

Vardayani Ratti

John Wesley Young Research Instructor · Dartmouth College, Hanover, NH

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Academic Appointments

Dartmouth College

Hanover, NH

John Wesley Young Researcher Instructor

2016- Present

- Postdoctoral research and teaching position

University of Guelph

Guelph, Canada

Postdoctoral Fellow, Natural Sciences and Engineering Research Council of Canada (NSERC-ENGAGE)

Feb 2016-July 2016

Education

University of Guelph

Guelph, Canada

PhD, Mathematics

2015

- Advisor: Dr. Hermann J. Eberl
- Thesis: Predictive Modeling of the Disease Dynamics of Honeybee-*Varroa destructor*-Virus Systems
- Funded by Natural Sciences and Engineering Research Council of Canada (NSERC)-Canadian Pollination Initiative (CANPOLIN) and Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA).

University of Guelph

Guelph, Canada

MSc, Mathematics

2011

- Advisor: Dr. Hermann J. Eberl
- Thesis: Local Stability Analysis of the Honeybee-*Varroa destructor*-Acute Bee Paralysis Virus
- Funded by Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA).

Panjab University

Chandigarh, India

MSc, Mathematics

2009

- Course Based Program

Guru Nanak Dev University

India

BSc, Mathematics, Physics, Chemistry

2007

- Course Based Program

Teaching Experience

Dartmouth College

Hanover, USA

Instructor (15-35 students)

July 2016- Present

- Introduction to Calculus (*Collaborative learning course*)
- Topics in Applied Mathematics (*Senior Undergraduate and Graduate course*)
- Linear Algebra with Applications
- Multivariable Calculus
- Ordinary Differential Equations
- Multivariable Calculus

University of Guelph

Guelph, Canada

Teaching Assistant (40-200 students)

2009-2015

- Partial Differential Equations
- Biomathematics
- Matrix Algebra (*Online course*)
- Elements of Calculus I, II
- Linear Algebra
- Integrated Math Physics I
- Differential Equations I
- Applied Differential Equations II
- Biomathematics

Research Interests

My research interest is in Mathematical Biology, in particular applications in ecology, infectious diseases, pollination biology and agriculture using differential equations. I have been studying mathematical models of infestation of honeybee colonies by viruses and varroa mite. I have determined the conditions under which the disease together with forager loss leads to colony losses. I have developed a new model of within-host HIV dynamics that includes cells protected from infection by the action of a CRISPR/Cas

intervention that disrupts the expression of CCR5 proteins in the protected cells. The model is used to predict the extent of the intervention required to offer a functional cure, and also determine parameters that must be measured in order to guide experiments underway currently in Dr. Alexandra Howell's laboratory. I recently completed a project that used a mosquito model to study the effect of spraying different treatments in the households of Kenya Highlands. I am currently developing a malaria model which includes partial immunity arising from re-inoculation, and that interfaces with a time varying mosquito model, in order to distinguish the malaria transmission patterns in two nearby towns with similar rainfall and temperature but different land use and topography. This project is in collaboration with Dr. Jonathan Chipman from Department of Geography. The connection between my seemingly disjoint research projects is the SIR type modeling approach and I employ both analytical and numerical methods in my research.

Publications (* indicates undergraduate student as co-author)

Manuscripts

- **Ratti, V.**; Rheingold, E.*; Wallace, D.I. Reduction of Mosquito Abundance Via Indoor Wall Treatments: A Mathematical Model. Journal of Medical Entomology. Doi: 10.1093/jme/tjy021. 2018. <https://academic.oup.com/jme/article/55/4/833/4915551>
- **Ratti, V.**; Kevan, P.G.; Eberl, H.J. A Mathematical Model of Forager Loss in Honeybee Colonies Infested with *Varroa destructor* and the Acute Bee Paralysis Virus. Bulletin of Mathematical Biology. 79(6): 1218-1253, 2017. <https://link.springer.com/article/10.1007/s11538-017-0281-6>
- **Ratti, V.**; Kevan, P.G.; Eberl, H.J. A Discrete-Continuous Modeling Framework to Study the Role of Swarming in a Honeybee-*Varroa destructor*-Virus System. Mathematical and Computational Approaches in Advancing Modern Science and Engineering. J.Belair (eds). Springer International Publishing, 299-308, 2016. https://link.springer.com/chapter/10.1007/978-3-319-30379-6_28
- **Ratti, V.**; Kevan, P.G.; Eberl, H.J. A Mathematical Model of the Honeybee-*Varroa destructor*-Acute Bee Paralysis Virus Complex with Seasonal Effects. Bulletin of Mathematical Biology. 77(8): 1493-1520, 2015. <https://link.springer.com/article/10.1007/s11538-015-0093-5>
- **Ratti, V.**; Kevan, P.G.; Eberl, H.J. A Mathematical Model of the Honeybee-*varroa destructor*-Acute Bee Paralysis Virus Complex. Canadian Applied Math Quarterly, 21(1): 63-93, 2013. <http://www.uoguelph.ca/canpolin/Publications/Ratti>

Book Chapter

- Eberl, H.J.; Kevan, P.G.; **Ratti, V.** Infectious disease modeling for honeybee colonies in J. Dellivers (ed). In Silico Bees, p.87-134, CRC, Press Boca Raton, 2014. bit.ly/bookbees

