

Ruth Geyer Shaw

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Education:

1976 B.A. Oberlin College, Oberlin, Ohio. Biology.
1983 Ph.D. Duke University, Durham, N.C. Botany, Genetics.

Positions Held:

1977-1978 Research assistant, Microbial Ecology Laboratory, Division of Engineering and Applied Sciences, Harvard University.
1978-1979 Teaching Assistant, Duke University.
1983 Post-doctoral Research Assistant, Duke University.
1984-1986 Post-doctoral Research Fellow, University of Washington.
1987-1992 Assistant Professor, University of California, Riverside.
1993-1994 Assistant Professor, University of Minnesota
1994-2000 Associate Professor, University of Minnesota
1995-1996 Sabbatical leave, University of Edinburgh
2000- Professor, University of Minnesota
2002-2003 Visiting Professor, Université de Montpellier II

Academic Honors and Fellowships:

1975 Florence Frew prize in Classics, Oberlin College.
1975 Phi Beta Kappa
1979-1982 National Science Foundation Graduate Fellowship
1982-1983 National Institutes of Health Traineeship administered by the University Program in Genetics, Duke University
1984-1986 National Institutes of Health Individual Post-doctoral Fellowship
1995-1996 Bush Sabbatical Fellowship, University of Minnesota
2002-2003 Fellowship, John Simon Guggenheim Memorial Foundation
2002-2003 College of Biological Sciences (UM) Sabbatical Supplement
2009 President's Award, American Society of Naturalists

Research Activities

Grants and Contracts

National Science Foundation:

Genetic Basis of Plant Interactions, 1989 - 1992. \$145,000.

Maximum likelihood analysis of Quantitative Genetic Data, 1991 - 1993. \$58,330.

Mating Success in Montane Wildflowers: Postpollination Mechanisms and Relative Fitness Contribution of Differential Outcrossing Distance, (co-P.I. with N.M. Waser and M.V. Price), 1989 - 1993. \$214,000.

Patterns of Genetic Variation in Natural Populations: Chromosomal, Single Gene and Polygenic, 1992-1994. \$5,330. (Doctoral Dissertation Improvement Award for Robert Podolsky).

Mutational effects on quantitative traits of *Arabidopsis thaliana*, 1996 - 2000. \$264,000.

Spontaneous mutation affecting quantitative traits in *Arabidopsis thaliana*, 2000-2005. \$404,000.

Biocomplexity: Evolution and ecology of perturbed interactions: modeling disequilibria in time and space, 2000 - 2005, co-PI with C. Neuhauser, PI, DN Alstad, G. May, P. Graham, co-PIs. \$2,965,346.

DISSERTATION RESEARCH: The effect of inbreeding on nitrogen use efficiency, 2002 -2003. \$8,000, co-PI with D. Alstad, for E. Lonsdorf.

Natural selection and evolutionary constraints in an elevated CO₂ environment. \$237,452 2004 - 2006. co-PI with P. Tiffin, P. Reich

LTREB: The interplay of genetic and numerical dynamics in severely fragmented prairie populations of *Echinacea*, \$225,000 2006-2011. PI, collaborative with S. Wagenius.

IGERT: Risk Analysis for Invasive Species and Genotypes, \$3,000,000 2007-2012. Co-PI with R. Newman, D. Andow, S. Galatowitsch, A. Kapuscinski.

Environmental Protection Agency: STAR Graduate Fellowship for Julie Otterson, 1995-1998, \$23,262.

Pioneer Hi-Bred International, Inc., Estimation of Quantitative Genetic Parameters in Inbred Populations", 1993 – 1995. \$60,000.

BBSRC(UK), Underwood Fund Grant, 1995 - 1996. \$8000.

University of Minnesota Initiative for Renewable Energy and the Environment:
Genetic basis of biomass accumulation in the model plant *Arabidopsis thaliana* grown in ambient and elevated CO₂ environments. \$25,000. 2004-2005. Co-PI with P. Tiffin, P. Reich.

Publications:

Journal Articles

Clay, K. and R. G. Shaw. 1981. An experimental demonstration of density-dependent reproduction in a natural population of *Diamorpha smalli*, a rare annual. *Oecologia* 51: 1-6.

