

Department of Mathematical Sciences  
New Mexico State University  
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### **Career History**

**Associate Professor, New Mexico State University** Fall 2008 to present  
**Assistant Professor, New Mexico State University** Fall 2003 to Fall 2008  
**College Assistant Professor, New Mexico State University** Spring 2000 to Fall 2003  
**NSERC Postdoctoral Fellow** Arizona State University 1996-1998  
**Lecturer in Mathematics** Vanderbilt University 1993

### **Degrees Earned**

**Ph.D.** Mathematics, McMaster University    December 1994  
**M.Sc.** Mathematics, McMaster University    August 1989  
**Hon. B.Sc.** Mathematics, Brock University    July 1987

### **Research Interests**

My principal interest is in mathematical models of complex biological and ecological systems. In particular, my research has involved the development and analysis of systems of differential equations that model species interaction under nutrient limitation. In addition to numerical techniques, I use analytical methods to obtain information about the qualitative behavior of the models; more recently I have begun to apply control theory to these models.

### **Scholarships, Awards**

1. Recipient: Outstanding Faculty Achievement Award in Teaching, College of Arts and Sciences.  
(April 23, 2015).
2. Recipient of the 2008 Donald C. Roush Award for Excellence in Teaching
3. Nominated for the 2006-2007 Patricia Christmore Teaching award
4. One of five finalists for the 2005-2006 Patricia Christmore Teaching award
5. ADVANCE Institutional Transformation Award, Spring 2005.
6. The 8<sup>th</sup> Bellman Prize for the best paper published in Mathematical Biosciences for the two-year period 1998-1999, with Dr. Hal Smith of Arizona State University.  
See Publication #8. Announcement appears in Mathematical Biosciences (2002) 179: 219-221.
7. NSERC Postdoctoral Fellowship 1994-1996, tenured 1996-1998
8. Ontario Graduate Scholarship 1992-1993
9. Ontario Graduate Scholarship 1991-1992
10. NSERC Postgraduate Scholarship 1989-1991
12. McMaster Graduate Student Teaching Assistant Excellence Award 1990-1991
12. McMaster Graduate Student Teaching Assistant Excellence Award 1988-1989
13. NSERC Undergraduate Student Research Award 1986-87

### **Publications**

1. M. Ballyk, I. Jawarneh, R. Staffeldt, "A Nutrient-Prey-Predator Model: Stability and Bifurcations", submitted to *Discrete and Continuous Dynamical Systems* (2019).
2. M. Ballyk, Wolkowicz, G.S.K., 2011 "Classical and resource-based competition: A unifying graphical approach," *Journal of Mathematical Biology*. 62:81-109.
3. M. Ballyk, E. Barany, "Stabilization of chemostats using feedback linearization and reduction of dimension." Proceedings of the 2009 American Control Conference, June 10-12, 2009, 2313-2318.
4. M. Ballyk, E. Barany, "The role of resource type in the control of chemostats using feedback linearization," *Ecological Modeling* 211: 25-35 (2008)
5. M. Ballyk, D. Jones, H. Smith, "The Biofilm Model of Freter: a review," in *Structured Population Models in Biology and Epidemiology*, Lecture Notes in Mathematics (Mathematical Biosciences Subseries) P. Magal, S. Ruan (eds.) Springer-Verlag, Volume 1932, 265-302 (2008)
6. H. Noussi, M. Ballyk, E. Barany, "Stabilization of chemostats using feedback linearization." Proceedings of the 46<sup>th</sup> IEEE Conference on Decision and Control, December 10-11, 2007, 677-682.
7. M. Ballyk, E. Barany, "The role of resource types in the control of chemostats using feedback linearization," Proceedings of the 26<sup>th</sup> American Control Conference, July 11-13, 2007.
8. M. Golinski, E. Barany, M. Ballyk, "Ecological conditions that favor the evolution of intermediate virulence in an environmentally transmitted parasite," *Journal of Mathematical Biology* 51: 389-402 (2005)
9. M. Ballyk, C.C. McCluskey, G.S.K. Wolkowicz, "Global analysis of competition for perfectly substitutable resources with linear response," *Journal of Mathematical Biology* 51: 458-490 (2005)
10. M.M. Ballyk, D.A. Jones, H.L. Smith, "Microbial competition in reactors with wall attachment: A mathematical comparison of chemostat and plug flow models," *Microbial Ecology* 41: 210-221 (2001)
11. M.M. Ballyk, H.L. Smith, "A model of microbial growth in a plug flow reactor with wall attachment," *Mathematical Biosciences* 158:95-126 (1999).
12. M.M. Ballyk, H.L. Smith, "A flow reactor with wall growth," in *Mathematical Models in Medical and Health Science*, ed. M. Horn, G. Simonett, G. Webb, Vanderbilt University Press, Nashville (1998).
13. M.M. Ballyk, D. Le, D.A. Jones, H.L. Smith, "Effects of random motility on microbial growth and competition in a flow reactor," *SIAM Journal on Applied Mathematics* 59:573-596 (1998).
14. G.S.K. Wolkowicz, M.M. Ballyk, Zhiqi Lu, "Microbial dynamics in a chemostat: Competition, growth, implications of enrichment," in *Differential Equations and Control Theory*, Proc. of Int. Conf. on Differential Equations and Control Theory, Wuhan, China, ed. Z. Deng et al, Marcel Dekker, Inc., New York (1996).

