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Education

Ph.D., Zoology, May 1982, University of Rhode Island, Kingston
M.S., Zoology, May 1979, University of Rhode Island, Kingston
B.A., Biology, June 1976, University of Massachusetts, Boston

Positions

Professor, 9/97 to present, Department of Biological Sciences, Cal State LA
Associate Professor, 9/92 to 8/97, Department of Biological Sciences, Cal State LA
Assistant Professor, 9/88 to 8/92 present, Department of Biological Sciences, Cal State LA
Assistant Professor, 9/87 to 8/88, Laboratory of Populations, Rockefeller University, NYC
Research Associate, 9/85 to 8/87, Laboratory of Populations, Rockefeller University, NYC
Postdoctoral Associate, 9/83 to 8/85, Laboratory of Populations, Rockefeller University, NYC
Killam Postdoctoral Fellow, 9/82 to 8/83, Biology Department, Dalhousie University, Nova Scotia

Teaching Experience

Lower Division: Human Physiology, Human Anatomy (labs), Principles of Biology III (majors),
Natural History of Animals (GE, labs)
Upper Division: Advanced Biometry, Biological Modeling, Biometrics, General Ecology, General
Genetics, Internet Resources in Biology, Population Genetics
Graduate Level: Biology Seminar, Topics in Animal Ecology, Seminar in Ecology

Mentoring

New Faculty: Dr. Sergio Escorza-Treviño, Dr. Robert Nissen
Postdoctoral: Recruited and supported Dr. Doug D. Donalson, Dr. Megan Donahue, Dr. Mel
Limson, and Dr. Edgar Diaz on external grants
Master's Degree: Patricia Arriola, Andre Baghoomian, Ling Cao, Warren Cheung, Melo Encinas,
Alberto Izarraraz, Jian Liu, Lucinda Robeldo, Luis Soto-Ortiz, Robin Sherwood-
Stephens, Robert Tan, Yervand Torosyan, Thomas Wong
Undergraduates: Tyler Andersen, Neha Bhatt, Dzu Bui, Jonnie Burton, Ling Cao, Emily Chen, Juan
Coleman, Julie Dunnahoe, Stephen Hardy, Karen Joseph, Anny Ku, Irene Lui, Judy
Lu, Tai Luu, Enrique Nuñez, Kent Pan, Chau Phu, Karina Preciado, Gabriel Rodas,
Claire Schulkey, Luis Soto-Ortiz, Rebecca Tatum, Yervand Torosyan, Timothy
Weisbrod, Julie Yang, Timothy Yeh
High School: Wan Chi, Samuel Diaz, Alexandria Dominguez, Alejandro Luna, Christina Ton

Research Interests

Nonlinear population dynamics including applications of chaos theory to ecology

Spatially-mediated dynamics in benthic communities
 Natural selection and population dynamics
 Application of mathematics and statistics to biological problems
 Use of technology to improve undergraduate and K-12 science education

Professional Affiliations

American Association for the Advancement of Science
 American Society of Naturalists
 Beta Beta Beta Biological Honor Society
 California Science Teachers Association
 Ecological Society of America
 Genetics Society of America
 National Center for Science Education
 National Science Teachers Association
 Phi Kappa Phi Honor Society
 Sigma Xi Honor Society
 Society for Mathematical Biology
 Southern California Academy of Sciences

Awards and Honors

President's Distinguished Professor Award, California State University, Los Angeles, AY 2010-2011
 Nominee for the Wang Family Excellence Award, California State University, Los Angeles, 2006
 Quality Education for Minorities Richard Nicholson Award for Excellence in Science Teaching, 2006
 California State University, Los Angeles, Chapter Sigma Xi Award, 1999
 Outstanding Professor Award, California State University, Los Angeles, AY 1998-1999
 Cal State LA "Million Dollar Club" for exceeding \$1M in external grant awards, October 1998
 Izaak Walton Killam Postdoctoral Fellowship, September 1982
 URI Graduate Research Fellowship, September 1980
 Rhode Island Chapter Sigma Xi award for best MS thesis in the biological sciences, November 1979
 Graduated Summa Cum Laude from University of Massachusetts, Boston, June 1976
 Environmental Internship, Audubon Society, Summer 1974
 Valedictorian, Notre Dame High School, June 1972

Research Highlights

Co-author of several research reports published in *Science*, *Nature*, and *Proceedings of the National Academy of Sciences* as well as other discipline-based peer-reviewed journals.

