

Van M. Savage
Curriculum Vitae
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ACADEMIC ADDRESS:

Harvard Medical School
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RESEARCH INTERESTS:

Organization and constraint of diversity in ecological systems; scaling across time, space, and size for population, community, and evolutionary processes; effects of climate change on ecosystems; biodiversity; vascular networks; species interactions; speciation-extinction dynamics

EDUCATION:

- 1996-2001 Ph.D. in Physics, Washington University, St. Louis, MO “Analytical and numerical methods for studying PT-symmetric but non-Hermitian Hamiltonians”, Carl Bender, Advisor
1996-1999 A.M. in Physics, Washington University, St. Louis, MO,
1992-1996 B.S. in Physics, Rhodes College, Memphis, TN, *cum laude*, *Phi Beta Kappa*

PROFESSIONAL EXPERIENCE:

- 2006-present *Postdoctoral Fellow*, Department of Systems Biology, Harvard Medical School, Boston, MA
2004-2006 *Systems Biology Postdoctoral Fellow*, Bauer Center for Genomics Research, Harvard University, Cambridge, MA
2001-2004 *Joint Postdoctoral Fellow*
The Santa Fe Institute, Santa Fe, NM
Particles and Fields Group, Los Alamos National Laboratory, Los Alamos, NM
1997-2001 *Graduate Research Assistantship*, Quantum Field Theory DOE grant, Washington University, St. Louis, MO

GRANTS AND AWARDS:

- 2008-2010 *NSF-Advancing Theory in Biology Grant*, “Combining theories for plant architecture, allometry, and traits to develop the next generation of scaling theory”, \$737,521, (co-PI)
2008 *ARC-NZ Workshop for Vegetation Function* “WG36 Trait-Based Models”, Approximately \$25,000-\$30,000, (PI and Organizer)
2006-2008 *NSF-Ecology Grant*, “Trait-based approaches for predicting ecosystem response to environmental change: Empirical tests and model development”, \$109,274, (listed as Senior Personnel but served role of co-PI because of my academic status—letter from PI Colleen Webb is available upon request)
2000 *NSF Physics Graduate Fellowship*, The Santa Fe Institute, Santa Fe, NM
1996 *Meritorious Award in Mathematical Contest in Modeling* by COMAP and the NSA, my team finished in top 15 out of 400 international teams, Rhodes College, Memphis, TN

PUBLICATIONS:

1266 Total Citations (using google scholar)

16 Ecology and Evolution Research Papers; 4 Responses to or Comments on Published Ecology and Evolution Papers; 1 Biology Book Chapter; 1 Biology Book Review; 8 Theoretical Particle Physics Research Papers

Ecology and Evolution Papers:

1. **V. M. Savage**, C. T. Webb, and J. Norberg, (2007) A trait-based framework for studying the effects of biodiversity on ecosystem functioning, *Journal of Theoretical Biology* **247**, 213-229.
2. A. P. Allen and **V. M. Savage**, Setting the absolute tempo of biodiversity dynamics (2007) *Ecology Letters* **10**, 637-646.
3. C.A. Price, B.J. Enquist, and **V.M. Savage**, Scaling the diversity of botanical form and function, (2007) *Proceedings of the National Academy of Sciences, USA*, **104(32)**, 13204-13209.
4. **V. M. Savage** and G. B. West, Towards a quantitative, metabolic theory of mammalian sleep, (2007) *Proceedings of the National Academy of Sciences, USA*, **104(3)**, 1051-1056.
5. **V. M. Savage**, A.P. Allen, J. F. Gillooly, A. B. Herman, J. H. Brown, and G. B. West, (2007) Scaling of number, size, and metabolic rate of cells with body size in mammals, *Proceedings of the National Academy of Sciences, USA*, **104(11)**, 4718-4723.
6. **V.M. Savage**, B.J. Enquist, and G.B. West, Comment on Chauvi-Berlinck, (2007) *Journal of Experimental Biology*, **210(21)**, 3873-3874.
7. **V. M. Savage**, E. P. White, M. E. Moses, S. K. M. Ernest, B. J. Enquist, E. L. Charnov (2006) Comment on, "The illusion of invariant quantities in life histories", *Science* **312**, 198b. **2 citations**
8. A.P. Allen, J. F. Gillooly, **V. M. Savage**, J. H. Brown, (2006). Kinetic effects of temperature on rates of genetic divergence and speciation, *Proceedings of the National Academy of Sciences, USA*, **103**, 9130-9135. **28 citations**
9. **V. M. Savage** and G. B. West (2006). Biological scaling and physiological time: Biomedical applications. *Complex System Science in Biomedicine*. Ed. T. S. Deisboeck and J. Y. Kresh, New York, Kluwer Academic.
10. J. F. Gillooly, A. P. Allen, **V. M. Savage**, E. L. Charnov, G. B. West J. H. Brown (2006). Response to Clarke and Fraser: effects of temperature on metabolic rate, *Functional Ecology* **20**, 400-404. **12 citations**
11. J. E. Cohen, T. Jonsson, C. B. Muller, H. C. J. Godfray, and **V. M. Savage**, (2005). Body sizes of hosts and parasitoids in individual feeding relationships, *Proceedings of the National Academy of Sciences, USA* **102(3)**, 684-689. **9 citations**
12. J. F. Gillooly, A. P. Allen, J. H. Brown, J. J. Elser, C. Martinez del Rio, **V. M. Savage**, G. B. West, W. H. Woodruff, and A. Woods. (2005). The Metabolic Basis of Whole-Organism RNA and Phosphorus Content, *Proceedings of the National Academy of Sciences, USA* **102**, 11923-11927. **13 citations**
13. **V. M. Savage**, J. F. Gillooly, J. H. Brown, G. B. West, and E. L. Charnov, (2004). Effects of body size and temperature on population growth, *The American Naturalist* **163(3)**, 429-441. **78 citations**
14. **V. M. Savage** (2004). Improved approximations to scaling relationships for species, populations, and ecosystems across latitudinal and elevational gradients. *Journal of Theoretical Biology* **227(4)**, 525-534. **19 citations**
15. **V. M. Savage**, J. F. Gillooly, W. H. Woodruff, G. B. West, A. P. Allen, B. J. Enquist, and J. H. Brown (2004). The predominance of quarter-power scaling in biology. *Functional*