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### Publications (Cont'd)

15. M.M. Ballyk, G.S.K. Wolkowicz, "An examination of the thresholds of enrichment: A resource-based growth model," *Journal of Mathematical Biology* 33:435-457 (1995).
16. G.S.K. Wolkowicz, M.M. Ballyk, S.P. Daoussis, "Interaction in a chemostat: Introduction of a competitor can promote greater diversity," *Rocky Mountain Journal of Mathematics* 25:515-543 (1995).
17. M.M. Ballyk, G.S.K. Wolkowicz, "Exploitative competition in the chemostat for two perfectly substitutable resources," *Mathematical Biosciences* 118:127-180 (1993)

### Recent Scholarly Activity in the areas of Teaching and Service

For the past five years much of my creative activity has been in the area of teaching and service to the Department of Mathematical Sciences. Once particularly large undertaking has been to better align our lower level mathematics courses (Math 120, 121, 142, 190) as well as the labs associated with Math 142 and 190. The goal is to have a coherent and positive learning experience for students as they move through our lower level courses and into our University level courses. Below I list just some of the work that I have done:

**Math 142:** This course and associated labs were entirely overhauled. Once a new text was chosen, lecture slides and online homework were created. The slides are so well timed with the online homework that I was able to automate the assignment of lecture homework (problems that students do in-between lectures in order to reinforce the ideas discussed in class) in addition to regular homework sets. Labs are now collaborative working environments. I write (and constantly revise) weekly labs that students work in pairs. The labs are staffed with both Graduate Assistants and Peer Learning Assistants. I conduct weekly meetings with all of them to review what happened in the lab the previous week and discuss the content of the lab for the present week. Work on this course is ongoing ... it gets better from semester to semester.

**Math 121:** This course, which typically runs anywhere between 8 and 16 sections in a single semester, was not at all coordinated when I first started. As such, there was tremendous variability in the achievement of student learning outcomes from section to section. It has been a huge (and ongoing) task to align all of the sections so that students in all of the sections have comparable learning experiences. The course now has common online homework, common midterms and a common final exam.

**Math 190:** Before I took over, the labs for Math 190 were uncoordinated and consisted of a too-long list of homework problem numbers taken from the text. I now write (and constantly revise) weekly labs that students work in pairs. Given the success of the Math 142 labs, Math 190 labs are now collaborative working environments. They are staffed with both Graduate Assistants and Peer Learning Assistants. I conduct weekly meetings with all of them to review what happened in the lab the previous week and discuss the content of the lab for the present week. Work on this course is ongoing ... it gets better from semester to semester.

