Dr Christian Yates

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Academic Employment and Qualifications

2014-Present **Lecturer** in the Department of Mathematical Sciences, University of Bath.

2011-2015 **Junior Research Fellow** (independent researcher)**, Christ Church,** University of Oxford.
Associate research fellow on the 2020 science project.

2007-2011 **D.Phil. (PhD)** at the **Oxford Systems Biology Doctoral Training Centre** and the **Centre for Mathematical Biology** **(EPSRC/BBSRC funding and stipend)**:

- Supervised/Advised by **Prof. Philip Maini, Dr. Ruth Baker** and **Dr. Radek Erban**.
- Title: "Comparing stochastic discrete and deterministic continuum models of cell migration".
- First student to pass/graduate from the Systems Biology Doctoral Training Centre.

2006-2007 **M.Sc.** in **Mathematical Modelling and Scientific Computing - Distinction**
Somerville College, University of Oxford **(EPSRC funding and stipend)**:

- Dissertation **"On the Dynamics and Evolution of Self-Propelled Particle Models"** awarded best in the year.

2003-2006 **Mathematics BA - 1st class honours. Somerville College**, University of Oxford.

Academic Prizes and Awards

2016 2016 – BBSRC STARS grant for the REP-MB (Research experience placements in Mathematical Biology) programme. 12 Mathematical Biology Summer internships spread over 3 years (£30k).

2016 Vice Chancellor's award for public engagement (winner - £2k).

2015 Vice Chancellor's award for public engagement (runner-up).

2015 London Mathematical Society research in pairs grant (£550).

2014 Silver award in the Mathematics section of the national 'SET for Britain' poster competition (£2k).

2013 Nuffield/LMS Undergraduate Research Grant. Stipend for undergraduate student to work on an 8 week modelling project.

2013 Poster prize at the 18th meeting of the European Society for Pigment Cell Research (September 2013, Lisbon).

2013 The Cheadle Hulme School Distinguished Alumnus Award (for mathematical outreach).

2012 ESMTB Reinhart-Heinrich Doctoral Thesis Award (runner up).

2009-2011 Leathersellers' Scholarship (St Catherine's College) - £3,000 p.a. - For academic achievement.

2009-2011 Martin Senior Scholarship (Worcester College) - For academic achievement.

2009 SIAM Student Travel Award - To present a paper at a SIAM conference on dynamical systems in Utah, USA.

2009 Worcester College Academic Travel Award - For the above conference.

2008 Inaugural Microsoft Research European Science Initiative Award - For the best short project in the Systems Biology Doctoral Training Centre, Oxford.

2007 The Nuclear Electric Prize - For attaining the highest marks in the year in the Mathematical Modelling and Scientific Computing M.Sc., Oxford.

2006 Mary Somerville Prize - For obtaining a degree in the first class in Mathematics finals.

Academic Fellowships and memberships

Fellow of the Institute for Mathematics and its applications (FIMA).
Fellow of the Higher Education Academy (FHEA).
Member of the Society for Mathematical Biology.
Member of the London Mathematical Society.

Teaching

2014-Present Lecturer and tutor in applied mathematics at the University of Bath.

- Lectured courses in Advanced Mathematical Biology, Mathematical Biology II, Modelling Dynamical Systems, Stochastic Methods.

2012-2014 Lecturer to D.Phil. students in Oxford's Doctoral Training Centres.

2011-2014 Lectureships at Christ Church and Somerville College (University of Oxford):

- First and second year undergraduate Applied Mathematics courses: Calculus of One variable, Calculus of Two or More Variables, Partial Differential Equations in Two Dimensions and Applications, Fourier Series and Partial Differential Equations,

Dynamics/Mechanics, Fluid Dynamics and Waves, Classical Mechanics, Calculus of Variations, Multivariable Calculus, Differential Equations.

- Admissions interviewer, Collections examiner.

Departmental Class Tutor.

2006-2009 Tutored/mentored students with Asperger's syndrome.