Ecology **18(2)**, 257-282. **93 citations**

16. J. H. Brown, J. F. Gillooly, A. P. Allen, **V. M. Savage**, and G. B. West. (2004) Toward a metabolic theory of ecology (MacArthur award paper), *Ecology* **85(7)**, 1771-1789. **274 citations**
 17. **V. M. Savage** (2003). Is biology just chemistry?: Book review of “Ecological Stoichiometry: The Biology of Elements from Molecules to the Biosphere” by Robert W. Sterner and James J. Elser. *Complexity* **8(6)**, 42-44.
 18. S. K. M. Ernest, B. J. Enquist, J.H. Brown, E. L. Charnov, J. F. Gillooly, **V. M. Savage**, E. P. White, F. A. Smith, E. A. Hadly, J. P. Haskell, S. K. Lyons, B. A. Maurer, K. J. Niklas & B. Tiffney (2003) Thermodynamic and metabolic effects on the scaling of production and population energy use. *Ecology Letters* **6**, 990-995. **47 citations**
 19. J. Jun, J. W. Pepper, **V. M. Savage**, J. F. Gillooly, and J. H. Brown. (2003). Allometric scaling in centrally foraging ant colonies, *Evolutionary Ecology Research* **5(2)**, 297-303. **9 citations**
 20. G. B. West, **V. M. Savage**, J. Gillooly, B. J. Enquist, W. H. Woodruff, and J. H. Brown. (2003). But why *does* metabolic rate scale with body size? Brief Communication. *Nature*, **421**, 713-714. **37 citations**
 21. J. F. Gillooly, E. L. Charnov, G. B. West, **V. M. Savage**, and J. H. Brown (2002). Effects of size and temperature on developmental time, *Nature* **417**, 70-73. **142 citations**
 22. J. F. Gillooly, J. H. Brown, G. B. West, **V. M. Savage**, and E. L. Charnov (2001). Effects of size and temperature on metabolic rate, *Science* **293**, 2248-2251. **264 citations**
- Biology Papers in Review:**
23. A. B. Herman, **V. M. Savage**, and G. B. West, A quantitative theory for tumor growth and vascularization, to be submitted to *Proceedings of the National Academy of Sciences, USA*.
 24. **V. M. Savage***, E. J. Deeds*, and W. Fontana, Sizing up allometric scaling theory: Beyond leading order, submitted to *Public Library of Science: Computational Biology*.
*denotes equal contribution

Physics Papers:

Note: In particle physics **authors are listed alphabetically**, not by order of importance or contribution. If authors were listed by contribution, I would be first author on all except 28.

