Rosalyn C. Rael

Curriculum Vitae

Contact Information

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Citizenship

USA

Research Interests

Applications of evolutionary game theory, ordinary differential equations, difference equations, networks, and stochastic models to the study of biological systems at multiple scales.

Education

The University of Arizona, Tucson, Arizona USA

Ph.D., Interdisciplinary Program in Applied Mathematics, May 2009

- Dissertation Title: Comparing Theory and Data on Multi-Species Interactions Using Evolutionary Game Theory
- Advisors: J. M. Cushing, Professor of Mathematics, University of Arizona; T. L. Vincent, Professor Emeritus of Aerospace and Mechanical Engineering, University of Arizona

M.S., Interdisciplinary Program in Applied Mathematics, December 2005

Western New Mexico University, Silver City, New Mexico USA

B.S., Mathematics, Botany, Zoology, May 2003

- Cumulative GPA: 4.0
- Summa cum laude

Employment/ Professional Experience

Research

Alliance for Graduate Education and the Professoriate Postdoctoral Fellow, Postdoctoral Research Fellow Fall 2009 - Summer 2011, Summer 2012 - present
University of Michigan, Department of Ecology and Evolutionary Biology, Ann Arbor, MI
Using stochastic models of competition to explore patterns of species abundance in niche-structured and neutral ecological communities.

Ford Postdoctoral Fellow Summer 2011 - Summer 2012
Pacific Ecoinformatics and Computational Ecology Lab, Berkeley, CA
Modeling the evolution of food webs using ODEs and large-scale computation to explore the effects of adaptive traits on ecosystem structure and stability.

NSF Graduate Research Fellow Fall 2004 - Spring 2006, Fall 2007 - Spring 2008
University of Arizona, Department of Mathematics, Tucson, AZ
Developed dissertation research on the evolution of competition amongst flour beetles using evolutionary game theory using differential and difference equations.

Graduate Research Assistant Summers 2004 - 2008
Pacific Ecoinformatics and Computation Ecology Lab & Rocky Mtn. Biological Lab, Gothic, CO
Used differential equation models and graph theory to research effects of species extinction on food web structure and ecosystem function. Developed model for evolution of food webs.

Undergraduate Research Assistant Summers 2002, 2003
Los Alamos National Laboratory, Los Alamos, NM
Modeled the effects of contraction on graph properties with application to epidemiology (2002), and the role of network topology in influenza epidemics (2003).

Employment/ Professional Experience (cont.)

Teaching

Guest lecturer Spring 2013, Fall 2013
Tulane University, New Orleans, LA
Lectured on evolutionary game theory for the course entitled "Mathematical Modeling in Ecology and Evolution," and assisted in providing material for a student project. Also covered two lectures in a Calculus I course.

Postdoctoral Short Course on College Teaching in Science and Engineering Spring 2010
University of Michigan, Ann Arbor, MI
Discussed teaching strategies, technology, curriculum design, and diversity. Prepared a syllabus for a future class in mathematical biology and a lesson plan for an inquiry-based lab.

Graduate Teaching Assistant Fall 2008 - Spring 2009, Fall 2006 - Spring 2007
University of Arizona, Department of Mathematics, Tucson, AZ
Taught College Algebra and Precalculus. Prepared course materials and presented all course lectures, held regular office hours, and assigned student grades.

Undergraduate Teaching Assistant Fall 2000 - Fall 2001
Western New Mexico University, Department of Natural Sciences, Silver City, NM
Prepared lab materials and assisted students in Genetics and General Botany labs, and provided tutoring for students taking Genetics.

Summer Schools

Complex Systems Summer School, June 2004
Santa Fe Institute and St. John's College, Santa Fe, NM
Completed a project on the effects of the topological structure of food webs on robustness with regard to extinction.

Mathematical and Theoretical Biology Institute, Summers 2001, 2003
Cornell University, Ithaca, NY; and Los Alamos National Laboratory, Los Alamos, NM
Modeled the evolution of pesticide resistance in the European corn borer (2001), and the effects of network topology on influenza epidemics (2003).

Publications

Rael, R. C., Ostling, A., D'Andrea, R., and Barabás, G. Emergent niches lead to increased differences from neutrality in species abundance distributions. In review.

Rael, R. C., D'Andrea, R., and Barabás, G., Ostling, A. Detecting departures from neutral species abundance distributions produced by niches. In preparation.

Shevstsov, J. and Rael, R. C. Indirect energy flows in niche model food webs: effects of size and connectance. In submission.

Rael, R. C., and Martinez, N. D. Evolutionary effects of predator-prey dynamics in small food webs. In preparation.

Barabás, G., D'Andrea, R., Rael, R., Meszéna, G. and Ostling, A., Emergent neutrality or hidden niches? *Oikos*, 2013.

