

DENIS PATTERSON

Department of Mathematical Sciences,
Durham University,
Upper Mountjoy Campus,
Stockton Road, Durham DH1 3LE

Office: MCS 3039
✉ denis.d.patterson@durham.ac.uk
🌐 denispatterson.com

Research Interests

Applied Analysis Dynamical systems, stochastic processes & functional differential equations
Applications Ecology, biological development & epidemiology

Academic Career

Current	Assistant Professor , Durham University Department of Mathematical Sciences
Nov. 2020–Jun. 2023	Postdoctoral Research Associate , Princeton University High Meadows Environmental Institute Mentor: Prof. Simon A. Levin
July 2018–Oct. 2020	Postdoctoral Research Associate , Brandeis University Department of Mathematics Mentor: Prof. Jonathan D. Touboul
May 2017–May 2018	Assistant Professor , Dublin City University School of Mathematical Sciences
Oct. 2013–Apr. 2018	PhD in Applied Mathematics , Dublin City University Thesis: <i>Asymptotic Growth in Nonlinear Stochastic and Deterministic Functional Differential Equations</i> Advisor: Prof. John A. D. Appleby
2009–2013	BSc in Actuarial Mathematics , Dublin City University First class honours

Publications

† alphabetical authorship, * equal contribution

Preprints

[P1] L. Xu, **D. D. Patterson**, S. A. Levin and J. Wang, *Global stability and tipping point prediction of the coral reef ecosystem*, submitted (2023).

Journal Articles

- [J18] **D. D. Patterson**, S. A. Levin, A. C. Staver and J. D. Touboul, *Pattern formation in mesic savannas*, Bulletin of Mathematical Biology, Vol. 86, No. 3 (2024). [Open Access]
- [J17] **D. D. Patterson**, A. C. Staver, S. A. Levin and J. D. Touboul, *Spatial dynamics with heterogeneity*, SIAM Journal on Applied Mathematics, S225-S248 (2023). [arXiv]
- [J16] Z. Qu*, **D. D. Patterson***, L. Childs, C. Edholm, J. Ponce, O. Prosper and L. Zhao, *Modeling immunity to malaria with an age-structured PDE framework*, SIAM Journal on Applied Mathematics, Vol. 83, No. 3 (2023), 1098–1125. [arXiv]
- [J15] L. Xu, **D. D. Patterson**, S. A. Levin and J. Wang, *Non-equilibrium early-warning signals for critical transitions in ecological systems*, Proceedings of the National Academy of Sciences, Vol. 120, No. 5 (2023), e2218663120.

- [J14] J. Feng*, W. H. Hsu*, **D. D. Patterson**, C. S. Tseng, Z. H. Zhuang, H. W. Hsin, Y.T. Huang, A. Faedo, J. L. Rubenstein, J. D. Touboul and S.J. Chou, *COUP-TFI specifies the medial entorhinal cortex identity and induces differential cell adhesion to determine the integrity of its boundary with neocortex*, Science Advances, Vol. 7, No. 27 (2021), eabf6808.
- [J13] L. Xu, **D. D. Patterson**, A. C. Staver, S. A. Levin, J. Wang, *Unifying deterministic and stochastic ecological dynamics via a landscape-flux approach*, Proceedings of the National Academy of Sciences, Vol. 118, No. 24 (2021), e2103779118. [arXiv]
- [J12] J. A. D. Appleby and **D. D. Patterson**[†], *Growth and fluctuation in perturbed nonlinear Volterra equations*, Applied Mathematics and Computation, Vol. 396, (2021) 125938. [arXiv]
- [J11] **D. D. Patterson**, S. A. Levin, A. C. Staver, J. D. Touboul, *Probabilistic foundations of spatial mean-field models in ecology and applications*, SIAM Journal on Applied Dynamical Systems, Vol. 19, No. 4 (2020), 2682–2719. [arXiv]
- [J10] J. A. D. Appleby and **D. D. Patterson**[†], *Blow-up and superexponential growth in superlinear Volterra equations*, Discrete & Continuous Dynamical Systems Series A, Vol. 38, No. 8 (2018), 3993–4017. [arXiv]
- [J9] J. A. D. Appleby and **D. D. Patterson**[†], *Growth rates of sublinear functional and Volterra differential equations*, SIAM Journal on Mathematical Analysis, Vol. 50, No. 2 (2018), 2086–2110. [arXiv]
- [J8] J. A. D. Appleby and **D. D. Patterson**[†], *Memory dependent growth in sublinear Volterra differential equations*, Journal of Integral Equations and Applications, Vol. 29, No. 4 (2017), 531–584. [arXiv]
- [J7] J. A. D. Appleby and **D. D. Patterson**[†], *Large fluctuations and growth rates of linear Volterra summation equations*, Journal of Difference Equations and Applications, Vol. 23, No. 6 (2017), 1047–1080. [arXiv]
- [J6] J. A. D. Appleby and **D. D. Patterson**[†], *Growth rates of solutions of superlinear ordinary differential equations*, Applied Mathematics Letters, Vol. 71 (2017), 30–37. [arXiv]
- [J5] J. A. D. Appleby and **D. D. Patterson**[†], *Hartman–Wintner growth results for sublinear functional differential equations*, Electronic Journal of Differential Equations, Vol. 2017, No. 21 (2017), 1–45. [arXiv]
- [J4] J. A. D. Appleby and **D. D. Patterson**[†], *On the admissibility of unboundedness properties of forced deterministic and stochastic sublinear Volterra summation equations*, Electronic Journal of Qualitative Theory of Differential Equations, No. 63 (2016), 1–44. [arXiv]
- [J3] J. A. D. Appleby and **D. D. Patterson**[†], *Classification of convergence rates of solutions of perturbed ordinary differential equations with regularly varying nonlinearity*, Electronic Journal of Qualitative Theory of Differential Equations, Proceedings of the 10th Colloquium on the Qualitative Theory of Differential Equations, No. 3 (2016), 1–38. [arXiv]
- [J2] J. A. D. Appleby and **D. D. Patterson**[†], *Subexponential growth rates in functional differential equations*, Discrete and Continuous Dynamical Systems Supplement (2015), 56–65. [arXiv]
- [J1] J. A. D. Appleby and **D. D. Patterson**[†], *On necessary and sufficient conditions for preserving convergence rates to equilibrium in deterministically and stochastically perturbed differential equations with regularly varying nonlinearity*, Recent Advances in Delay Differential and Difference Equations, Springer Proceedings in Mathematics & Statistics 94 (2014), 1–85. [arXiv]