Supervision

Current Students

Michael Bentley (Oxford - Plants - PhD student) - "Molecular evolution of cooperative traits in bacteria".
George Chappelle (Bath - Maths - MMath and REP_MB summer placement) - "Representing cell-cell pushing in models of cell migration".
Enrico Gavagnin (Bath - Maths - PhD student) - Representing pigmentation mammalian pigmentation patterns with stochastic individual-based models.
Chris Lester (Oxford - Maths - PhD student) - "Stochastic modelling of biochemical reaction networks".
Jennifer Owen (Bath - Biology and Biochemistry - PhD student) - "Understanding zebrafish pigmentation patterns through mathematical modelling".
Robert Ross (Oxford - Maths - PhD student) - "Modelling cell migration, proliferation, and interactions on growing domains".
Cameron Smith (Bath - Maths - PhD student) - "Hybrid methods for simulating stochastic reaction diffusion processes".
Paul Taylor (Oxford - Maths - PhD student) - "Stochastic lattice models of diffusion in biological systems".
Annekatherine Wilkins (Oxford - Biochemistry - PhD student) - "*Caenorhabditis elegans* as a vector of repellent pathogens".

Former students

Mr Jonathan Harrison (M.Math. and Nuffield/LMS Undergraduate Research Bursary 2013/14) - "A stochastic-deterministic hybrid model for representing reaction-diffusion equations".
Mr Tom Howe (Bath - M.Math. 2015) – "Developing hybrid PDE-volume exclusion process models for cell migration".
Mr Jake Taylor-King (Oxford - M.Sc. 2013) - "Hard-sphere velocity-jump processes: applications to swarm robotics".
Mr Christopher Lester (Oxford - M.Math. 2013) - "The stochastic modelling of biochemical reactions".
Jennifer Owen (Bath - M.Math. 2016) - "Modelling embryonic cell migration in mouse development".
Mr Christopher Paroussis (Oxford - M.Sc. 2012) - "Multi-level Monte Carlo methods for biological systems".
Mr James Peters (Oxford - M.Math. 2014) - "Pushing in exclusion process models of cell migration".
Mr Konstantinos Sakellariou (Oxford - M.Res. 2012) - "Investigation of cellular dispersal in perineural tumour invasion through random walk models".
Mr Cameron Smith (Bath - M.Math. 2016) - "Hybrid methods for simulating diffusion on fixed and growing one-dimensional domains".
Dr Robin Thompson (Oxford - M.Math. and Nuffield Foundation Undergraduate Research Bursary 2011) - "Modelling cell migration and adhesion during development".

Reviewing Duties

2010-Present Reviewer for Bulletin of Mathematical Biology, Biophysical Journal, Journal of Mathematical Biology, Journal of Theoretical Biology, Journal of the Royal Society Interface, Mathematical Biosciences, Open Biology, Physica A, Physica D, PLoS Computational Biology, PlosOne, Physical Review E, Physical Review Letters, Reproduction.

Reviewer of grant proposals for Air Force Office of Scientific Research, USA.

Academic Responsibilities

2015-Present Centre for Mathematical Biology **seminar coordinator.**

- Inviting and hosting speakers for weekly interdisciplinary meetings.

2015-Present **Widening participation**, **outreach and Engagement** officer.

- **Encouraging participation** in university and, in particular, Mathematics from underrepresented groups.
- **Engagement** with the general public on research and non-research mathematics.

2014-Present DPhil/PhD **viva examiner.**
2013-2014 Doctoral Training Programme **viva and project examiner** and MMath **project examiner**.
2009-Present Academic referee for undergraduate and graduate students.
2009-2010 **Organiser** of the Junior Applied Mathematics Seminar (JAMS) series:
2009-2010 **Vice President** of the Oxford SIAM Student Chapter:
2008-2009 Worcester College **MCR President.**
2003-2004 Somerville College **JCR Chairman/First year officer.**