Shaw, R. G. 1986. Response to density in a wild population of the perennial herb *Salvia lyrata*: variation among families. *Evolution* 40: 492-505.

Shaw, R. G. and J. Antonovics. 1986. Density-dependence in *Salvia lyrata*: the effects of experimental alteration of seed densities. *Journal of Ecology* 74: 797-813.

Shaw, R. G. 1987. Density-dependence in *Salvia lyrata*: experimental alteration of densities of established plants. *Journal of Ecology* 75: 1049-1063.

Shaw, R. G. and J. Antonovics. 1987. The dynamics of an experimental population of *Salvia lyrata*: the population cage approach applied to plants. *New Phytologist* 107: 415-426.

Mitchell-Olds, T. and R. G. Shaw. 1987. Regression analysis of natural selection: statistical inference and biological interpretation. *Evolution* 41: 1149-1161.

Shaw, R. G. 1987. Maximum-likelihood approaches applied to quantitative genetics of natural populations. *Evolution* 41: 812-826.

Tsuji, J. S., R. G. Huey, F. H. Van Berkum, T. Garland, Jr, and R. G. Shaw. 1989. Locomotor performance of hatchling fence lizards (*Sceloporus occidentalis*): quantitative genetics and morphometric correlates. *Evolutionary Ecology* B3: 240-252.

Thompson E. A. and R. G. Shaw. 1990. Pedigree analysis for quantitative traits: variance components without matrix inversion. *Biometrics* 46: 399-413.

Shaw, R. G. 1991. The comparison of quantitative genetic parameters between populations. *Evolution* 45: 143-151.

Shaw, R. G. and H. L. Billington. 1991. Comparison of variance components between two populations of *Holcus lanatus*: a reanalysis. *Evolution* 45: 1287-1289.

Platenkamp, G. A. J., and R. G. Shaw. 1992. Environmental and genetic constraints on adaptive population differentiation in *Anthoxanthum odoratum*. *Evolution* 46: 341-352.

Thompson, E. A. and R. G. Shaw. 1992. Estimating polygenic models for multivariate data on large pedigrees. *Genetics* 131:971-978.

Shaw, R. G. 1992. Comparison of quantitative genetic parameters: reply to Cowley and Atchley. *Evolution* 46: 1967-1969.

Hill, J. P., E. M. Lord, and R. G. Shaw. 1992. Morphological and growth rate differences among outcrossing and self-pollinating races of *Arenaria uniflora* (Caryophyllaceae). *Journal of Evolutionary Biology* 5: 559-573.

Platenkamp, G.A.J. and R. G. Shaw. 1993. Environmental and genetic maternal effects on seed characters in *Nemophila menziesii*. *Evolution* 47: 540-555.

Shaw, R. G. and G. A. J. Platenkamp. 1993. Quantitative genetics of response to competitors in *Nemophila menziesii*. *Evolution* 47: 801-812.

Mitchell, R. J. and R. G. Shaw. 1993. Heritability of floral traits for the perennial wild flower *Penstemon centranthifolius* (Scrophulariaceae): clones and crosses. *Heredity* 71: 185-192.

Shaw, R. G. and T. Mitchell-Olds. 1993. ANOVA for unbalanced data: an overview. *Ecology* 74: 1638-1645.

Shaw, R. G. and N. M. Waser. 1994. Quantitative genetic interpretations of postpollination reproductive traits in plants. *American Naturalist* 143: 617-635.

Andersson, S. and R. G. Shaw. 1994. Phenotypic plasticity in *Crepis tectorum* (Asteraceae): genetic correlations across light regimes. *Heredity* 72: 113-125.

Montalvo, A.M. and R.G. Shaw. 1994. Quantitative genetics of sequential life-history and juvenile traits in the partially selfing perennial, *Aquilegia caerulea*. *Evolution* 48: 828-841.

Shaw, R. G., G. A. J. Platenkamp, F. H. Shaw, R. H. Podolsky. 1995. Quantitative genetics of response to competitors in *Nemophila menziesii*: a field experiment. *Genetics* 139: 397-406.