Academic Honours & Awards

2017	Outstanding Graduate Researcher Award , Dublin City University
2013–2017	Government of Ireland Postgraduate Scholarship , Irish Research Council
2013	Student Actuary Prize , Society of Actuaries in Ireland
2012	Hamilton Award for Mathematics , Royal Irish Academy

Selected Academic Talks

- Apr. 2024 **AMS Spring Sectional Meeting**, Howard University, USA (invited)
- Nov. 2023 **Mathematical Biology Seminar**, University of Illinois, USA (invited)
- Mar. 2023 **AMS Spring Southeastern Sectional Meeting**, Georgia Tech, USA
- Oct. 2022 **International Conference on Mathematical Modeling & Analysis of Populations in Biological Systems VIII**, Univ. of Louisiana Lafayette, USA
- Oct. 2022 **AMS Fall Eastern Sectional Meeting**, UMass Amherst, USA (invited)
- July 2022 **SIAM Conference on the Life Sciences**, Philadelphia, USA (invited)
- July 2022 **Mathematical Models in Ecology & Evolution Conference**, University of Reading, UK
- Apr. 2022 **Joint Mathematics Meeting**, online (invited)
- Apr. 2022 **MathBio Seminar**, Arizona State University, USA (invited)
- Mar. 2022 **MathBio Seminar**, Virginia Tech, USA (invited)
- Mar. 2022 **AMS Spring Eastern Sectional Meeting**, online (invited)
- Mar. 2022 **Program in Applied & Computational Math Seminar**, Princeton University, USA
- June 2021 **Society for Mathematical Biology Annual Meeting**, online
(*Cell & Developmental Biology Contributed Talk Prize winner*)
- May 2021 **SIAM Conference on Applications of Dynamical Systems**, online
- Apr. 2021 **Fourth Northeast Regional Conference on Complex Systems**, online
- Oct. 2019 **International Conference on Mathematical Modeling & Analysis of Populations in Biological Systems VII**, Arizona State University, USA
- Sep. 2019 **Dynamical Systems Seminar**, Boston University, USA (invited)
- May. 2019 **SIAM Conference on Applications of Dynamical Systems**, Snowbird, Utah, USA
- Apr. 2019 **Mathematics and Statistics Seminar**, University of Limerick, Ireland (invited)
- Mar. 2019 **Mathematics Everytopic Seminar**, Brandeis University, USA (invited)
- July 2017 **Equadiff 2017**, Slovak University of Technology in Bratislava, Slovakia
- May 2017 **SIAM UK and Ireland Student Chapter Conference**, National University of Ireland Galway (Best Talk Prize)
- Apr. 2017 **British Applied Mathematics Colloquium**, University of Surrey, UK
- Mar. 2017 **Mathematics and Statistics Seminar**, University of Limerick, Ireland (invited)