Public Science Engagement

2016	Work on animal pigmentation patterns covered by Reuters, the Guardian, the Telegraph, the Daily Mail, The Mirror amongst others. Over 30k reads on the Conversation.
2015	Locust research covered on BBC radio 4's Today programme, Reuters, RTE - Ireland's national broadcaster and the BBC world service amongst others. Over 60k reads on the Conversation.
2014-present	University of the West of England and University of Bath Royal Institution Mathematical Masterclass lecturer.
2012-present	University widening participation taster day.
2014	Ignite talks titled "What is Mathematical Biology?"
2014	Sparks podcast on Mathematical Biology and Alan Turing.
2013	Mathematical consultant on "Dara O'Briain's school of hard sums" TV show (series 3).
2012	Appeared on BBC's consumer affairs programme Watchdog on the maths of mortgages. Freelance writer for **The Times**. Articles on the mathematics of the Olympics and the mathematics of flight. Mathematical consultant on "Dara O'Briain's school of hard sums" TV show (series 2). Problem setter for **The Times** series of books "Everything is mathematical".
2011-Present	Director and trustee of "MathsWorldUK", the U.K.'s fledgling Mathematical Museum project.
2011	Appeared on the BBC's flagship science programme Bang Goes the Theory discussing the properties of conic sections with Dr Yan Wong. Mathematical consultant on "Dara O'Briain's school of hard sums" TV show (series 1).
2009-2011	**Sub-editor** of and contributor to the Oxford Student science magazine Bang! • Editing (for content and style) three popular science articles per issue. • Contributions include "The poetry of pi", "To infinity and beyond" and "The Domino Effect".
2010-2011	Consultant for the "Maths in the City" walking tours project with Professor Marcus Du Sautoy.
2009-Present	STEM ambassador – developing and delivering a range of widening participation events.
2009-2015	Senior member of **mathematical out-reach group** M^3 (The mathemagicians with Professor Marcus Du Sautoy): • Opened the Oxfordshire Science Festival 2010 with a talk on the Mathematics of Music. • Talk with Professor Marcus Du Sautoy at Science Oxford - "An ABC of 123". • Mathematical Biology event at the Manchester Science festival. • A variety of school out-reach days, science festivals and carnivals.

Other Attributes

Programming: MATLAB (advanced), **C++** (proficient), **Maple** (proficient).
I.T.: Proficient **Linux** and **LaTeX** user and user of **Office** programmes.
Languages: French, good written and spoken.

Publications

1. J.U. Harrison and C.A. Yates (2016). "A hybrid algorithm for coupling PDE and compartment-based dynamics". *J. R. Soc. Int. (In press).*
2. B. Franz, J.P. Taylor-King, **C.A. Yates**, R. Erban (2016). "Hard-sphere interactions in velocity jump models". *Phys. Rev. E (PRE) (In press).*
3. R.J.H. Ross, R.E. Baker, C.A. Yates (2016) "How domain growth is implemented determines the long-term behavior of a cell population through its effect on spatial correlations". *Phys. Rev. E (PRE) (In press).*
4. P.R. Taylor, M.J. Simpson, R.E. Baker and **C.A. Yates**, (2016) "Coupling volume-excluding compartment-based models of diffusion at different scales: Voronoi and pseudo-compartment approaches". *Journal of the Royal Society Interface (JRSI).* 13(120).
5. Lester, R.E. Baker, M.B. Giles and **C. Yates** (2016). "Extending the multi-level method for the simulation of stochastic biological systems". *Bull. Math. Bio. (In press).*
6. R.L. Mort*, R.J.H. Ross*, K.J. Hainey, O. Harrison, M.A. Keighren, G. Landini, R.E. Baker, K.J. Painter, I.J. Jackson, **C.A. Yates** (2016). "**Reconciling diverse mammalian pigmentation patterns with a fundamental mathematical model**" *Nat. Comms* 7 10288. Supplementary material to accompany this paper can be found here.
7. P.R. Taylor, **C.A. Yates**, M.J. Simpson, R.E. Baker (2015) " **Reconciling transport models across scales: The role of volume exclusion**". *Phys. Rev. E (PRE)* 92(4) 040701
8. L. Dyson*, **C.A. Yates***, J. Buhl A.J. McKane (2015). "**Onset of collective motion in locusts is captured by a minimal model**" *Phys. Rev. E (PRE)* 92(5) 052708. Supplementary material to accompany this paper can be found here.
9. **C.A. Yates**, A. Parker and R.E. Baker (2015) "**Incorporating pushing in exclusion process models of cell migration**" *Phys. Rev. E (PRE)* 91(5) 052711.
10. **C.A. Yates** and M.B. Flegg (2015) "**The pseudo-compartment method for coupling PDE and compartment-based models of diffusion**" *Journal of the Royal Society, Interface (JRSI)* 12(106) 20150141. Supplementary material to accompany this paper can be found here.
11. R.J.H. Ross, **C.A. Yates** and R.E. Baker (2015). "**Inference of cell-cell interactions from population density characteristics and cell trajectories on static and growing domains**" *Mathematical Biosciences* 26(11) 108-118.

