

# Thomas M. Bury

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Department of Physiology  
Faculty of Medicine  
McGill University  
Montréal, QC  
H3A 0G4 Canada

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ORCID: [0000-0003-1595-9444](https://orcid.org/0000-0003-1595-9444)  
Email: [thomas.bury@mcgill.ca](mailto:thomas.bury@mcgill.ca)  
Website: [thomasbury.net](http://thomasbury.net)  
Google Scholar: [scholar.google.ca](https://scholar.google.ca)

## EDUCATION

- 2015 – 2019    **PhD, Applied Mathematics**, University of Waterloo, Canada  
Thesis: Detecting and distinguishing transitions in ecological systems: model and data-driven approaches.  
Advisors: Dr. Chris Bauch, Dr. Madhur Anand
- 2014 – 2015    **MMATH, Mathematics**, University of Cambridge, UK  
Director of studies: Dr. Julia Gog, OBE
- 2011 – 2014    **BA, Mathematics**, University of Cambridge, UK

## PROFESSIONAL APPOINTMENTS







- 2020 – present    **Postdoctoral Researcher**  
Department of Physiology  
Faculty of Medicine  
McGill University, Canada

## AWARDS & HONORS

- 2022 – 2024    FRQNT postdoctoral research scholarship (\$45,000 *per annum*)
- 2021            CAMBAM postdoctoral fellowship, Centre for Applied Mathematics in Bioscience and Medicine, McGill University (\$10,000)
- 2021            PNAS [Cozzarelli Prize](#) for scientific excellence and originality—finalist
- 2020            CAMBAM postdoctoral fellowship, Centre for Applied Mathematics in Bioscience and Medicine, McGill University (\$7,000)
- 2019            Doctoral thesis award, University of Waterloo (\$5000)
- 2019            Combined travel grants, Waterloo Institute for Complexity and Innovation (\$2500)
- 2017            Research dissemination award, GRADTalks, University of Waterloo (\$500)
- 2017            Second place at Fields Thesis Competition, Fields Institute, Toronto (\$300)
- 2017            Finalist at 3-Minute Thesis competition, University of Waterloo (\$100)
- Recording:  [youtube.com/watch?v=UQ1nW9PNi8](https://youtube.com/watch?v=UQ1nW9PNi8)