Waser, N. M., R. G. Shaw, and M. V. Price. 1995. Seed set and seed mass in *Ipomopsis aggregata*: variance partitioning and inferences about postpollination selection. *Evolution* 49: 80-88.

Shaw, F. H., R. G. Shaw, G. S. Wilkinson, and M. Turelli. 1995. Changes in the genetic variance-covariance: **G** whiz!. *Evolution* 49: 1260-1267.

- Wilensky, C.A., Holt, J.S., Ellstrand, N.C., Shaw, R.G. 1995. Genotypic diversity of Kikuyugrass (*Pennisetum clandestinum*) populations in California. *Weed Science* 43: 209-214.
- Reznick, D. N., F. H. Shaw, F. H. Rodd, R. G. Shaw. 1997. Evaluation of the rate of evolution in natural populations of guppies (*Poecilia reticulata*). *Science* 275: 1934-1937.
- Byers, D. L., G. A. J. Platenkamp, and R. G. Shaw. 1997. Variation in seed characters in *Nemophila menziesii*: evidence of a genetic basis for maternal effect. *Evolution* 51: 1445-1456.
- Podolsky, R. P., R. G. Shaw, and F. H. Shaw. 1997. Population structure of morphological traits in *Clarkia dudleyana*. II. Constancy of within-population genetic variance. *Evolution* 51: 1785-1796.
- Mitchell, R. J., R. G. Shaw, and N. M. Waser. 1998. Pollinator selection, quantitative genetics, and predicted evolutionary responses of floral traits in *Penstemon centranthifolius* (Scrophulariaceae). *International Journal of Plant Sciences* 159: 331-337.
- Shaw, R. G., D. L. Byers, and F. H. Shaw. 1998. Genetic components of variation in *Nemophila menziesii* undergoing inbreeding: morphology and flowering time. *Genetics* 150: 1649-1661.
- Hauser, T. P., R. G. Shaw, and H. Ostergard. 1998. Hybridisation between weedy populations of *Brassica campestris* and varieties of oilseed rape (*B.napus*): I. Fitness of F₁ progeny. *Heredity* 81:429-435.
- Waser, N.M., M.V. Price, and R. G. Shaw. 2000. Outbreeding depression varies among cohorts of *Ipomopsis aggregata* planted in nature. *Evolution* 54: 485-491.
- Shaw, R. G., D. L. Byers, and E. Darms. 2000. Spontaneous mutational effects on reproductive traits of *Arabidopsis thaliana*. *Genetics* 155: 369-378.
- Jannink, J.-L., J. H. Orf, N. R. Jordan, and R. G. Shaw. 2000. Index selection for weed suppressive ability in soybean. *Crop Sci* 40: 1087-1094.
- Keightley, P. D., E. K. Davies, A. D. Peters, R. G. Shaw. 2000. Properties of ethylmethane sulfonate-induced mutations affecting life-history traits in *Caenorhabditis elegans* and inferences about bivariate distributions of mutation effects. *Genetics* 156: 143-154.
- Davis, M.B. and R. G. Shaw. 2001. Range shifts and adaptive responses to quaternary climate change. *Science* 292: 673-679.
- Etterson, J. R. and R. G. Shaw. 2001. Constraint to adaptive evolution in response to

global warming. *Science* 294: 151-154.

Shaw, F. H., C. J. Geyer and R. G. Shaw. 2002. A comprehensive model of mutation affecting fitness and inferences for *Arabidopsis thaliana*. *Evolution* 56:453-463.

Mercer, K., J. Jordan, D. Wyse, and R. G. Shaw. 2002. Multivariate differentiation of quackgrass (*Elytrigia repens*) from three farming systems. *Weed Science* 50: 677-685.

Neuhauser, C., D. A. Andow, G. Heimpel, G. May, R. G. Shaw, and S. Wagenius. 2003. Community genetics: expanding the synthesis of ecology and genetics. *Ecology* 84: 545-558.

Shaw, R. G., F. H. Shaw, and C. J. Geyer. 2003. What fraction of mutations reduces fitness: a reply to Keightley and Lynch. *Evolution* 57: 686-689.

Chang, S.-M. and R.G. Shaw. 2003. The contribution of spontaneous mutation to variation in environmental response in *Arabidopsis thaliana*: responses to nutrients. *Evolution* 57: 984-994.