The interdisciplinary research program in which I participate reached a milestone when we published the first experimental evidence of chaos in ecological population dynamics. This generated interest in the scientific and popular press. For example, the research received high praise in *Nature* (Kareiva 1995), "This work is an unusual blend of nonlinear dynamics theory, statistics and experimentation—and the results are of uncommon clarity for ecology." In *Science*, Godfray and Hassell (1997) wrote that our work "provides the most convincing evidence to date of complex dynamics and chaos in a biological population." Below is a listing of some of the articles that report on our research:

- Kareiva, P. 1995. Predicting and producing chaos. *Nature* **375**: 189–190.
- Surplee, C. 1995. Checking for bugs in chaos theory. *Washington Post*, 22 May, p. 2.
- Shorter articles also appeared in the following newspapers: *Newsday* (18 May 1995), *Boston Globe* (22 May 1995), *Denver Rocky Mountain News* (23 May 1995), *Chicago Tribune* (28

May 1995), *Seattle Times* (30 May 1995), *Portland Oregonian* (28 May 1995), *Montreal Gazette* (21 May 1995), *Orange County Register* (18 May 1995), *Cleveland Plain Dealer* (20 June 1995).

- Godfray, H. C., and Hassell, M. P. 1997. Chaotic beetles. *Science* **275**: 323–324.
- Leutwyler, K. 1997. Cautioned by chaos. *Scientific American*, March, p. 20.
- Perry, J. N., Woiwod, I. P., Smith, R. H., and Morse, D. 1997. Estimating chaos in an insect population. *Science* **276**: 1881–1882.
- Rohani, P., and Earn, D.J.D. 1997. Chaos in a cup of flour. *Trends in Ecology and Evolution* **12**: 171.
- Cipra, B.A. 1997. Chaotic bugs make leap from theory to experiment. *SIAM News*, July/August.
- Knight, J. 1997. Boom time for beetles. *New Scientist*, 29 November, p. 19.
- Cipra, B. A. 1998. Beetlemania: chaos in ecology. Pages 72–81 in *What's Happening in the Mathematical Sciences, Volume 4*, American Mathematical Society.
- Dalton, R. 2000. NSF aims to inject more maths into biology. *Nature* **407**: 931.
- Bjørnstad, O. N. and Grenfell, B. T. 2001. Noisy clockwork: time series analysis of population fluctuations in animals. *Science* **293**: 638–643.
- Cipra, B.A. 2003. In population dynamics, it's a dogma eat dogma world. *SIAM News*, June.
- Caswell, H. 2003. Models, experiments, and chaos. *Ecology* **84**: 2804–2905.
- Benton, T.G. 2006. Revealing the ghost in the machine: Using spectral analysis to understand the influence of noise on population dynamics. *Proceedings of the National Academy of Sciences, USA* **103**: 18387–18388.

By invitation, the interdisciplinary research team of which I am a member delivered a series of three seminars as part of the *Year of Science and Technology* at Wake Forest University on 13–15 September 1999.

Dr. Rita R. Colwell, then Director of the National Science Foundation, included a slide of our work as part of her presentations at Princeton University on 13 April 2000 and the Annual Meeting of the American Institute of Biological Sciences, Arlington, VA, on 24 March 2001. She introduced the slide by saying, “Now at the level of population, we see the first demonstration of chaos in a biological population.”

In the 5 December 2006 issue of the *Proceedings of the National Academy of Sciences*, the editors commissioned a commentary article to accompany our paper. In the commentary, titled “Revealing the ghost in the machine: Using spectral analysis to understand the influence of noise on population dynamics,” Prof. Tim Benton of the University of Leeds praises our work and describes its importance to the study of ecological dynamics.

By invitation, Dr. Carlos Robles and I contributed a paper to a Special Topics section of *Ecology* dealing with “Paradigms in Ecology” which appeared in June, 2002. This article discussed our innovations in using cellular automata to model mussel population dynamics in intertidal ecological communities.

A book which I coauthored, *Chaos in Ecology*, has received favorable reviews. For example, in the journal *Ecology*, Caswell (2003) writes, “In terms of what they reveal about the mechanisms of population growth, about nonlinear stage-structured population models, and about chaos in ecology, these experiments are on the level of classic works of Gause, Nicholson, Park, and Huffaker. In terms of the integration of experiment and theory, they surpass even those studies.”