**Future work:** I have identified a target population of students in Math 121 that would benefit from Supplemental Instruction and I am piloting two sections in Fall 2019. The lab consists of a brief synopsis of the week's material followed by a collaborative lab. Thus far, students are very happy with the experience.

## **Conferences and Colloquium Talks**

1. R.I Ruiz-Cooley, M. Ballyk, B. Milligan, "Are Sperm Whales Keystone Predators?" Presented by R.I. Ruiz-Cooley at the 18th Biennial Conference on the Biology of Marine Animals - Quebec City, Canada<sup>[SEP]</sup>12-16 October 2009.
2. M. Ballyk, E. Barany, "Stabilization of chemostats using feedback linearization and reduction of dimension." Presented by E. Barany at the 2009 American Control Conference, St. Louis, MO, June 10-12, 2009.
3. M. Ballyk, E. Barany, "Stabilization of chemostats using feedback linearization and reduction of dimension." Presented by M. Ballyk at the SIAM Conference on Applications of Dynamical Systems, Snowbird, UT, May 17-21, 2009.
4. M. Ballyk, S. Galayda, B. Milligan, "Teaching dynamical systems at the high school level." A poster presented by M. Ballyk at the SIAM Conference on Applications of Dynamical Systems, Snowbird, UT, May 17-21, 2009.
5. M. Ballyk, G.S.K. Wolkowicz, "Classical and resource-based competition: A unifying graphical approach." Invited speakers to Mathematical Tools for Multi-scale Biological Models, Montana State University, Bozeman, MT, June 4-6, 2008.
6. M. Ballyk, E. Barany, "The role of resource types in the control of chemostats using feedback linearization," Presented by M. Ballyk at a special session of the AMS Western Sectional Meeting, University of Arizona, Tucson, AZ, April 21-22, 2007.
7. M. Ballyk, J. Cook, P. Mallapragada, M. Mitchell, I. Pivkina, S. Schibel, "Analysis and Application of Performance Prediction Tools." Poster submitted as part of the "High End Computing along the Rio Grande" high-performance computing consortium display at SC|06 (Supercomputing), November 11-17, 2006.
8. M.M. Ballyk, "Enrichment thresholds for growth and predation," International Workshop on Differential Equations and Mathematical Biology, Le Havre, France, July 11-13, 2005.
9. M.M. Ballyk, "Adventures in Mathematical Ecology," Mathematics Awareness Month Colloquium at New Mexico State University, April 20, 2005.
10. M.M. Ballyk, G.S.K. Wolkowicz, "Enrichment thresholds for growth and predation," Presented by M. Ballyk at a special session of the AMS Central Sectional Meeting, Texas Tech University, Lubbock, TX, April 8-10, 2005.
11. M.M. Ballyk, W. Boecklen, "UBM: A training program for research on the interface of Mathematics and Biology at New Mexico State University," Presented by M. Ballyk at a special session of the MAA Southwestern Section Conference, University of Texas at El Paso, April 1-3, 2005.
12. M.M. Ballyk, C. Connell McCluskey, G.S.K. Wolkowicz, "Competition in the chemostat for two perfectly substitutable resources," Presented by M. Ballyk at the International Conference on Nonlinear Dynamics and Evolution Equations, Memorial University of Newfoundland, Canada, July 6-10, 2004.

**Conferences and Colloquium Talks (cont'd)**

**13.** M.M. Ballyk, G.S.K. Wolkowicz, "Microbial growth and interaction under nutrient limitation," Presented by M. Ballyk at the McMaster University Department of Mathematics and Statistics Colloquium, March 19, 2004.

**14.** M.M. Ballyk, G.S.K. Wolkowicz, "Enrichment Thresholds or Growth and Predation," Presented by M. Ballyk at the Fourth Geoffrey J. Butler Memorial Conference in Differential Equations and Mathematical Biology, Edmonton, Alberta, Canada, June 2003.

**Seminars**

**1.** M.M. Ballyk, "Classical and resource-based competition: A unifying graphical approach," Analysis/Applied Math Seminar, NMSU, October, 2009.