25. C. W. Bernard and **V. M. Savage** (2003). \mathcal{PT} -symmetric quantum field theories and the Langevin equation. *Czech Journal of Physics*, **54**, 109-118.
26. F. Cooper and **V. M. Savage** (2002). Dynamics of the chiral phase transition in the 2+1 dimensional Gross-Neveu model, *Physics Letters B* **545**, 307-314. **5 citations**
27. C. W. Bernard and **V. M. Savage** (2001). Numerical simulations of \mathcal{PT} -symmetric quantum field theories, *Physical Review D* **64**, 085010. **21 citations**
28. C. M. Bender, M. V. Berry, P. N. Meisinger, **V. M. Savage**, and M. Simsek (2001). Complex WKB analysis of energy-level degeneracies of non-Hermitian Hamiltonians, *Journal of Physics A Letters* **34**, L31-L36. **35 citations**
29. C. M. Bender, K. A. Milton, and **V. M. Savage** (2000). Solution of Schwinger-Dyson equations for \mathcal{PT} -symmetric quantum field theories, *Physical Review D* **62**, 085001. **57 citations**
30. C. M. Bender, S. Boetcher, and **V. M. Savage** (2000). Conjecture on the interlacing of zeros in complex Sturm-Liouville problems, *Journal of Mathematical Physics* **41**, 6381-6387. **56 citations**
31. C. M. Bender, S. Boetcher, H. F. Jones, and **V. M. Savage** (1999). Complex square well—a new exactly solvable quantum mechanical model, *Journal of Physics A* **32**, 6771-6781. **43 citations**
32. C. M. Bender, F. Cooper, P. N. Meisinger, and **V. M. Savage** (1999). Variational ansatz for \mathcal{PT} -symmetric quantum mechanics, *Physics Letters A* **259**, 224-231. **35 citations**

Popular Press Coverage in 2007:

The Edge World Question Center, “What are you optimistic about (for 2007)?”, Steven Strogatz, Cornell University Professor, describes my work on sleep and says it is what he is most optimistic about for the new year.

http://www.edge.org/q2007/q07_14.html

Harvard Gazette, “Sleep found to repair and reorganize the brain”, cover article describing my recent work on sleep and cell size

<http://www.news.harvard.edu/gazette/2007/03.15/01-sleepsize.html>

Thomson Scientific's Essential Science Indicators, feature on my work and entry into top 1% of scientists in environment and ecology in terms of citations, appearing in December 2007.

<http://in-cites.com/scientists/2007menu.html>

Science Daily, “Species sizes affect lives of cells in mammals”, highlight of paper on organismal constraints on cell size and cellular metabolic rate

<http://www.sciencedaily.com/releases/2007/03/070308220603.htm>

PNAS In This Issue, “Geometry of vascular systems governs plant forms”, highlighting of paper on selective pressures on plant architectures, *PNAS* **104** 12952

INVITED PRESENTATIONS:

Ecology and Evolution Talks:

Colloquium Speaker, “Scaling from unicells to whales: New methods for studying physiological and ecological systems”, University of Washington, Seattle, WA 2007

Invited Speaker, PIBBS Seminar, “Biological scaling and climate change: Effects of temperature on population growth, species interactions, and rates of adaptation”, University of New Mexico, Albuquerque, NM 2007

Colloquium Speaker, “Scaling in biology”, Rhodes College, Memphis, TN 2007

Poster Presentation, Gordon Research Conference on the Metabolic Basis of Ecology, “Cold-blooded killers: Effects of body size and temperature on predator-prey relations”, Bates College, Lewiston, ME 2006

Colloquium Speaker, “Scaling from unicells to whales”, Washington State University, Pullman, WA 2006

Colloquium Speaker, “Scaling from unicells to whales: constraints on evolution and development”, University of Mississippi, Oxford, MS 2005

Invited Speaker, Physics and Complex Systems Seminar, “Scaling in biology”, Chalmers University, Gothenburg, Sweden, 2005.

Colloquium Speaker, “Scaling in biology: A unifying approach to cells, individuals, and Ecosystems”, James Cook University, Townsville, Australia, 2005.

Invited Speaker and Participant, Vascular Design A: Working meeting of the ARC-NZ Research Network for Vegetation Function, Macquarie University, Sydney, Australia, 2005.

Invited Speaker, Gordon Research Conference, “The Allometry of Stoichiometry”, Bates College, ME, 2004.

Plenary Speaker, Undergraduate Research and Creative Activity Symposium, Rhodes College, Memphis, TN, 2004

Colloquium Speaker, PRIMES program (joint between biology, engineering, and math departments), “Resource-distribution networks and biochemical kinetics”, Colorado State University, Fort Collins, CO, 2003

Symposium Speaker, Ecological Society of America Annual Meeting, “Effects of body size and temperature on population growth”, Savannah, GA, 2003

Invited Speaker, Santa Fe Institute workshop: Towards an ecology based on first principles of size, temperature, and stoichiometry, “Effects of size and temperature on population growth”, Santa Fe, NM, 2002

Invited Speaker, Biology Seminar, “Scaling in populations and ecosystems”, University of Arizona, Tucson, AZ, 2002

Physics Talks:

Invited Speaker, International workshop on non-Hermitian Hamiltonians, “ \mathcal{PT} -symmetric quantum field theories and the Langevin equation”, Prague, Czech Republic, 2003.