Rael, R. C., Vincent, T. L., and Cushing, J. M. Competitive outcomes changed by evolution. *Journal of Biological Dynamics*. 5: 3, 227-252, 2011. (work announced in: Barry, P. Mathematicians show how beetles can share a niche. *Science News*. 175(3):14).

Rael, R. C., Costantino, R. F., Cushing, J. M., and Vincent, T. L. Using stage-structured evolutionary game theory to model experimentally observed evolution of a genetic polymorphism. *Evolutionary Ecology Research*. 11:141-151, 2009.

Restrepo, J. M., Rael, R. C., and Hyman, J. M. Modeling the influence of polls on elections: A population dynamics approach. *Public Choice*. 140:389-420, 2009.

Rael, R. C., Vincent, T. L., Costantino, R. F., Cushing, J. M. Evolution of corn oil sensitivity in the flour beetle. *Annals of the International Society of Dynamic Games, vol. 9: Advances in Dynamic Game Theory*. Birkhäuser, 2007.

Publications (cont.)

Rael, R. C., and Starzomski, B. Effects of extinctions on food webs. *Proceedings of the Complex Systems Summer School*. 2004.

Rael, R. C., and Wickland, T. Effects of contractions on graph properties with application to epidemiology. *Los Alamos National Laboratory Theoretical Division Technical Report*. 2002.

Awards and Fellowships

Graduate and Post-graduate

- Ford Postdoctoral Fellowship, 2011-present
- Alliance for Graduate Education and the Professoriate Postdoctoral Fellowship, 2009 - 2011
- SACNAS Nat.Conference Outstanding Graduate Oral Presentation in Math, Fall 2008
- AWM Sonya Kovalevsky Day Grant, Spring 2008
- Univ. of Arizona Graduate and Professional Student Council Travel Grant, Summer 2008
- Herbert E. Carter Travel Award, Spring 2008
- NSF Graduate Research Fellowship, 2003-2008
- NSF VIGRE Fellowship, Summer 2004, Summer 2007
- NetSci International Workshop & Conference on Network Science Travel Award, Spring 2006
- NSF IGERT Fellowship, Fall 2003-Spring 2004

Undergraduate

- Highest GPA Award, WNMU graduating class 2003
- WNMU Academic Achievement Award
- Alliance for Minority Participation Scholarship
- Cardinal Key National Honor Society

Selected Talks

Invited

Fall 2013: *Species abundance patterns among competing species*
SACNAS National Conference, San Antonio, TX.

Summer 2013: *Species Abundance Distributions in Ecological Communities with Niche and Neutral Dynamics*
SIAM Annual Meeting, San Diego, CA.

Spring 2013: *Competition, Coexistence, and Evolutionary Games in Ecosystem Networks*
Xavier University of Louisiana Mathematics Colloquium, New Orleans, LA.

Fall 2011: *Species Abundance Patterns and Competition in a Stochastic Niche Model*
Center for Computational Science Seminar, Tulane University, New Orleans, LA.

Fall 2011: *Species Abundance Distributions in a Stochastic Competition Model*
The Third International Conference on Math Modeling & Analysis of Populations in Biological Systems (ICMA III), San Antonio, TX.

Spring 2011: *Evolutionary Game Theory in Trophic Interactions*
AMS/MAA Joint Meetings, New Orleans, LA.

Summer 2010: *Body Size Evolution in Food Webs*
Fourteenth International Symposium on Dynamic Games and Applications, Banff, AB, CAN.

Spring 2010: *Evolution Reverses Competitive Outcomes: An Evolutionary Game Theory Approach to Population Dynamics*
Department of Mathematics Colloquium, University of Wisconsin, Whitewater.

Fall 2009: *Evolutionary Changes in Competitive Outcomes*
The Second International Conference on Mathematical Modeling and Analysis of Populations in Biological Systems, Huntsville, AL.

Summer 2008: *Evolution Reverses Competitive Outcomes*
Thirteenth International Symposium on Dynamic Games and Applications, Wrocław, Poland.

Summer 2008: *Emergence of Coexistence from Competition in an Evolutionary Game*
SIAM Annual Meeting, San Diego, CA.

Fall 2007: *Evolutionary Games in Flour Beetle Populations*
Department of Mathematics and Statistics Graduate Student Research Seminar, Arizona State University, Tempe, AZ.

Selected Talks (cont.)

Fall 2007: *Evolution Reverses Competitive Outcomes*
Mathematical Modeling and Analysis of Populations in Biological Systems Conference, University of Arizona, Tucson, AZ.

Summer 2006: *Evolution of Competitive Coexistence Among Flour Beetles*
Twelfth International Symposium on Dynamic Games & Applications, Sophia-Antipolis, France.

Fall 2004: *Evolution of Corn Oil Sensitivity in Tribolium castaneum*
Eleventh International Symposium on Dynamic Games & Applications, Tucson, AZ.