**2.** M.M. Ballyk, "Analysis of Gypsy Moth Spread," presentation and poster for the Board of Regents Tour of Science Hall, May 6, 2005.

**3.** M.M. Ballyk, "Resource-based models of predator-prey interaction," Brown-bag, NMSU Biology Department, April 11, 2005.

**4.** M.M. Ballyk, "Enrichment thresholds for growth and predation," Analysis/Applied Math Seminar, NMSU, March 30, 2005.

**5.** M.M. Ballyk, "Control of Chemostats by Feedback Linearization," AIMS/Phimac Seminar, McMaster University Department of Mathematics and Statistics, November 23, 2004.

**6.** M.M. Ballyk, Modeling the Mammalian Large Intestine, Applied Analysis Seminar, NMSU Department of Mathematical Sciences, September 2003.

**7.** M.M. Ballyk, An Introduction to Mathematical Formulation and Analysis, Basic Notions Seminar, NMSU Department of Mathematical Sciences, August 2003.

## Curriculum Vitae for Mary Margaret Ballyk

### Grants

Title/Co-PI's	Date Submitted	Agency	Amount	Duration	Status
Collaborative Research: Integrating Mathematics into the Introductory Biology Curriculum: A First Step	11/2011	NSF	\$161,367	2 years	Expired
UBM-Group: Research Mentoring in Mathematical Biology at New Mexico State University P.I. Ballyk, Barany, Boecklen, James, Shuster, Curtiss	02/2009	NSF	\$240,190	3 years	Expired
Undergraduate Research Mentoring at the Interface of Mathematics and Biology (continuation) P.I. Boecklen, Ballyk	09/2008	IAS <sup>1</sup>	\$48,534	1 year	Expired
Undergraduate Research Mentoring at the Interface of Mathematics and Biology P.I. Boecklen, Ballyk	04/2008	IAS	\$7,070	1 year	Expired
MCC <sup>2</sup> Phase II P.I. Bulger-Tamez, Kurtz, Gruzka, Matthews	10/2009	NMPED <sup>3</sup>	\$4,532,000	3 years	Expired
MCC - Expanded P.I. Bulger-Tamez, Kinzer	04/2009	NMPED	\$500,000	1 year	Expired
MCC P.I. Bulger-Tamez, Kinzer	04/2008	NMPED	\$500,000	1 year	Expired
MCC <sup>2</sup> P.I. Kurtz, Scott, Wiburg	01/2007	NMPED	\$2,925,000	3 years	Expired
Project: MESH <sup>5</sup> P.I. Dr. David Finston	07/2006	DOE	\$600,000	3 years	Expired
Council of Research Centers Mini-grant Award <sup>4</sup>	06/2005	CORC	\$24,970	1 year - extended	Expired
Center for Research Excellence in Computational Biology Research and Education <sup>5</sup> P.I. Dr. Desh Ranjan	01/2004	NSF	\$4,997,241	5 years	Expired
ADVANCE Startup Grant	n/a	NSF	\$30,666	01/03 – 03/07	Expired
UBM: An Interdisciplinary Program in Mathematical Biology at New Mexico State University PI: Dr. W.J. Boecklen	06/2003	NSF	\$100,311	3 years	Expired

<sup>1</sup> Institute for Advanced Studies <sup>2</sup> Mathematically Connected Communities <sup>3</sup> New Mexico Public Education Department

<sup>4</sup> Co-PIs: Dr. M. Ballyk (Mathematical Sciences), Dr. J. Cook (Electrical Engineering), Dr. M. Mitchell (Chemical Engineering), and Dr. I. Pivkina (Computer Science).<sup>5</sup> I was a participant on this grant.