Our research in nonlinear dynamics and chaos theory is making its way into the ecological and applied mathematics literature, including textbooks. The following books all include detailed descriptions and figures and/or equations based on our research:

- Alligood, K., Sauer, T., and Yorke, J. A. 1996. *Chaos: An Introduction to Dynamic Systems*. Springer.
- Brauer, F. and Castillo-Chavez, C. 2001. *Mathematical Models in Population Biology and Epidemiology*. Texts in Applied Mathematics, Springer.
- Caswell, H. 2000. *Matrix Population Models*. Sinauer Associates, Inc.
- Ford, E. D. 2000. *Scientific Method for Ecological Research*. Cambridge University Press.
- Haefner, J. W. 1996. *Modeling Biological Systems: Principles and Applications*. Chapman and Hall
- Istas, J. 2005. *Mathematical Modeling for the Life Sciences*. Springer.
- Mahner, M., and Bunge, M. A. 1997. *Foundations of Biophilosophy*. Springer.
- May, R. M. 2001. *Stability and Complexity in Model Ecosystems, 3rd edition*. Princeton University Press.
- McLean, A. R. 2007. *Theoretical Ecology: Principles and Applications*. Oxford University Press.
- Mueller, L. and Joshi, A. 2000. *Stability in Model Populations*. Princeton University Press.
- Rooney, N., McCann, K. S., Noakes, D. L. G., and Yodzis, P. 2007. *From Energetics to Ecosystems: The Dynamics and Structure of Ecological Systems*. Springer.
- Schowalter, T. D. 2006. *Insect Ecology: An Ecosystem Approach*. Academic Press, New York.
- Sole, R. V., and Bascompte, J. 2006. *Self-Organization in Complex Ecosystems*. Princeton University Press.
- Stewart, I. 2002. *Does God Play Dice?: The New Mathematics of Chaos*. Wiley-Blackwell.
- Taubes, C. H. 2001. *Modeling Differential Equations in Biology*. Prentice Hall. (Reproduces our 1995 *Nature* paper in its entirety.)
- Turchin, P. 2003. *Complex Population Dynamics: A Theoretical/Empirical Synthesis*. Princeton University Press.
- Vandermeer, J. H., and Goldberg, D. E. 2003. *Population Ecology: First Principles*. Princeton University Press.

With support from the National Science Foundation, I organized and hosted a two day conference on the “Dynamics of Layering in Biological Systems.” This conference, which was held in Pasadena on 15-16 January 2010, brought together biologists and mathematical modelers from around the world to discuss how to model complex layered systems from microbial biofilms to temperate forests. Graduate students and postdoctoral fellows also participated in the conference.

Student mentoring has been a important aspect of my research activities. In my laboratory I have mentored three postdoctoral fellows, served as major professor to ten graduate students, and supervised research by 25 undergraduates and five high school students. All of these individuals have been supported by external awards that fund my research program. One of my MS students, Lucinda Robledo, went on to a doctoral program at UC Santa Cruz, and another, Luis Soto, completed a doctoral program at the University of California, Irvine. Two more students from my laboratory started graduate programs in Fall 2008: Alberto Izarraraz at Claremont Graduate School and Claire Schulkey at Washington University.

Educational Innovations

Director and founder of the *Virtual Courseware Project* which is devoted to the development of on-line simulations for science education (www.ScienceCourseware.org). Over five million students

have used these web-based applications. The Virtual Courseware Project has received special recognition and several awards. In January 2005 the Education World web site designated the Virtual Courseware Project as an “A+ Exceptional Site.” The Virtual Courseware Project was designated “Red Hot Site of the Day” on 29 May 2007 by RedOrbit.com. On 30 May 2008 the Virtual Courseware Project received the “MANeLA Virtual Laboratory Award” from the Merlot African Network at a ceremony in Ghana, West Africa.

Author of *Drosophila*, a web-based simulation that is part of the NSF-funded project called *Virtual Courseware for Inquiry-based Science Education* (www.ScienceCourseware.org/vcise/). This application provides high school students with a “virtual lab bench” where they can conduct experiments to learn the genetic principles of inheritance. It also provides teachers with on-line tools for assessing their students. We have partnered with administrators and teachers in the Los Angeles Unified School District to field test this software. This application was featured in the 5 May 2006 “NetWatch” section of the journal *Science*.

Author of *Global Warming*, a suite of nine web-based simulations and tutorials that deal with the science of climate change. This application was featured in the 1 April 2004 “NetWatch” section of the journal *Science*.

Author of *Biology Labs On-Line*, a collection of 12 web-based applications, marketed by Benjamin Cummings and jointly owned by the California State University and the publisher. Students around the world have purchased over 700,000 subscriptions to these applets (www.BiologyLabsOnLine.com).

Author of web service called *Virtual FlyLab* which has been used extensively for genetics instruction. When it was released in June of 1995, this was one of the first interactive simulations available on the World-Wide-Web for science education. This web site has been accessed by over 650,000 students from hundreds of universities, colleges, and high schools across the world and has received a variety of “best of the web” awards. It was also praised in the following print articles:

- Anderson, R. 1997. On-line evolution. *Natural History* **106**: 13.
- Jacobson, L. 1999. Mixed-mode simulation. *Syllabus* **12**: 38–40.