12. B, Knapp, R. Bardenet, ..., **C.A. Yates**, D. Gavaghan and C.M. Deane (2015). "**Ten simple rules for a successful cross-disciplinary collaboration**" *PLoS Computational Biology* 11(4) e1004214.
13. J. P. Taylor-King, B. Franz, **C.A. Yates** and R. Erban (2015). "**Mathematical Modelling of Turning Delays in Swarm Robotics**" (Accepted for *IMA Journal of Applied Mathematics*).
14. P. Taylor, R.E. Baker and **C.A. Yates** (2015). "**Deriving appropriate boundary conditions, and accelerating position-jump simulations, of diffusion using non-local jumping**" *Physical Biology* 12(1) 016006.
15. C. Lester, **C.A. Yates**, M.B. Giles, and R.E. Baker (2015). "**An adaptive multi-level simulation algorithm for stochastic biological systems**" *Journal of Chemical Physics* 142(2) 024113.
16. **C.A. Yates** (2014). "**Discrete and continuous models for tissue growth and shrinkage**" *Journal of Theoretical Biology (JTB)* 350 37-48.
17. J.M. Osborne, M.O. Bernabeu ... **C.A. Yates** et al. (2014) "Ten Simple Rules for Effective Computational Research" *PLoS Computational Biology* 10(3) e1003506. Supplementary material to accompany this paper can be found here.
18. **C.A. Yates** and R.E. Baker (2013). "**The importance of the Voronoi domain partition for position-jump reaction-diffusion processes on non-uniform rectilinear lattices.**" *Physical Review E (PRE)* 88(5) 054701. Supplementary material to accompany this paper can be found here.
19. G. Rosser, A.G. Fletcher, D.A. Wilkinson, J.A. de Beyer, **C.A. Yates**, J.P. Armitage, P.K. Maini and R.E. Baker (2013). "**Novel methods for analysing bacterial tracks reveal persistence in *Rhodobacter sphaeroides***" *PLoS Computational Biology* 9(10) e1003276
20. **C.A. Yates** and R.E. Baker (2013). "**Isotropic model for cluster growth on a regular lattice**". *Physical Review E (PRE)* 88(2) 023304.
    Supplementary material to accompany this paper can be found here.
21. **C.A. Yates** and G. Klingbeil (2013). "**Recycling random numbers in the stochastic simulation algorithm**" *Journal of Chemical Physics (JCP)* 138(9) 094103.
22. **C.A. Yates**, R.E. Baker R. Erban and P.K. Maini (2012). "**Going from microscopic to macroscopic on nonuniform growing domains**" *Physical Review E (PRE)* 86 021921. Supplementary material to accompany this paper can be found here.
23. **C.A. Yates** (2012) "Comparing stochastic discrete and deterministic continuum models of cell migration". *ESMTB Communications* 1(15) 31-36.
24. R. Thompson, **C.A. Yates** and R.E. Baker (2012). "**Modelling cell migration and adhesion during development**" *Bulletin of Mathematical Biology* 72(12) 2793-2809.
25. T. Wood, **C.A. Yates**, D. Wilkinson and G. Rosser (2012). "**Simplified multitarget tracking using the PHD filter for microscopic video data**". *IEEE Transactions on Circuits and Systems for Video Technology (IEEE. T. Circ. Syst. Vid.)* 22(5) 702-713.
26. **C.A. Yates** and K. Burrage (2011). "**Look before you leap: A confidence-based method for selecting species criticality whilst avoiding negative populations in τ-leaping**". *Journal of Chemical Physics (JCP)* 134, 084109.
27. **C.A. Yates**, R. Baker, R. Erban and P.K. Maini (2011). "**Refining self-propelled particle models for collective behaviour**". *Canadian Applied Math Quarterly (CAMQ)* 18(3).
28. C. Escudero, **C.A. Yates**, J. Buhl, I.D. Couzin, R. Erban, I.G. Kevrekidis (2010). "**Ergodic directional switching in mobile insect groups**". *Physical Review E (PRE))* 82(1) 11926.
29. R.E. Baker, **C.A. Yates** and R. Erban (2009). "**From Microscopic to Macroscopic Descriptions of Cell Migration on Growing Domains**". *Bulletin of Mathematical Biology* 72(3) 719-762.
30. **C.A. Yates**, R. Erban, C. Escudero, I. Couzin, J. Buhl, I. Kevrekidis, P. Maini and D. Sumpter, (2009). "**Inherent noise can facilitate coherence in collective swarm motion**". *Proceedings of the National Academy of Sciences (PNAS)* 106(14) 5464-5469.
    Supplementary material to accompany this paper can be found here.