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### Service or Professional Duties

#### **Reviewer for**

U54 collaboration between the Fred Hutch and NMSU  
Journal of Biological Dynamics  
Bulletin of Mathematical Biology  
IEEE Conference on Decision and Control  
Nonlinear Analysis Series B: Real World Applications  
Discrete and Continuous Dynamical Systems Series B  
Journal of Mathematical Biology  
SIAM Journal on Applied Mathematics  
American Naturalist

### Committees

Pre-Calculus Courses Coordinator (July 2018 – present)  
Undergraduate Curriculum Committee (Chair) (Fall 2013-present)  
Undergraduate Curriculum Committee (Member)  
(Fall 2003 - Spring 2006, Fall 2007 - Spring 2009, Fall 2011-Spring 2013)  
Advisory Committee (January 2012 – December 2013, January 2015 – present)  
Pi Mu Epsilon, Math Club, and Liaison to Recruiting Committee (Fall 2008 – Spring 2014)  
Promotion and Tenure Committee (Fall 2009 – Spring 2010)  
Ad Hoc Calculus Textbook Committee (Fall 2008 - Spring 2009, August 2012 – October 2012)  
Hiring Committee (Fall 2008 - Spring 2009)  
Ad Hoc Committee on Hiring (Fall 2007 - Summer 2008)  
Recruiting Committee (Fall 2007 - Spring 2008)  
Ad Hoc Committee on Calculus (Fall 2006 – Spring 2009)  
Competitions and Modeling Committee (Fall 2004 - Spring 2007)  
Co-organizer of the Analysis/Applied Mathematics seminar (Fall 2003 - Spring 2005)  
Algebra, Precalculus, and General Education Assessment (Fall 2014-Spring 2016)

Course coordinator for Math 120, Fall 2014, Spring 2015, Fall 2018-present  
Course Coordinator/Co-coordinator for Math 121, Fall 2016-present  
Course Coordinator for Math 142, Fall 2015, Spring 2016, Fall 2016, Fall 2018-present  
Course Coordinator for Math 190, Spring 2018, Fall 2018-present  
Course coordinator for Math 191, Fall 2005, Fall 2017  
Course coordinator for Math 392, Fall 2005, Fall 2009, Fall 2011, Fall 2012

**Courses Taught: Credit Instruction**

MATH 120: Intermediate Algebra, 3 courses  
MATH 121: College Algebra, 2 courses  
MATH 142: Business Calculus, 4 courses  
MATH 190: Trig and Pre-Calculus, 1 course  
MATH 191: Calculus and Analytic Geometry I, 4 courses  
MATH 192: Calculus and Analytic Geometry II, 1 course  
MATH 279: Introduction to Higher Math, 2 courses  
MATH 301: Special Topics, 1 course  
MATH 332: Introduction to Analysis, 8 courses  
MATH 377: Introduction to Numerical Methods, 2 courses  
MATH 392: Introduction to Ordinary Differential Equation, 12 courses  
MATH 471/Math 517: Complex Variables, 2 courses  
MATH 472/Math 518: Fourier Series, 4 courses  
MATH 491/Math 527: Real Analysis I, 2 courses  
MATH 492/Math 528: Real Analysis II, 2 courses  
MATH 586: Nonlinear Dynamics, 1 course

**Teaching-related Programs**

1. Mathematically Connected Communities (January 2007 – August 2017): The mission of MCC is to improve student achievement and the teaching and learning of K-12 mathematics by building a statewide learning community of mathematics educators, mathematicians, and public school leaders. As part of my work for the MCC project, I help design and staff summer academies and learning labs for K-12 teachers in New Mexico.
2. Collaborative Research: Integrating Mathematics into the Introductory Biology Curriculum: A First Step (June 1, 2012 -August 31, 2014): In Spring 2012 the NSF-TUES program considered 1050 proposals and recommended 125 for funding. The major focus of our funded proposal, “Integrating mathematics into the introductory biology curriculum: A first step”, was to transform undergraduate biology education by increasing mathematical and statistical literacy of students at the early stages of their education. We worked to establish the relevancy of mathematics and statistics to biology, promote interdisciplinary thinking and problem solving, and decrease student anxiety regarding mathematics and statistics. The goal was to better prepare and motivate students to successfully pursue education and careers in STEM disciplines.
3. UBM-Group: Research Mentoring in Mathematical Biology at New Mexico State University (Spring 2009 – Spring 2013): The goal of this program was to enhance undergraduate education and training at the intersection of mathematics and biology. We endeavored to better prepare undergraduate students to pursue graduate study and careers in fields that integrate the mathematical and biological sciences. The central focus of the program was to provide students with long-term, cohort-based research experiences that combine biological experimentation with mathematical modeling. Nine students were mentored through this program.