Kavanaugh, C.M. and R.G. Shaw. 2005. The contribution of spontaneous mutation to variation in environmental response in *Arabidopsis thaliana*: responses to light. *Evolution* 59:266-275.

Davis, M.B., R.G. Shaw, and J.R. Etterson. 2005. Evolutionary responses to changing climate. *Ecology* 86: 1704-1714.

Heiser, D.A. and R.G. Shaw. 2006. The fitness effects of outcrossing in *Calylophus serrulatus*, a permanent translocation heterozygote. *Evolution* 60:64-76.

Mercer, K.L., R.G. Shaw, and D.L. Wyse. 2006. Increased germination of diverse crop-wild hybrid sunflower seeds. *Ecol. Appl.* 16:845-854.

Gomez, N. and R.G. Shaw. 2006. Inbreeding effect on male and female fertility and inheritance of male sterility in *Nemophila menziesii* (Hydrophyllaceae). *American Journal of Botany* 93: 739-746.

Shaw, R.G. and Chang, S.-M. 2006. Gene action of new mutations in *Arabidopsis thaliana*. *Genetics* 172: 1855-1865.

Mercer, K. M., D. L. Wyse, and R. G. Shaw. 2006. Effects of competition on the fitness of wild and crop-wild hybrid sunflower from a diversity of wild populations and crop lines. *Evolution* 60: 2044-2055.

Geyer, C. J., S. Wagenius, and R. G. Shaw. 2007. Aster models for life history analysis. *Biometrika* 94: 415-426.

Mercer, K. M., R. G. Shaw, D. A. Andow, and D. L. Wyse. 2007. Stress and

domestication traits increase the relative fitness of crop-wild hybrids in sunflower. *Ecology Letters* 10: 383-393.

Lau J.A., Shaw R.G., Reich P.B., P. Tiffin. 2007. Strong ecological but weak evolutionary effects of elevated CO₂ on a recombinant inbred population of *Arabidopsis thaliana*. *New Phytologist* 175: 351-362.

Lopez, S., F. Rousset, F.H. Shaw, R.G. Shaw and O. Ronce. 2008. Migration load in plants: role of pollen and seed dispersal in heterogeneous landscapes. *J. Evol. Biol.* 21: 294-309.

Shaw, R.G., C.J. Geyer, S. Wagenius, H.H. Hangelbroek, J.R. Etterson. 2008. Unifying life history analyses for inference of fitness and population growth. *American Naturalist* 172: E35-E47.

Crozier, L. G., A. P. Hendry, P. W. Lawson, T. P. Quinn, N. Mantua, J. Battin, R. G. Shaw, R. B. Huey. 2008. Evolutionary responses to climate change for organisms with complex life histories: evolution and plasticity in Pacific salmon. *Evolutionary Applications* 1:252-270.

Franks, S. J., Avise, J. C., Bradshaw, W. E., Conner, J. K., Etterson, J. R., Mazer, S. J., Shaw, R. G., Weis, A. E. 2008. The Resurrection Initiative: Storing Ancestral Genotypes to Capture Evolution in Action. *Bioscience* 58: 870-873.

Ronce, O., F. H. Shaw, F. Rousset, R. G. Shaw. 2009. Is inbreeding depression lower in maladapted populations? A quantitative genetics model. *Evolution* 63: 1807-1819.

Book Chapters:

Platenkamp, G. A. J., and R. G. Shaw. 1995. Limits to adaptive population differentiation of quantitative traits in plants. In *Ecogeographic Races: Papers presented at the 73rd annual meeting of the pacific division of AAAS in honor of the 100th anniversary of the birth of Gote Turesson*. A. Kruckeberg, R.B. Walker, and A. E. Leviton, Eds.

Shaw, R. G. and D. L. Byers. 1998. Genetics of maternal and paternal effects. In *Maternal effects as adaptations*, T. A. Mousseau and C. W. Fox, eds. Oxford Univ. Press.

Computer programs:

Shaw, R. G. and F. H. Shaw. 1992, 1994. Quercus: programs for quantitative genetic analysis using maximum likelihood. Published electronically on the Internet, <http://biosci.cbs.umn.edu/eeb/quercus.html>.