Represented the 23 campuses of the California State University in a presentation on the use of technology in education to the California Postsecondary Education Commission (CPEC) on December 15, 1996 in Sacramento.

Before the popularity of the World-Wide-Web, I author a variety PC-based applications for science instruction that were used on several campuses. Two of these, *FlyLab* and *KaryotypeLab*, were described in news articles in *Chronicle of Higher Education* (8 July 1992) and *Science* (4 November 1994), respectively.

Publications—Academic Books

Costantino, R.F., and **Desharnais, R.A.** 1991. “Population Dynamics and the *Tribolium* Model: Genetics and Demography.” Springer-Verlag, New York (258 pages).

Cushing, J.M., Costantino, R.F., Dennis, B., **Desharnais, R.A.**, and Henson, S.M. 2002. “Chaos in Ecology: Experimental Nonlinear Dynamics.” Academic Press, New York (225 pages).

Desharnais, R.A. (editor). 2005. “Population Dynamics and Laboratory Ecology.” Academic Press, New York (374 pages).

Publications—Peer-Reviewed Journal Articles

- Desharnais, R.A.**, and Costantino, R.F. 1980. Genetic analysis of a population of *Tribolium*. VII. Stability: Response to genetic and demographic perturbations. *Canadian Journal of Genetics and Cytology* **22**: 577–589.
- Costantino, R. F., and **Desharnais, R.A.** 1981. Gamma distributions of adult numbers for *Tribolium* populations in the region of their steady states. *Journal of Animal Ecology* **50**: 667–681.
- Desharnais, R.A.**, and Costantino, R.F. 1982. Natural selection and fitness entropy in a density-regulated population. *Genetics* **101**: 317–329.
- Desharnais, R.A.**, and Costantino, R.F. 1982. Approach to equilibrium and the steady-state probability distribution of adult numbers in *Tribolium brevicornis*. *American Naturalist* **119**: 102–111.
- Desharnais, R.A.**, and Costantino, R.F. 1983. Natural selection and density-dependent population growth. *Genetics* **105**: 1029–1040.
- Desharnais, R.A.**, and Costantino, R.F. 1985. Genetic analysis of a population of *Tribolium*. VIII. The stationary stochastic dynamics of adult numbers. *Canadian Journal of Genetics and Cytology* **27**: 341–350.
- Desharnais, R.A.**, Foltz, D.W., and Zouros, E. 1985. Maintenance of genetic polymorphism under conditions of genotype-dependent growth and size-selective mortality. *Canadian Journal of Genetics and Cytology* **27**: 279–288.
- Desharnais, R.A.** 1986. Natural selection, fitness entropy, and the dynamics of coevolution. *Theoretical Population Biology* **30**: 309–340.
- Desharnais, R.A.**, and Cohen, J.E. 1986. Life not lived due to disequilibrium in heterogeneous age-structured populations. *Theoretical Population Biology* **29**: 385–406.
- Desharnais, R.A.**, and Liu, L. 1987. Stable demographic limit cycles in laboratory populations of *Tribolium castaneum*. *Journal of Animal Ecology* **56**: 885–906.
- McCabe, J.T., Kawata, M., Sano, Y., Pfaff, D.W., and **Desharnais, R.A.** 1990. Quantitative *in situ* hybridization to measure single-cell changes in vasopressin and oxytocin mRNA levels after osmotic stimulation. *Cellular and Molecular Neurobiology* **10**: 59–71.
- Desharnais, R.A.**, Dennis, B., and Costantino, R.F. 1990. Genetic analysis of a population of *Tribolium*. IX. Maximization of population size and the concept of a stochastic equilibrium. *Genome* **33**: 571–580.
- Dennis, B., **Desharnais, R.A.**, Cushing, J.M., and Costantino, R.F. 1995. Nonlinear demographic dynamics: mathematical models, statistical methods, and biological experiments. *Ecological Monographs* **65**: 261–281.
- Costantino, R.F., Cushing, J.M., Dennis, B., and **Desharnais, R.A.** 1995. Experimentally induced transitions in the dynamic behavior of insect populations. *Nature* **375**: 227–230.
- Wilson, W.G., Nisbet, R.M., Ross, A.H., Robles, C., and **Desharnais, R.A.** 1996. Abrupt population changes along smooth environmental gradients. *Bulletin of Mathematical Biology* **58**: 907–922.
- Cushing, J.M., Dennis, B., **Desharnais, R.A.**, and Costantino, R.F. 1996. An interdisciplinary approach to understanding nonlinear ecological dynamics. *Ecological Modelling* **92**: 111–119.
- Costantino, R.F., **Desharnais, R.A.**, Cushing, J.M., and Dennis, B. 1997. Chaotic dynamics in an insect population. *Science* **275**: 389–391.