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4. Undergraduate Research Mentoring at the Interface of Mathematics and Biology (Spring 2008 – Fall 2009): This program was a precursor to the Research Mentoring Program described above. Five students were mentored through this program.

### **Courses Taught: Non-Credit Instruction**

### **Student Advising**

Advisor of Jean-Jacques Kengwoung-Keumo, Ph.D., Mathematical Sciences

Minor advisor of Ashley Tuefel, M.S, Department of Biology

Minor advisor of Mr. Brecken Uhl, Ph.D., Electrical Engineering

Minor advisor of Ms. Aysegul Birand Pawar, Ph.D., Department of Biology.

Minor advisor of Mr. James Sullivan, M.S., Department of Mechanical Engineering.

Ph.D. Committee member for Mr. Michael Golinsky, Ph.D., Department of Biology.

Ph.D. Committee member for Mr. Hubert Noussi, Ph.D., Department of Mathematical Sciences.

Ph.D. Committee for Suzanne Galayda, Ph.D., Department of Mathematical Sciences.

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**Student evaluation summary totals from Fall 2003 to Spring 2019**

<b>Term</b>	<b>Course</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>F</b>
Fall 2003	Math 392	18				
Spring 2004	Math 332	7				
Fall 2004	Math 392	25	3	1		
	Math 332	11	1			
Spring 2005	Math 472/518	18	1			
Fall 2005	Math 191	20	2			
	Math 392	29	1	1		
Spring 2006	Math 392	30	1			
	Math 472/518	16	1			
Fall 2006	Math 191	26				
	Math 392	23	2			
Spring 2007	Math 191	31	1			
	Math 472/518	28	2			
Fall 2007	Math 192	28	1			
	Math 471/517	28	3			
Spring 2008	Math 392	25	2			
	Math 472/518	26	2			
Fall 2008	Math 332	8				
	Math 392	27	2			
Spring 2009	Math 301	10	2			
	Math 332	15		1	1	
Fall 2009	Math 392	33				
	Math 471/517	27	2	2		
Spring 2010	Math 332	10	1			
	Math 377	24	3	1	1	
Fall 2011	Math 301	6	1			
	Math 332	7				
	Math 392	31		1		
Spring 2012	Math 377	11	2	1		1
	Math 392	33	1	1		
Fall 2012	Math 332	5	2	1		
	Math 392	27	2			
Spring 2013	Math 332	11	2			
	Math 392	16	4	2		
Fall 2013	Math 120	28	1			
	Math 527	7		1		

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### Student evaluation summary totals from Fall 2003 to Spring 2019 (cont'd)

<b>Term</b>	<b>Course</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>F</b>
Spring 2014	Math 120	9	1			
	Math 492/528	7				
Fall 2014	Math 120	28				
	Math 491/527	7	1			
Spring 2015	Math 120	20				
	Math 492/578	6				
Fall 2015	Math 142	67	12	4	1	1
	Math 279	7	2			
Spring 2016	Math 142	75	9	1		
	Math 279	7	4	1	1	
Fall 2016	Math 121	24	5			
	Math 142	68	12	2	1	1
Spring 2017	Math 121	27	1	2	1	
	Math 142	64	10	3	1	
Fall 2017	Math 191	25	1	2		
	Math 586	7	1			
Spring 2018	Math 332	6	2			
	Math 190	34	1			
Fall 2018	Math 142	54	6			
	Math 280	30	1			
Spring 2019	Math 332	11				
<b>Total</b>		1308	117	28	7	3
		89%	8%	2%		