colgen** (2019-ongoing, Python): Visualization and Bayesian analysis of collective level genealogies
- **Dropsignal** (2016-2020, Python and Javascript): Signal processing for millifluidic experiments.
- **ULM** (2015-2017, Pascal): Population dynamics simulations.
- **rnetcarto** (2014-2015, R and C): R-package for modularity optimisation of graph partition.
- **VContact** (2013-2014, Python): publicly-available tool for large-scale automated virus classi-

fication.

Community involvement

- **Association Écocampus ENS :** (*President for the year 2013*), Environmental association of ENS students.
- **Club CPN en pays viganais :** (*President for the years 2011-2012*), Naturalist and DIY straw bale house building association.