Papers submitted and in preparation

- R.J.H. Ross, C.A. Yates and R.E. Baker (2016). "**Pattern formation and variable species densities are induced by domain growth**". *Phys. Rev. E (under review)*.
- R.J.H. Ross, R.E. Baker and C.A. Yates (2016). "**The effect of domain growth on spatial correlations**". *J. of Theor Biol. (under review)*.
- R.J.H. Ross, R.E. Baker and C.A. Yates (2016). "**Using approximate Bayesian Computation to quantify cell-cell adhesion parameters in cell migratory processes**". *Nature publishing group Systems Biology and Applications (In preparation)*.
- M. Malickova, C.A. Yates, K. Bodova (2016). **A stochastic model of ant trail following with two pheromones**" (under review at *Journal of the Royal Society Interface (JRSI)*).
- M. Bentley, C.A. Yates, J. Hein, G. Preston, K. Foster (2016) "**Molecular evolution of cooperative traits in bacteria**" (In preparation).
- M.C. Stoddard*, C.A. Yates* and Rick Prum (2016)"**How the eggshell got its spots: a computational model of avian eggshell pigmentation patterns**" (In preparation).
  * Denotes joint first authorship.

Selected Talks

06-2016	Invited speaker at the SMB/ECMTB conference minisymposium Spatial patterning at the single cell level "Connecting coarse- and fine-grained volume excluding models of diffusion".
07-2016	Invited speaker at the Evolution group seminar series at the University of Bath Biology and Biochemistry Department. "Hybrid frameworks for modelling cell migration".
06-2016	Invited speaker at the Spatially Distributed Stochastic Dynamical Systems in Biology as part of the Newton Institute programme on Stochastic Dynamical Systems in Biology: Numerical Methods and Applications. "Hybrid frameworks for modelling cell migration".

05-2016 Invited speaker at the Cell and Developmental Biology Seminar series at the University of Bath Biology and Biochemistry Department. "Hybrid frameworks for modelling cell migration".

05-2016 Invited speaker at the applied non-linear mathematics Seminar at the University of Bristol Engineering Department. "Hybrid frameworks for modelling cell migration".

04-2016 Invited speaker at the workshop on "fluctuation-driven phenomena in biological systems" at the University of Warwick Mathematics department. "Hybrid frameworks for modelling cell migration".

11-2015 Invited speaker at University of Birmingham Applied Mathematics Seminar.

10-2015 Invited speaker at the Biomath seminar series, Chalmers University, Gothenburg, Sweden.

09-2015 Contributed talk at the IMA Conference on Numerical Methods for Simulation, University of Oxford, "The pseudo-compartment method for coupling PDE and compartment-based models of diffusion".

06-2015 Speaker, chair and organizer at SMB mini-symposium on "Multiscale hybrid modelling of stochastic reaction-diffusion systems", Atlanta, Georgia, "The pseudo-compartment method for coupling PDE and compartment-based models of diffusion".

03-2015 Invited speaker at the SAMBa Mathematical Biology month seminary series, University of Bath.