Invited Seminars (past 10 years):

- 1999 Symposium on Spontaneous mutation, European Society of Evolutionary Biology, Barcelona
1999 University of South Dakota, Department of Biology
2000 University of California, Davis, Evolution and Ecology Seminar
2000 NCR21 meeting (Plant and animal breeders from midwest land-grant universities), St. Paul.
2001 University of Minnesota, Department of Physiology
2001 Minnesota Agricultural Extension Agents and Specialists
2001 Washington State University, Department of Biology, invited by graduate students to speak, fall 2001
2001 University of Southern California, Department of Molecular Biology
2002 University of Minnesota, Ecology, Evolution and Behavior
2002 Universite de Montpellier II, Institut des Sciences de l'Evolution
2003 University of Edinburgh, ICAPB, Genetics
2003 University of Fribourg, Ecology and Evolution
2004 Kellogg Biological Station, Michigan State University
2004 Initiative in Organismal Interactions Retreat, Washington State University and University of Idaho
2004 Plant Biological Sciences Colloquium, University of Minnesota
2005 Department of Biology, University of Minnesota-Duluth, March 4
2005 Center for Population Biology, University of California, Davis. (Distinguished speaker, 5 talks, April 11-15; Invited by graduate students in CPB)
2005 Department of Biology, Carleton College, October 24
2006 Dept. of Ecology, Evolution and Organismal Biology, Iowa State University.
2006 Symposium on evolutionary consequences of anthropogenic changes to Pacific salmon, Seattle WA
2007 Elroy L. Rice Lecture in Ecology, University of Oklahoma
2007 Yodzis Colloquium, University of Guelph, Ontario Canada
2008 Department of Biological Sciences, University of Notre Dame (March 18)
2008 Department of Biology, University of Virginia (April 4)

Contributed talks at the joint meeting of the Society for the Study of Evolution and the American Society of Naturalists in 1981, 1983, 1985, 1992, 1995, 1997 (2), 1998 (2), 2004 (1 talk, co-author on 3 posters), 2005 (1 talk, co-author on 1 poster), 2008 (1 talk, co-author on 3 others), 2009 (1 talk).

Undergraduate advising:

- Julie Etterson (summa cum laude, 1994)
Jon Poppele (magna cum laude, 1997)
Jennifer Larson
Christy Olson
Emily Wennerlind (cum laude, 1998)

Kelly Wilson
Abe Gol (spring, 2004)
Jeremy Kobany (2004-5)
Karl Tinsley (2006)

Graduate advising:

Member of graduate faculties beginning in 1993: Ecology, Evolution, and Behavior, Plant Biological Sciences, Conservation Biology, Applied Plant Sciences

Students advised:

Robert Podolsky, Plant Genetics (UC-Riverside), Ph.D. 1994. "Population genetic structure of *Clarkia dudleyana*". Biostatistician, University of Georgia Medical School.

Elizabeth Svenson, Ecology (co-advised with P. Morrow), M.S. 1995. "Response of prairie species and old-field vegetation in an experimental restoration from seed".

Julie Etterson, Ecology, Evolution and Behavior, Ph.D. 2000. "Evolutionary potential of the annual legume, *Chamaecrista fasciculata*, in relation to global warming." Associate Professor, U. Minnesota-Duluth.

David Heiser, Ecology, Evolution and Behavior, M.S. 2000. "Fitness effects of outcrossing and the occurrence of insect-mediated cross-pollination in *Calylophus serrulatus*, a prairie perennial". Peabody Museum, Yale University.

Christine Kavanaugh, Plant Biological Sciences, M.S. 2000. "The effects of spontaneous mutation on fitness and response to shading in *Arabidopsis thaliana*." Monsanto.

Nadilia Gomez, Plant Biological Sciences, M.S. 2001 (co-advised with G. May). "Effect of inbreeding on male and female fertility of *Nemophila menziesii*." Ph.D. completed in Applied Plant Sciences, U.M. Postdoc with US Forest Forest Service.

Stacey Halpern, Ecology, Evolution and Behavior Ph.D. 2003 (co-advised with P. Morrow). "Evaluating the potential for adaptation to climate change in *Lupinus perennis*." Assistant Professor, Pacific University.