## PUBLICATIONS


## PAPERS

- 2023 **T. M. Bury**, K. Diagne, D. Olshan, L. Glass, A. Shrier, B. Lerman and G. Bub. The Inverse Problem for Cardiac Arrhythmias *Chaos: An Interdisciplinary Journal of Nonlinear Science*. doi:[10.1063/5.0161210](https://doi.org/10.1063/5.0161210).  
 • Code:  [ThomasMBury/cardiac-inverse](https://github.com/ThomasMBury/cardiac-inverse)
- ‡ **T. M. Bury**, D. Dylewsky, C. Bauch, M. Anand, L. Glass, A. Shrier and G. Bub. Predicting discrete-time bifurcations with deep learning. *Nature Communications*. doi:[10.1038/s41467-023-42020-z](https://doi.org/10.1038/s41467-023-42020-z). **Editors' highlight**.  
 • Code:  [ThomasMBury/dl\\_discrete\\_bifurcation](https://github.com/ThomasMBury/dl_discrete_bifurcation)
- ‡ **T. M. Bury**. ewstools: A Python package for early warning signals of bifurcations in time series data *Journal of Open Source Software*. doi:[10.21105/joss.05038](https://doi.org/10.21105/joss.05038).  
 • Code:  [ThomasMBury/ewstools](https://github.com/ThomasMBury/ewstools)
- ‡ K. Diagne, **T. M. Bury**, M. Deyell, Z. Laksman, A. Shrier, G. Bub and L. Glass. Rhythms from two competing periodic sources embedded in an excitable medium *Physical Review Letters*. doi:[10.1103/PhysRevLett.130.028401](https://doi.org/10.1103/PhysRevLett.130.028401). **Editors' suggestion**.
- 2022 ‡ F. Dablander and **T. M. Bury**. Deep learning for tipping points: Preprocessing matters. *Proceedings of the National Academy of Sciences*. doi:[10.1073/pnas.2207720119](https://doi.org/10.1073/pnas.2207720119).
- ‡ D. Dylewsky, T. Lenton, M. Scheffer, **T. M. Bury**, C. Fletcher, M. Anand, and C. Bauch. Universal early warning signals of phase transitions in climate systems. *Journal of the Royal Society Interface*. doi:[10.1098/rsif.2022.0562](https://doi.org/10.1098/rsif.2022.0562).
- 2021 ‡ **T. M. Bury**, R. Sujith, I. Pavithran, M. Scheffer, T. Lenton, M. Anand, and C. Bauch. Deep learning for early warning signals of tipping points. *Proceedings of the National Academy of Sciences*. doi:[10.1073/pnas.2106140118](https://doi.org/10.1073/pnas.2106140118). **Cozzarelli finalist**.  
 • Code:  [ThomasMBury/deep-early-warnings-pnas](https://github.com/ThomasMBury/deep-early-warnings-pnas)
- ‡ J. Menard, **T. M. Bury**, C. T. Bauch, and M. Anand. When conflicts get heated, so does the planet: coupled social-climate dynamics under inequality *Proceedings of the Royal Society B*. doi:[10.1098/rspb.2021.1357](https://doi.org/10.1098/rspb.2021.1357).
- 2020 **T. M. Bury**, C. Lerma, G. Bub, Z. Laksman, M. W. Deyell, L. Glass. Long ECGs reveal rich and robust dynamical regimes in patients with frequent ectopy. *Chaos: An Interdisciplinary Journal of Nonlinear Science*. doi:[10.1063/5.0023987](https://doi.org/10.1063/5.0023987).
- ‡ **T. M. Bury**, C. T. Bauch, M. Anand. Detecting and distinguishing tipping points using spectral early warning signals. *Journal of the Royal Society Interface*. doi:[10.1098/rsif.2020.0482](https://doi.org/10.1098/rsif.2020.0482).  
 • Code:  [ThomasMBury/ewstools](https://github.com/ThomasMBury/ewstools)
- 2019 ‡ **T. M. Bury**, C. T. Bauch, M. Anand. Charting pathways to climate change mitigation in a coupled socio-climate model. *PLoS computational biology*. doi:[10.1371/journal.pcbi.1007000](https://doi.org/10.1371/journal.pcbi.1007000).  
 • Code:  [ThomasMBury/socio\\_climate\\_model](https://github.com/ThomasMBury/socio_climate_model)
- ‡ D. A. Pananos, **T. M. Bury**, C. Wang, J. Schonfeld, S. P. Mohanty, B. Nyhan, M. Salathé, C. T. Bauch. Critical dynamics in population vaccinating behavior. *Proceedings of the National Academy of Sciences* doi:[10.1073/pnas.1704093114](https://doi.org/10.1073/pnas.1704093114).

## OPEN-SOURCE SOFTWARE

2019 – present **ewstools**

A Python package for computing early warning signals for bifurcations in time series data.  
doi:[10.5281/zenodo.3497512](https://doi.org/10.5281/zenodo.3497512)

- Role: Creator, core developer
- Code:  [ThomasMBury/ewstools](https://github.com/ThomasMBury/ewstools)