Under Revision

- **Ratti, V.**; Nanda, S.; Eszterhas, S. K.; Howell, A.; Wallace, D.I. A Mathematical Model of HIV dynamics Treated with a Population of Gene Edited Hematopoietic Progenitor Cells Exhibiting Threshold Phenomenon. Mathematical Medicine and Biology, 2018. Pre-print available at <https://math.dartmouth.edu/~vratti/publications.html>

Under preparation

- Wallace, D.I.; Kachalia, A.A.*; **Ratti, V.** Effect of habitat diversity on the population dynamics of *Anopheles gambiae*.
- **Ratti, V.**; Wallace, D.I. A malaria model, combined with time varying mosquito model, to study the effect of land use and topography on disease transmission.

Theses

- Predictive Modeling of the Disease Dynamics of Honeybee-*Varroa destructor*-Virus Systems, 2015
- Local Stability Analysis of the Honeybee-*Varroa destructor*-Acute Bee Paralysis Virus, 2011

Honors & Awards

2018	\$750 Postdoctoral Scholar Professional Development Award	Dartmouth College
2016	\$750 Landahl Travel Grant	Society of Mathematical Biology (SMB)
2011	\$5000 Queen Elizabeth II-Graduate Scholarship in Science and Technology	University of Guelph
2011-2013	\$3350 Dean's Scholarship	University of Guelph
2009-2010	\$1130 Dean's Scholarship	University of Guelph

Mentoring and Service

- **Mentor**, undergraduate student under James O. Freedman Presidential Scholars program, Dartmouth College
- **Co-mentor**, two undergraduate students (Freshman and Sophomore), Dartmouth College
- **Organizer**, minisymposium on Honeybee modeling at the Annual meeting of Society of Mathematical Biology (SMB), Utah (2017)
- **Organizer**, Applied Mathematics Seminars, Dartmouth College (2017-2018)
- **Judge**, poster session at Joint Mathematics Meeting, San Diego, 2018
- **Mentor**, undergraduate student in a research project based on software implementation of a mathematical model on diseases in honeybee colonies, University of Guelph
- **Mentor**, graduate student on a MSc project, University of Guelph
- **Committee Member**, served on an award selection committee for Teaching Assistant Advisory Council (TAAC)
- **Volunteer**, participated in various activities at the Honeybee Research Center (Guelph) as a member of the Apiculture Club

Refereeing (By invitation)

- Grant proposal for Natural Sciences and Engineering Research Council of Canada (NSERC)
- Mathematical Bioscience and Engineering
- Journal of Behaviour

Selected Talks

- The Fields Institute for Research in Mathematical Sciences, Toronto, Canada, 2018 (**Invited**)
- Arizona State University, Arizona, USA, 2018 (**Invited**)
- Sonia Kovalevsky Day, Hanover, USA, 2018 (**Plenary Lecture**)
- Rochester Institute of Technology, Rochester, USA, 2018 (**Invited**)
- Bowdoin College, Maine, USA, 2018 (**Invited**)
- Joint Mathematics Meeting, San Diego, USA, 2018
- Minisymposium on Mathematical Biology, Dartmouth College, 2017(**Invited**)
- Joint Mathematics Meeting, Atlanta, USA, 2017
- Society of Mathematical Biology (SMB) Annual Meeting and Conference, Nottingham, UK, 2016
- The 2015 AMMCS-CAIMS Congress, Waterloo, Canada, 2015
- The 2015 BIOMAT. International Symposium on Mathematical and Computational Biology, Indian Institute of Technology, Roorkee, India, 2015
- Emergency Management research expo, Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA), University of Guelph, Canada, 2014
- Canadian Association of Professional Apiculturists, Edmonton, Alberta, Canada, 2013
- Society of Mathematical Biology (SMB) Annual Meeting and Conference, Tempe, Arizona, USA, 2013
- 2013 Southwestern Ontario Graduate Mathematics and Statistics Conference, University of Guelph, Canada, 2013
- Emergency Management research expo, Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA), University of Guelph, Canada, 2013
- Missouri Botanical Garden (MBG), St. Louis, Missouri, USA, 2012
- The 5th Geoffrey J. Butler Memorial Conference on Differential Equations and Population Biology, University of Alberta, Canada, 2011
- CMS Winter Meeting, Toronto, Canada, 2011

Other Research Experience

Missouri Botanical Garden (MBG)

St. Louis, USA

- Hands on project on Associative Learning in Honeybees
- Trained the bees using Proboscis Extension Reflex (PER)

Skills

Technical Skills	Matlab, Maple, XPPAUT, R, Mathematica
General	MS Word, Excel, Power Point, LaTeX
Teaching Management Systems	Canvas, WebWork

Society Memberships and Research Networks

- Society of Mathematical Biology (SMB)
- Society of Industrial and Applied Mathematics (SIAM)
- American Mathematical Society (AMS)
- NSERC Canadian Pollination Initiative
- Canadian Mathematical Society (CMS)

Professional Development

- National Institutes of Health (NIH) Grant writing workshop
- Future Faculty Teaching Workshop Series
- Syllabus Design Workshop Series