- Desharnais, R.A.**, Costantino, R.F., Cushing, J.M., and Dennis, B. 1997. Estimating chaos in an insect population. Reply to Perry et al. *Science* **276**: 1881–1882.
- Dennis, B., **Desharnais, R.A.**, Cushing, J.M., and Costantino, R.F. 1997. Transitions in population dynamics: equilibria to periodic cycles to aperiodic cycles. *Journal of Animal Ecology* **66**: 704–729.
- Clark, S.J., and **Desharnais, R.A.** 1998. Honest answers to embarrassing questions: detecting cheating in the randomized response model. *Psychological Methods* **3**: 160–168.
- Costantino, R.F., Cushing, J.M., Dennis, B., **Desharnais, R.A.**, and Henson, S.M. 1998. Resonant population cycles in alternating habitats. *Bulletin of Mathematical Biology* **60**: 247–273.
- Cushing, J.M., Dennis, B., **Desharnais, R.A.**, and Costantino, R.F. 1998. Moving toward an unstable equilibrium: saddle nodes in population systems. *Journal of Animal Ecology* **67**: 298–306.
- Cushing, J.M., Costantino, R.F., Dennis, B., **Desharnais, R.A.**, and Henson, S.M. 1998. Nonlinear population dynamics: models, experiments, and data. *Journal of Theoretical Biology* **194**: 1–9.
- Henson, S.M., Cushing, J.M., Costantino, R.F., Dennis, B., and **Desharnais, R.A.** 1998. Phase switching in population cycles. *Proceedings of the Royal Society* **265**: 2229–2234.
- Henson, S. M., Costantino, R. F., Cushing, J. M., Dennis, B., and **Desharnais, R. A.** 1999. Multiple attractors and population dynamics in periodic habitats. *Bulletin of Mathematical Biology* **61**: 1121–1149.
- Cushing, J.M., Henson, S.M., **Desharnais, R.A.**, Dennis, B., Costantino, R.F., and King, A. 2001. A chaotic attractor in ecology: theory and experimental data. *Chaos, Solitons, and Fractals* **12**: 219–234.
- Dennis, B., **Desharnais, R.A.**, Cushing, J.M., Henson, S.M. and Costantino, R.F. 2001. Estimating chaos and complex dynamics in an insect population. *Ecological Monographs* **71**: 277–303.
- Robles, C.D., Alvarado, M.A., and **Desharnais, R.A.** 2001. The shifting balance of marine predation in regimes of hydrodynamic stress. *Oecologia* **128**: 142–152.
- Desharnais, R.A.**, Dennis, B., Cushing, J.M., Henson, S.M., and Costantino, R.F. 2001. Chaos and population control of insect outbreaks. *Ecology Letters* **4**: 229–235.
- Henson, S.M., Costantino, R.F., Cushing, J.M., **Desharnais, R.A.**, and Dennis, B. 2001. Lattice effects observed in chaotic dynamics of experimental populations. *Science* **294**: 602–605.
- Robles, C. and **Desharnais, R.** 2002. History and current development of a paradigm of predation in rocky intertidal communities. *Ecology* **83**: 1521–1536.
- Henson, S.M., Costantino, R.F., **Desharnais, R.A.**, Cushing, J.M., and Dennis, B. 2002. Basins of attraction: population dynamics with two stable 4-cycles. *Oikos* **98**: 17–24.
- King, A.A., **Desharnais, R.A.**, Henson, S.M., Costantino, R.F., Cushing, J.M., and Dennis, B. 2002. Random perturbations and lattice effects in chaotic population dynamics: Reply to Domokos and Scheuring. *Science* **297**: 2163a.
- Dennis, B., **Desharnais, R.A.**, Cushing, J.M., Henson, S.H., and Costantino, R.F. 2003. Can Noise Induce Chaos? *Oikos* **102**: 329–340.
- Edmunds, J., Cushing, J.M., Costantino, R.F., Henson, S.M., Dennis, B., and **Desharnais, R.A.** 2003. Park's *Tribolium* competition experiments: a non-equilibrium species coexistence hypothesis. *Journal of Animal Ecology* **72**: 703–712.