Invited Speaker, Physics Theory Seminar, “Numerical simulations of \mathcal{PT} -symmetric but non-Hermitian Hamiltonians”, Ohio State University, Columbus, OH, 2002

TEACHING EXPERIENCE:

Faculty, Santa Fe Institute Complex Systems Summer School, lectured on mathematical methods, including scaling theory, diffusion equations, probability and statistics, data analysis, and coupled ordinary and partial differential equations for studying systems in ecology, evolution, physiology, physics, medicine, and economics, Santa Fe, NM, 2007

Faculty, Santa Fe Institute Complex Systems Summer School, Beijing, China, 2005-2007

Faculty, Integrative Biology Course Evolutionary and Ecological Genomics, lectured on scaling methods for studying biological systems Patzcuaro, Mexico, 2006

Faculty, Complex Systems School, joint between the Indian Institute for Mathematical Sciences and the Santa Fe Institute, Chennai, India, 2006

Guest Lecturer, Introductory Physics, Washington University, St. Louis, MO, University College, 1998, and Summer, 2001

Teaching Assistant, Epic of Evolution (joint course between Physics, Biology, and Earth and Planetary Sciences Departments), provided solution sets, helped with in-class demonstrations and assigning of final grades, and graded, Washington University, St. Louis, MO, 2000

Teaching Assistant, Mathematical Methods in Physics and Advanced Mathematical Methods in Physics, made solution sets and graded, Washington University, St. Louis, MO, 1998-1999

Teaching Assistant, Physics and Society, provided solution sets, held office hours, helped assign final grades, and graded, Washington University, St. Louis, MO, 1998

Teaching Assistant, Introductory Physics, taught 3 lab sections per week, assigned final lab grades, one of 4 out of 12 TAs to hold office hours, and graded, Washington University, St. Louis, MO, 1996-1998

Teaching Assistant, Intermediate Lab, guided students through experiments, helped assign final grades, and graded, Rhodes College, Memphis, TN, 1994-1995

COMMITTEES AND PROFESSIONAL SERVICE:

Advisor to Alex Herman (currently in MD/PhD program at UCSF), Research Experience for Undergraduates, Santa Fe Institute, Santa Fe, NM, 2002-2004

Referee for National Science Foundation, Nature, The American Naturalist, Proceedings of the National Academy of Sciences, Ecology Letters, Trends in Ecology and Evolution, Oikos, Journal of Animal Ecology, Journal of Experimental Biology, Journal of Theoretical Biology, British Journal of Cancer, Tree Physiology, Physics in Medicine and Biology, Journal of Physics A: Mathematics and General, Journal of Mathematical Physics, Physics Letters A, International Journal of Modern Physics Letters

Member of Selection Committee for the Complex Systems Summer School at the Santa Fe Institute, Santa Fe, NM, 2002-2006

Member of Teaching Assistant Committee, Washington University, St. Louis, MO, 2000

Graduate Council Representative and Student Government Senator, Washington University, St. Louis, MO, 1998-2000

Chair of Academic Affairs Committee, Along with two others, I wrote a 40 page report based on our extensive research and dialogue with other colleges that suggested changes to the tenure-review process at Rhodes College. The majority of our suggestions were adopted. Rhodes College, Memphis, TN, 1994-1996

REFERENCES:

Walter Fontana

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Department of Systems Biology
Harvard Medical School
Boston, MA 02115
E-mail: walter@hms.harvard.edu

Brian Enquist

Professor
Department Of Ecology and Evolutionary Biology
University of Arizona
Tucson, AZ 85721
E-mail: benquist@email.uarizona.edu

Geoffrey B. West

President of the Santa Fe Institute
Senior Laboratory Fellow, Los Alamos National Laboratory
Santa Fe Institute
Santa Fe, NM 87501
Telephone: 505-667-5382
E-mail: gbw@lanl.gov
Geoff is frequently traveling, so it is often best to contact his assistant at: dlu@santafe.edu

Joel E. Cohen

Abby Rockefeller Mauze Professor
Rockefeller University
New York City, NY 10021
E-mail: cohen@mail.rockefeller.edu

James H. Brown

Distinguished Professor
Member of National Academy of Sciences
Biology Department
University of New Mexico
Albuquerque, NM 87131
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E-mail: jhbrown@unm.edu
Jim is frequently traveling, so it is often best to contact his assistant at: shannon@unm.edu