Eric Lonsdorf, Ecology, Evolution and Behavior Ph. D. 2003 (co-advised with D. Alstad). "Consequences of inbreeding in fragmented habitat for plant populations and communities." Postdoc at N. AZ. U. and Lincoln Park Zoo.

Jason Hill, Plant Biological Sciences, Ph. D.2004. "Effects of spontaneous mutation on fitness of *Arabidopsis thaliana*". Postdoc, U. MN.

Kristin Mercer, Applied Plant Sciences Ph.D. 2005 (co-advised with D. Wyse). "Seed

germination, growth and fitness in crop-wild sunflower hybrids from multiple genetic backgrounds: genetic and environmental effects on evolution of wild populations."
Postdoc Ohio State Univ.

Laurie Stone, Plant Biological Sciences, M.S. 2007 (co-advised with P. Tiffin). "CO₂, N, and Biodiversity Effects on Phenotypic Selection and Demography of Native Grassland Perennials."

Rachel Mills, Plant Biological Sciences, M.S. 2008. "Evolutionary divergence of the invasive prairie species *Melilotus officinalis*"

Current students: John Stanton-Geddes (EEB), Amy Dykstra (PBS), Marcus Warwell (EEB), Gina Quiram (EEB).

Postdoctoral Associates:

Gerrit A. J. Platenkamp, postdoctoral funded by my NSF grant 1988-1991, environmental consultant.

Stefan Andersson, postdoctoral funded by Swedish NSF 1992-1993, currently lecturer at University of Lund.

Diane Byers, postdoctoral funded by my setup funds and NSF grant 1993-1998, currently Associate Professor at Illinois State University.

Shumei Chang, postdoctoral funded by NSF grant 1999-2001. Associate Professor at Univ. of Georgia.

Stuart Wagenius, postdoctoral funded by NSF biocomplexity grant, 9/2000 - 5/2001. Conservation scientist, Chicago Botanic Garden.

Helen Hangelbroek, postdoctoral funded by NSF biocomplexity grant, 2003 - 2005.

Jen Lau, postdoctoral funded by NSF grant (Peter Tiffin, PI, P. Reich and R. Shaw, co-PIs), (2005-2007). Assistant Professor, Michigan State University.

Caroline Ridley, postdoctoral funded by NSF LTREB grant (2008-2009).

Visiting Professional Associates:

Thure Hauser, visitor for several weeks in 1996, currently postdoc in Riso, Denmark.
Philip Service, sabbatical visitor fall, 1997. Associate Professor, Northern Arizona Univ.

Professional Affiliations and Service

American Genetic Association: Editorial Board, Journal of Heredity, 1992-1995; elected

member of Council, 1999-2001

American Society of Naturalists: Editorial Board, *The American Naturalist*, 1993-1997; Committee to name recipient of Sewall Wright Award, 1995, 2001; Committee to name recipients of Young Investigator Prizes, 1995, 1998 [Chair]; Committee to name new Editor-In-Chief for *The American Naturalist*, 2007; Editor, *The American Naturalist*, 2009-

Genetics Society of America: Editorial Board, *Genetics*, 1994-2001

Society for the Study of Evolution: Member; Editorial Board, 1995-1997; Member of the Council, 1997-1999; Member of Finance Committee, 1999-2001; Vice President, 2005; member, planning committee for 2008 meeting to be held in Minneapolis.

Editor, *New Phytologist*, 2004-2009

NSF - Population Biology Panel, Spring 1993, Fall 1997, Spring 2004; RTG site visit, Spring 1992; Committee of Visitors, Spring 1995; STC site visit, Jan 1999; IRC-EB panel, Spring 1999, Spring 2000; Evolutionary Synthesis Center workshop, Spring 2002; Population and Evolutionary Processes Panel, Spring 2006, Spring 2008.

Reviewer of grant proposals for NSF, USDA, NSERC (Canada), RCENR (Finland; chaired grant panel on Ecology, Sept 2002)

NIH (Program Project Review Panel, Fall 1994; Genetic Variation and Evolution Panel, Spring 2006, Fall 2007, reviews of single proposals, spring and summer 2009)