## CONFERENCE PRESENTATIONS


- 2023 Deep learning for predicting critical transitions. *Workshop: Challenges of predicting critical transitions in natural systems*, Exeter University, UK. (**invited, plenary**)
- Slides:  [doi.org/10.6084/m9.figshare.24895866.v1](https://doi.org/10.6084/m9.figshare.24895866.v1)
- Deep learning discrete-time bifurcations: an application to noisy cardiac systems. *SIAM Conference on Applications of Dynamical Systems*, Portland OR.
- Slides:  [doi.org/10.6084/m9.figshare.24183513.v1](https://doi.org/10.6084/m9.figshare.24183513.v1)
- 2021 Deep learning for early warning signals of bifurcations. *Dynamics Days Europe*, Virtual.
- Slides:  [doi.org/10.6084/m9.figshare.16892431.v1](https://doi.org/10.6084/m9.figshare.16892431.v1)
- Long ECGs reveal rich and robust dynamical regimes in patients with frequent PVCs. *Society for Mathematical Biology Annual Meeting*, Virtual.
- Slides:  [doi.org/10.6084/m9.figshare.16892593.v1](https://doi.org/10.6084/m9.figshare.16892593.v1)
- 2020 Fold or Flip? Distinguishing bifurcations in advance with spectral early warning signals. *Workshop on Critical Transitions in Complex Systems*, Shanghai Institute for Biological Sciences, Virtual. (**invited**)
- Slides:  [doi.org/10.6084/m9.figshare.16892644.v1](https://doi.org/10.6084/m9.figshare.16892644.v1)
  - Recording:  [drive.google.com/file/d/1kp2G6q-Eu-H13JpVgUCcbezF\\_rZzKjJ3](https://drive.google.com/file/d/1kp2G6q-Eu-H13JpVgUCcbezF_rZzKjJ3)
- 2019 Spectral early warning signals improve tipping point detection and description. *Society for Mathematical Biology Annual Meeting*, Montréal, Canada.
- Poster:  [doi.org/10.6084/m9.figshare.16892395.v2](https://doi.org/10.6084/m9.figshare.16892395.v2)
- Spectral early warning signals improve tipping point detection and description. *Canadian Society of Applied and Industrial Mathematics, Annual Meeting*, Whistler, Canada.
- Slides:  [doi.org/10.6084/m9.figshare.16892662.v1](https://doi.org/10.6084/m9.figshare.16892662.v1)
- 2018 Early warning indicators of ecological tipping points. Do they predict critical transitions, or something else? *Ecological Society of America, Annual Meeting*, New Orleans, U.S.
- Characterizing impending transitions in complex systems. *Dynamics Days US*, Denver, U.S.
- 2017 The mathematics of tipping points. *TEDx UofT*, Toronto, Canada. (**invited**)
- Recording:  [youtube.com/watch?v=pfm7OqBVA6I](https://youtube.com/watch?v=pfm7OqBVA6I)
- Anticipating Critical Transitions in Socio-Ecological Systems *Applied Mathematics, Modeling and Computational Science, International Conference*, Waterloo, Canada.
- Regime Shifts in Socio-Ecological Systems *Mathematical Models in Ecology and Evolution, Conference*, London, UK.

Regime Shifts in Socio-Ecological Systems *WICI Interdisciplinary Conference on Resilience in Complex Natural and Human Systems*, Waterloo, Canada.

## INVITED SEMINARS

- 2023      Youreka Symposium, McGill University.  
 • Slides:  [doi.org/10.6084/m9.figshare.24183543.v1](https://doi.org/10.6084/m9.figshare.24183543.v1)
- 2021      Department of Physiology Seminar Series, McGill University.  
 • Slides:  [doi.org/10.6084/m9.figshare.24415936.v1](https://doi.org/10.6084/m9.figshare.24415936.v1)
- 2020      Applied Mathematics Seminar, Centre de Recherches Mathématiques, Montréal, QC.  
 • Recording:  [youtube.com/watch?v=QGs2knhnXDM](https://youtube.com/watch?v=QGs2knhnXDM)  
 • Slides:  [doi.org/10.6084/m9.figshare.16892632.v1](https://doi.org/10.6084/m9.figshare.16892632.v1)
- Applied Mathematics Seminar Series, University of Ottawa.  
 Seminar Series in Quantitative Life Sciences and Medicine, McGill University.

## MEDIA COVERAGE (SELECTED)

- 2023      Physics Today  
 •  [pubs.aip.org/physicstoday/article/](https://pubs.aip.org/physicstoday/article/)
- 2021      The Independent  
 •  [independent.co.uk/climate-change/news/](https://independent.co.uk/climate-change/news/)
- 2021      The Daily Mail  
 •  [dailymail.co.uk/sciencetech/](https://dailymail.co.uk/sciencetech/)
- 2019      Canadian Broadcasting Corporation  
 •  [cbc.ca/news/canada/](https://cbc.ca/news/canada/)

## TEACHING

### GRADUATE

- 2021 – 2022    **Instructor**, *McGill University*  
 Foundations of Quantitative Life Sciences, (Fall 2021, Fall 2022)
- 2017 – 2018    **Teaching Assistant and Guest Lecturer**, *University of Waterloo*  
 Stochastic Processes in the Physical Sciences, (Winter 2017, Winter 2018)
- 2017            **Teaching Assistant**, *University of Waterloo*  
 Mathematical Modeling with Differential Equations, (Fall 2017)

### UNDERGRADUATE

- 2018            **Instructor**, *University of Waterloo*  
 Calculus I for the Sciences, (Fall 2018)