Contributed

Summer 2013: *Detecting differences in species abundance patterns of niche and neutral communities*, Ecological Society of America Annual Meeting, Minneapolis, MN.

Summer 2013: *Differences in species abundance patterns of niche and neutral communities*
Biodiversity in a Changing World Workshop, Montreal, QC, CAN.

Spring 2013: *Differentiating Species Abundance Distributions of Niche and Neutral Communities*, Annual Meeting of the Society for Mathematical Biology, Tempe, AZ.

Fall 2012: *Ecological Patterns in Niche and Neutral Communities*
Theory Group Meeting, Ecol. and Evolutionary Bio. Dept., Univ. of Michigan, Ann Arbor, MI.

Summer 2012: *The Influence of Speciation on the Evolution of Complex Food Web Structure*
Ecological Society of America Annual Meeting, Portland, OR.

Summer 2012: *Dynamics and Evolution of Complex Food Web Networks*
Annual Meeting of the Society for Mathematical Biology, Knoxville, TN.

Summer 2011: *Species Abundance Distributions in a Stochastic Competition Model*
AMS/MAA Joint Meetings, Boston, MA.

Fall 2010: *Evolution of Body Size in Food Webs*
Workshop for Young Researchers in Mathematical Biology, Mathematical Biosciences Institute, Columbus, OH.

Fall 2010: *Scaling of abundance patterns across a niche axis*
Theory Group Meeting, Ecol. and Evolutionary Bio. Dept., Univ. of Michigan, Ann Arbor, MI.

Fall 2008: *Coexistence Emerges Through Evolution*
SACNAS National Conference, Salt Lake City, UT.

Spring 2008: *Who Eats Whom? Ecological Structure & the Effects of Extinction on Food Webs*
Program in Applied Mathematics Graduate Student Colloquium, Univ. of Arizona, Tucson, AZ.

Spring 2007: *From Flour Beetles to Food Webs: Applications of Evolutionary Game Theory*
Applied Mathematics Graduate Student Recruitment Workshop, Univ. of Arizona, Tucson, AZ.

Fall 2006: *Introduction to Evolutionary Game Theory and Its Application to Flour Beetles*
Program in Applied Mathematics Graduate Student Colloquium, Univ. of Arizona, Tucson, AZ.

Poster Presentations

- Blackwell-Tapia Conference, Mathematical Biology Institute, Fall 2010
- UA Graduate Interdisciplinary Department Programs Showcase, 2006
- NetSci International Workshop and Conference on Network Science, 2006
- MGE@MSA/WAESO Annual Conference, 2003
- SACNAS National Conferences, 2001, 2002
- AMS/MAA Joint Meeting, 2001

Outreach Experience

Girls in STEM at Tulane (GIST), Spring 2013
Assisted in running a mathematics workshop for middle school girls.

SACNAS Conference abstract and poster judge, Fall 2012
Evaluated student presentation abstract submissions. Judged undergraduate posters in mathematics and helped evaluate judges' score sheets to determine prize winners.

Outreach Experience (cont.)

WISE GISE Science and Engineering Summer Program, Summer 2011
Contributed to the organization and running of a population dynamics workshop for 7th and 8th grade girls.

Sonya Kovalevsky High School Mathematics Day, Spring 2008
Co-organized the event. Contributed to event scheduling, student and teacher recruitment, and purchasing supplies. Conducted a workshop on modeling in population genetics with a group of students and teachers on the University of Arizona campus.

Mathematical Modeling Class Group Mentor, Spring 2008
Mentored a group of undergraduate students conducting a research project on chaos in a dynamical system model of flour beetle populations.

Martin Luther King Jr./Cesar E. Chavez Speaker Series, Spring 2008
Contributed to the organization and development of the event for LAGSES (Latino/a Association of Graduate Students in Engineering and Science) at the University of Arizona, and recruited speakers.

High School Workshop, Fall, 2007
Conducted a workshop for high school students on modeling ecosystem interactions.

Professional Affiliations

- SIAM (Society for Industrial and Applied Mathematics)
- AWM (Association for Women in Mathematics)
- SACNAS (Society for the Advancement of Chicanos and Native Americans in Science)
- ESA (Ecological Society of America)
- ISDG (International Society for Dynamic Games)
- SMB (Society for Mathematical Biology)

Computer Skills

Operating systems

- Linux • Windows • Mac OS

Software and Programming Languages

- Skilled: Matlab, Mathematica, LaTeX, Excel, PowerPoint, Scientific Workplace
- Familiar: `C++`, HTML, Maple
- Learning: R, Python

References

Dr. Annette Ostling	aostling@umich.edu	Postdoctoral Supervisor (current)
Dr. Neo Martinez	neo@peacelab.net	Postdoctoral Supervisor (past)
Dr. Jim Cushing	cushing@math.arizona.edu	Dissertation Advisor