02-2015 Invited speaker at the Condensed Matter Theory group meeting, University of Bath "Discrete-state Multi-level simulation for modelling biological processes."

11-2014 Invited speaker at the BIRS workshop on "Particle-based stochastic Reaction-Diffusion Models in Biology" in Banff, Canada, "A PDE/compartment hybrid method for simulating stochastic reaction-diffusion systems."

10-2014 Invited speaker, the "Imperial Biomaths" seminar series, Imperial College London, "Discrete-state Multi-level simulation for modelling biological processes."

06-2014 Speaker, chair and organizer at ECTMB mini-symposium on "Position-jump models of biological processes on irregular lattices", Gothenburg, Sweden, "Relevance of the Voronoi domain partition for position-jump reaction-diffusion processes on non-uniform rectilinear lattices".

06-2014 Invited speaker at ECTMB mini-symposium on "Collective motion of fewer than 100 particles", Gothenburg, Sweden, "Spatial "self-propelled particle" and non-spatial "reaction-network" models explain locust swarm cohesion".

05-2014 Invited speaker, CoMPLEX, University College London, "Modelling Melanocyte cell migration".

03-2014 Invited speaker, School of Physics and Astronomy, University of Manchester. "Revisiting locust switching behaviour".

11-2013 Invited speaker at the Department of Mathematical Sciences, University of Essex. "Modelling Melanocyte cell migration".

10-2013 Invited speaker, School of Physics and Astronomy, University of Manchester. "Modelling Melanocyte cell migration".

11-2012 Invited speaker, Mathematical Biology seminar, Heriot-Watt University.

10-2012 Invited speaker, statistics workshop, University of Oxford. "From Antigenic variation to antZ".

07-2012 Invited speaker, University of Hakodate, Japan.

05-2012 2020 science seminar series. "From Antigenic variation to AntZ".

03-2012 Invited speaker, CoSy Lunch Seminar series, University of Uppsala, Sweden. "Modelling cell migration: from discrete to continuous".

02-2012 Invited speaker, Computational Biology group meeting, University of Oxford. "Stochastic modelling: From locusts to egg-shells".

05-2011 Applied mathematics talk, University of Oxford mathematics open day for prospective undergraduate students.

04-2011 Talk/discussion "Return to Eden: how biologically relevant can on-lattice models *really* be?", Oxford Cell-Based Modelling series.

10-2010 Invited Speaker, Math-Bio-Medicine (MBM) seminar series, University of Leeds. "United by noise: randomness helps swarms stay together".

09-2010 Invited speaker, Culham Science Centre (home of UK's fusion research programme, and JET). "United by noise: randomness helps swarms stay together".

11-2009 Junior Applied Mathematics Seminar "Comparing stochastic and deterministic models for cell migration".

05-2009 Invited speaker, Department of Engineering, Princeton University, "United by noise: randomness helps swarms stay together".

05-2009 Mini-symposium speaker, SIAM Snowbird Dynamical Systems conference, Snowbird, Utah. "United by noise: randomness helps swarms stay together".

03-2009 Invited speaker, 2nd Annual Oxford SIAM Student Chapter Conference. "United by noise: randomness helps swarms stay together".

10-2008 Junior Applied Mathematics Seminar. "Locust Pocus: how does randomness help swarms stay together? "

Referees

Professor Philip K. Maini (Director, Wolfson Centre for Mathematical Biology and former D.Phil. supervisor).
Wolfson Centre for Mathematical Biology, Mathematical Institute, University of Oxford, Andrew Wiles Building, Radcliffe Observatory Quarter, Woodstock Road, Oxford, OX2 6GG, UK.
Email: maini@maths.ox.ac.uk

Professor David J. Gavaghan (Director, Doctoral Training Centre and D.Phil. examiner).
Department of computer science, Wolfson Building, Parks Road, Oxford, OX1 3QD.
Email: david.gavaghan@dtc.ox.ac.uk.

Professor David Sumpter (Professor of Applied Mathematics and Former M.Sc. supervisor).
Matematiska Institutionen, Uppsala Universitet, Box 480, 751 06 Uppsala, Sweden.
Email: david@math.uu.se.