- Henson, S.M., King, A.A., Costantino, R.F., Cushing, J.M., Dennis, B., and **Desharnais, R.A.** 2003. Explaining and predicting patterns in stochastic population systems. *Proceedings of the Royal Society of London B* **270**: 1549–1553.
- King, A.A., Costantino, R.F., Cushing, J.M., Henson, S.H., **Desharnais, R.A.**, and Dennis, B. 2004. Anatomy of a chaotic attractor: Subtle model-predicted patterns revealed in population data. *Proceedings of the National Academy of Sciences USA* **101**: 408–413.
- Desharnais, R.A.**, Edmunds, J., Costantino, R.F., and Henson, S.M. 2005. Species competition: uncertainty on a double invariant loop. *Journal of Difference Equations and Applications* **11**: 311–325.
- Brown, A., **Desharnais, R.A.**, Roy, B.C., Malik, S., and Gomez, F.A. 2005. Optimization of conditions for flow-through partial-filling affinity capillary electrophoresis to estimate binding constants of ligands to receptors. *Analytica Chimica Acta* **540**: 403–410.
- Desharnais, R.A.**, Costantino, R.F., Cushing, J.M., Henson, S.M., Dennis, B., and King, A.A. 2006. Experimental support for the scaling rule of demographic stochasticity. *Ecology Letters* **9**: 537–547.
- Reuman, D.C., **Desharnais, R.A.**, Costantino, R.F., Ahmad, O.S., Cohen, J.E. 2006. Power spectra reveal the influence of stochasticity on nonlinear population dynamics. *Proceedings of the National Academy of Sciences USA* **103**: 18860–18865.
- Reuman, D.C., Costantino, R.F., **Desharnais, R.A.**, Cohen, J.E. 2008. Color of environmental noise affects the nonlinear dynamics of cycling, stage-structured populations. *Ecology Letters* **11**: 820–830.
- Martinez, J.G., Waldon, M., Huang, Q., Alvarez, S., Oren, A., Sandoval, N., Du, M., Feimeng, Z., Zenz, A., Lohner, K., **Desharnais, R.A.**, Porter, E. 2009. Membrane-targeted synergistic activity of docosahexaenoic acid and lysozyme against *Pseudomonas aeruginosa*. *Biochemical Journal* **419**: 193–200.
- Robles, C.D., **Desharnais, R.A.**, Garza, C., Donahue, M.J., Martinez, C.A. 2009. Complex equilibria in the maintenance of boundaries: experiments with mussel beds. *Ecology* **90**: 985–995.
- Lee, J.T., Jansen, M., Yilma, A.N., Nguyen, A., **Desharnais, R.A.**, and Porter, E. 2010. Antimicrobial lipids: novel innate defense molecules are elevated in sinus secretions of patients with chronic rhinosinusitis. *American Journal of Rhinology and Allergy* **24**: 99–104.
- Robles, C.D., Garza, C., **Desharnais, R.A.**, Donahue, M.J. 2010. Landscape patterns in boundary intensity: a case study of mussel beds. *Landscape Ecology* **25**: 745–759.
- Donahue, M.J., **Desharnais, R.A.**, Robles, C.D., Arriola, P. 2011. Mussel bed boundaries as dynamic equilibria: thresholds, phase shifts, and alternative states. *American Naturalist* **178**: 612–625.
- Rodriguez, N.R., Eloi, M. D., Huynh, A., Dominguez, T., Cheung Lam, A. H., Molina-Carcamo, D., Naser, Z., **Desharnais, R.A.**, Salzman, N. H., and Porter, E. 2012. Paneth cell expansion in response to *Salmonella enterica* serovar Typhimurium infection. *Infection and Immunity* **80**: 266–275.
- Kiwata, J., Anouseyan, R., **Desharnais, R.A.**, Cornwell, A., Khodiguan, N., and Porter, E. 2014. Effects of aerobic exercise on lipid-effector molecules of the innate immune response. *Medicine & Science in Sports & Exercise*: **46**: 506–512.