Teaching Experience

Courses Taught (as primary instructor)

- Fall 2023 Advanced Mathematical Biology, Durham University
- Summer 2020 Differential Equations (fully online), Brandeis University
- Fall 2019 Probability, Brandeis University
- Spring 2019 Multivariate Calculus, Brandeis University
- Winter 2017 Simulation for Finance (graduate course), Dublin City University

Undergraduate Research Projects

Summer 2023	Kimberly Shen (Physics, Princeton), “Fire spread in forest-savanna ecosystems”
Fall 2021	Oliver Liang (Applied Math, Brandeis), “Collective dynamics of mobile particles”
Fall 2020	Jingman Li & Yuning Liu (Applied Math, Brandeis), “Network epidemic models”
Spring 2020	Hange Zhu (Applied Math, Brandeis), “Pattern formation in heterogeneous domains”
Summer 2019	Hanyu Song (Applied Math, Brandeis), “Mathematical models of somitogenesis”

Programming & Software

General	C++, Python, R, Hive, SQL, VBA, Git/Github
Math specific	MATLAB, Mathematica, XPP/Auto, Matcont, FreeFEM++, GeoGebra, L ^A T _E X

Professional Activities & Affiliations

Workshops & Organizational Activities

- 2022 Convergence Accelerator Team Award (\$10,500) from the NSF-Simon’s Center for Multiscale Cell Fate Research (UC Irvine) for the project “Developing methodologies for spatial and demographic heterogeneity in malaria immune dynamics”
- Selected participant in the AMS Mathematical Research Community “Dynamics of Infectious Diseases”, 2020-2022 (\$3,125 in personal funding)
- Conference & workshops organized:
 - “Infectious Disease Modeling across scales” funded and hosted by the American Institute of Mathematics, April 2023
 - “Critical Transition Workshop Series”: Part I, Part II, 2022 (virtual), and Part III, 2023 (hosted by Princeton University)
 - “Climate & Math Conference”, Brandeis University, May 26th, 2022 (virtual)
- Minisymposia/special sessions organized:
 - “Multiscale Approaches to Modeling Ecological and Evolutionary Dynamics” at the AMS Southeastern Spring Sectional Meeting (2023), Georgia Tech, USA
 - “Dynamics of PDEs on heterogeneous domains: Theory & applications” at the Joint Mathematics Meeting (JMM 2023), Boston MA, USA
 - “Vegetation Modeling: nonlinear PDE approach” at Mathematical Models in Ecology & Evolution Conference (MMEE 2022), University of Reading, UK
 - “Stochastic Networks in Neuroscience and Ecology” at the SIAM Conference on Applications of Dynamical Systems (DS21), Virtual
- Seminar series organized:
 - Brandeis Mathematical Biology Seminar series (2018–2019)
 - DCU Mathematical Sciences Postgraduate Seminar series (2014–2017)

Reviewing

- Applied Mathematics and Computation
- Applied Mathematical Modelling
- Bulletin of Mathematical Biology
- Chaos: An Interdisciplinary Journal of Nonlinear Science
- Electronic Journal of the Qualitative Theory of Differential Equations
- Journal of Difference Equations and Applications
- Mathematical Biosciences and Engineering
- Nature Communications
- Nonlinearity
- Proceedings of the National Academy of Sciences
- PLoS Computational Biology
- SIAM Journal on Applied Mathematics

Outreach and Diversity, Equity & Inclusion Activities

- EDI Committee Member, Mathematical Sciences, Durham University (2023/2024)
- Member of the Mathematical Sciences First Generation Scholars Network, Durham University
- EEB Scholars Program invited panelist, Fall 2022
- Postdoctoral representative on the *Diversity & Inclusion Climate Committee* and *Outreach Subcommittee* member (Princeton University), Fall 2021, Spring 2022 and Fall 2022
- Speaker for the “MRSEC Pizza Talks” science outreach program at Waltham High School, Fall 2020
- Judge for SCUDEM 2020 and 2021 (high school/undergraduate mathematical modeling competition)
- University coordinator for the BITE/DCU Voluntary Math Tuition programme 2017/2018 (math outreach to disadvantaged schools to promote university access through tutoring and mentorship)
- DCU Access Service tutor 2015/2016 (academic support for disadvantaged university students)

Professional Memberships

- American Mathematical Society (AMS)
- Society for Industrial and Applied Mathematics (SIAM)
- Society for Mathematical Biology (SMB)

Last updated: January 9, 2024