- 2018      **Teaching Assistant**, *University of Waterloo*  
Partial Differential Equations I (Winter 2018)
- 2016      **Teaching Assistant**, *University of Waterloo*  
Introduction to Differential Equations, (Winter 2016)
- 2015 – 2016      **Teaching Assistant**, *University of Waterloo*  
Various calculus courses for math and engineering students  
(Fall 2015, Summer 2016, Fall 2016)

## CREDENTIALS

- 2017 – 2019      Certificate of University Teaching, *University of Waterloo*  
An in-depth, selective, 2-year teaching course for PhD students. Includes multiple teaching observations, guided self-reflection and improvement, workshops and a pedagogical research project.
- 2015 – 2016      Fundamentals of University Teaching, *University of Waterloo*  
Includes weekly workshops on teaching fundamentals including active learning, equitable teaching, and effective delivery.

## STUDENT SUPERVISION

### DOCTORATE

- 2019 – present      Khady Diagne (co-advisor)  
McGill University  
Project: Spatio-temporal dynamics of pure parasystole in cardiac tissue

### UNDERGRADUATE


- 2020 – 2021      Alix Vanpoperinghe (advisor)  
McGill University  
Project: Simulation of cardiac monolayers under optogenetic control
- 2020 – 2021      Glisant Plasa (co-advisor)  
McGill University  
Project: Reinforcement learning for discovery of reentry mechanisms in cardiac tissue

## ACADEMIC SERVICE

### COMMITTEES

- 2021 – present      CGSM evaluation committee member, *McGill University*  
Served as an evaluator for the 2021, 2022 and 2023 Canada Graduate Scholarship-Master's competition.
- 2017 – 2018      Senate Graduate and Research Council, *University of Waterloo*  
Served as the math grad student representative for matters of academic quality and research activity within the university.

## SUMMER SCHOOLS AND WORKSHOPS

- 2021 Summer School in Nonlinear Dynamics for the Life Sciences (online)  
*CAMBAM and NSERC-CREATE, McGill University*  
Technical lead for 2-week, international summer school with 50 participants and 24 instructors.
- 2020 Interactive Data Visualisation in Python (online)  
*CAMBAM-CRM, McGill University*  
Designed and implemented 5-hour workshop with 60 participants including students and faculty.  
• Code:  [ThomasMBury/workshop\\_datavis\\_python](https://github.com/ThomasMBury/workshop_datavis_python)
- 2018 A Hands-on Introduction to Mathematical Modelling  
*Waterloo Institute for Complexity and Innovation: Leveraging systems approaches to improve human and planetary health*  
Co-designed and implemented 4-hour workshop.

## OUTREACH

- Ongoing Interviews with newspapers and magazines including *The Scientific American*, *The Waterloo Region Record*, *The McGill Tribune* and *The Charlatan*.
- Ongoing Technical author for [Towards Data Science](#), Medium publication.
- 2024 Member of the career panel at the McGill Quantitative Life Sciences Research Day.
- 2023 Lecture to CEGEP students at Youreka Canada. “Data science: practice and principles”. Montréal, Canada.
- 2023 Poster judge for the Faculty of Medicine and Health Sciences Student Research Day. *McGill University*, Montréal, Canada.
- 2022 – 2023 Poster judge for the Quantitative Life Sciences Research Day in 2022 and 2023. *McGill University*, Montréal, Canada.
- 2022 Lecture to high school students at Kelly College. “Mathematics beyond school: university, careers and life”. Devon, UK.
- 2016 – 2018 Workshop facilitator at primary school visits. *Let’s Talk Science*, Waterloo, Canada.
- 2017 [TEDx speaker](#). *University of Toronto*, Toronto, Canada.  
Volunteer at Physics Lab Day for Grade 11-12. *University of Waterloo*, Waterloo, Canada.  
Science fair judge for Grade 8 projects. *Centennial Public School*, Waterloo, Canada.

## REVIEWER

- Nature
- Nature Communications
- Nature Climate Change
- Proceedings of the National Academy of Sciences
- Physical Review X
- Ecology Letters
- Proceedings of the Royal Society A
- Proceedings of the Royal Society B
- Journal of the Royal Society Interface
- Royal Society Open Science
- Wiley: Ecology and Evolution
- Wiley: Methods in Ecology and Evolution
- Chaos: An Interdisciplinary Journal of Nonlinear Science
- Physica D: Nonlinear Phenomena
- Ecological Economics
- Climatic Change
- PLoS One

## LANGUAGES

English            Native

French            TEFaQ Level C1 (proficiency) obtained in 2020.