Publications—Book Chapters

- Desharnais, R.A.** 1986. The advantages of APL for population modeling. Pages 14–27 in “APL as a Tool of Thought” (D. McCormick and J. Freeman, eds.). Association for Computing Machinery Special Interest Group on APL, New York.
- McCabe, J.T., **Desharnais, R.A.**, and Pfaff, D.W. 1989. Graphical and statistical approaches to data analysis for in situ hybridization. Pages 822–848 in “Methods in Enzymology, Vol. 168, Hormone Action, Part K: Neuroendocrine Peptides.” (P. M. Conn, ed.). Academic Press, New York. [Reprinted as pages 107–133 in “Selected Methods in Enzymology, Neuroendocrine Peptides” (P. M. Conn, ed). Academic Press, New York.]
- Desharnais, R.A.** 1997. Population dynamics of *Tribolium*. Pages 303–328 in “Structured Population Models in Marine, Terrestrial, and Freshwater Systems,” S. Tuljapurkar and H. Caswell (editors), Chapman & Hall, New York.
- Donalson, D.D., **Desharnais, R.A.**, Robles, C.D., and Nisbet, R. 2003. Spatial dynamics of a benthic community: Applying multiple models to a single system. Pages 429–444 in “Handbook of Scaling Methods in Aquatic Ecology: Measurement, Analysis and Simulation,” edited by L. Seuront and P. Strutton. CRC Press, Boca Raton, Florida.
- Costantino, R.F., **Desharnais, R.A.**, Cushing, J.M., Dennis, B., Henson, S.M., and King, A.A. 2005. Nonlinear stochastic population dynamics: The flour beetle *Tribolium* as an effective tool of discovery. Chapter 4 in “Population Dynamics and Laboratory Ecology,” R.A. Desharnais (editor), Academic Press, New York.
- Costantino, R.F., and **Desharnais, R.A.** 2012. Chaos. Pages 126–131 in “Encyclopedia of Theoretical Ecology,” edited by A. Hastings and L.J. Gross, University of California Press.

Publications—Instructional Materials and Related Articles

- Desharnais, R.A.**, and Jefferson, M. 1994. “Lecture Notes for Principles of Biology III.” Burgess Publishing, Edina, Minnesota (146 pages).
- Novak, G.A., and **Desharnais, R.A.** 1994. Integrating the electronic desktop into the science curriculum. *Selected Papers from the National Conference on Teaching and Learning* **5**: 121–127.
- Desharnais, R.A.** 1996. Strange attractors: chaos theory as a catalyst for the collaboration of science and art. *Collaborative Inquiry in a Postmodern Era: A Cat’s Cradle* **2**: 27–35.
- Novak, G.A., and **Desharnais, R.A.** 1998. Virtual courseware for science education. *Selected Papers from the Ninth International Conference on College Teaching and Learning* **9**: 99–107.
- Desharnais, R.A.**, and Novak, G.A. 1998. Virtual courseware for science education. *Syllabus* **12**: 54–60.
- Desharnais, R.A.** 1999. Learning by doing with Biology Labs On-Line. *Strategies for Success* **31**: 4–5.
- Palladino, M.A., **Desharnais, R.A.**, and Bell, J. 2001. “Student Lab Manual for Biology Labs On-Line.” Benjamin Cummings, San Francisco (165 pages).
- Palladino, M.A., **Desharnais, R.A.**, and Bell, J. 2001. “Instructor’s Lab Manual for Biology Labs On-Line.” Benjamin Cummings, San Francisco (160 pages).
- Desharnais, R.A.**, and Escorza-Treviño, S. 2003. “Lab Manual for Biometrics.” California State University, Los Angeles (111 pages).

Limson, M., Witzlib, C, and **Desharnais, R.A.** 2007. Using web-based simulations to promote inquiry. *ScienceScope* **30**: 36–42.

Desharnais, R.A., and Limson, M. 2007. Designing and implementing Virtual Courseware to promote inquiry-based learning. *Journal of Online Learning and Teaching* **3**: 30–39.

Narguizian, P. and **Desharnais, R.A.** 2012. Virtual Courseware: web-based simulations for promoting inquiry-based teaching and learning. *California Classroom Science*: tinyurl.com/ksr2xuy.

Publications—Other

Romanko, K.A., and **Desharnais, R.A.** 1990. Confessions of a technophile (humor). *ComputerEdge* **8**: 56–58.

Desharnais, R.A. 1990. Review of “Population Harvesting: Demographic Models of Fish, Forest, and Animal Resources” by W.M. Getz and R.G. Haight. *Quarterly Review of Biology* **65**: 375.

Romanko, K.A., and **Desharnais, R.A.** 2005. The Quantum Casino (poem). *Astropoetica*, Issue. 3.3, Fall.

Romanko, K.A., and **Desharnais, R.A.** 2006. Damnodynamics: The Science of Hell (poem). *Poe Little Thing*, Issue 4, Winter.

Desharnais, R.A. 2009. “The Shadow Dancer.” Short story in *Cinema Spec: Tales of Hollywood and Fantasy*, edited by Karen A. Romanko. Raven Electric Ink, Los Angeles.

Major Grant Support

Program: NSF Mathematical Biology

Title: “Synchrony in Metapopulations at Multiple Time-Scales: Theory, Experiments and Field Data”

PI’s: Desharnais, R.A., Cohen, J.E., and Costantino, R.F.

Award: \$600,000; 15 September 2012 to 31 August 2017

Program: NSF Emerging Frontiers

Title: “Dynamics of Layering in Biological Systems”

PI’s: Desharnais, R.A., Robles, C.D., and Murray, R.M.

Award: \$750,000; 1 September 2008 to 31 August 2012

Program: NSF Division of Undergraduate Education (subcontract from CSU Chancellor’s Office)

Title: “Building Locally, Linking Globally: Networking Micro-Communities of Noyce Scholars for Advancing Innovations and Improvement in Mathematics and Science Education”

PI’s: Desharnais, R.A., and Narguizian, P.

Award: \$76,000; 1 October 2007 to 30 September 2011

Program: NSF Division of Mathematical Biology

Title: “Spectral analysis of population time series using nonlinear stochastic models”

PI’s: Desharnais, R.A.

Award: \$400,000; 15 February 2005 to 14 February 2011

Program: NSF Elementary, Secondary and Informal Education

Title: “Virtual Courseware for Inquiry-Based Science Education”

PI’s: Desharnais, R.A., and Mayo, D.

Award: \$1,299,272; 1 March 2004 to 31 August 2010

- Program: NSF Centers for Research Excellence in Science and Technology
Title: "Experimental Field Tests of a Model of Intertidal Zonation"
PI's: Robles, C.D., and Desharnais, R.A.
Award: \$615,995; 1 September 2003 to 31 August 2010
- Program: NSF Division of Applied Mathematics
Title: "Stochastic Nonlinear Population Dynamics"
PI's: Desharnais, R.A.
Award: \$47,641; 1 September 2002 to 31 August 2004
- Program: NSF Division of Biological Oceanography
Title: "Modeling spatially-structured dynamics for benthic predation"
PI's: Desharnais, R.A., and Robles, C.D.
Award: \$557,428; 1 July 2001 to 31 March 2007
- Program: NSF Division of Undergraduate Education
Title: "Virtual Courseware for Environmental Science Education"
PI's: Desharnais, R.A., and Novak, G.A.
Award: \$500,000 (NSF & CSU match); 1 February 2000 to 31 January 2003
- Program: NSF Division of Applied Mathematics
Title: "Nonlinear Demographic Dynamics"
PI's: Desharnais, R.A.
Award: \$153,000; 1 September 1999 to 31 March 2003
- Program: NSF Centers for Research Excellence in Science and Technology
Title: "Spatially-Structured Dynamics of a Dominant Seashore Species"
PI's: Robles, C.D., Desharnais, R.A., and Qiu, H.L.
Award: \$1,273,298; 1 September 1998 to 31 August 2003
- Program: NSF Division of Undergraduate Education
Title: "Virtual Courseware for Science Education"
PI's: Desharnais, R.A., and Novak, G.A.
Award: \$525,000 (NSF & CSU match); 1 February 1998 to 31 January 2000
- Program: NSF Division of Applied Mathematics
Title: "Nonlinear Demographic Dynamics"
PI's: Desharnais, R.A.
Award: \$165,000; 1 September 1996 to 31 August 1999
- Program: NSF Division of Undergraduate Education
Title: "Integrating the Electronic Blackboard into the Natural Science Curriculum"
PI's: Desharnais, R.A., and Novak, G.A.
Award: \$200,000; 1 January 1995 to 30 June 1998
- Program: NSF Division of Applied Mathematics
Title: "Nonlinear Demographic Dynamics"
PI's: Desharnais, R.A.
Award: \$157,264; 1 September 1993 to 31 August 1996

Program: NSF Division of Biological Oceanography
Title: "Size Dependent Feedback in Littoral Predation"
PI's: Robles, C.D., and Desharnais, R.A.
Award: \$259,913; 1 September 1992 to 31 August 1995

Program: NSF Division of Undergraduate Education
Title: "Integrating the Electronic Blackboard into the Natural Science Curriculum"
PI's: Desharnais, R.A., and Novak, G.A.
Award: \$250,000; 1 September 1992 to 31 August 1994

Program: NSF Division of Undergraduate Education
Title: "The Interactive Electronic Blackboard for Natural Science and Math Education"
PI's: Desharnais, R.A., and Novak, G.A.
Award: \$98,934; 1 April 1991 to 30 September 1993

Program: EPA Exploratory Research
Title: "The Effects of Genetic Selection on Population Dynamics"
PI's: Cohen, J.E., and Desharnais, R.A.
Award: \$143,301; 15 October 1985 to 14 October 1987

Total External Grant Support: \$8,072,046