

Zoe G. Cardon

The Ecosystems Center
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EDUCATIONAL BACKGROUND:

Ph.D., Department of Biological Sciences, Stanford University, 1994. *Cellular and Physiological Investigations of Stomatal Regulation*, Joseph Berry advisor.
B.S. Biology, B.A. Spanish, Utah State University, 1988; College of Science valedictorian; graduation *Magna Cum Laude*.

PROFESSIONAL EXPERIENCE:

Senior Scientist, The Ecosystems Center, Marine Biological Laboratory, Woods Hole, MA (Jan. 2008-)
Adjunct Associate Scientist, Ecosystems Center, Marine Biological Laboratory, Woods Hole, MA (May 2006- Dec. 2007)
Associate Director, Center for Integrative Geosciences, University of Connecticut at Storrs (May 2005-Dec. 2007)
Graduate Program Director, Center for Integrative Geosciences, University of Connecticut at Storrs (March 2005-Dec. 2007)
Head, Biology Honors Program (Ecology and Evolutionary Biology, Physiology and Neurobiology, and Molecular and Cell Biology Departments, Univ. of CT, 2003-2005)
Dept. of Ecology and Evolutionary Biology, University of Connecticut at Storrs
Associate Professor (Fall 2003-Dec. 2007)
Assistant Professor (August 1997-Summer 2003)
Biology Dept., Bowdoin College, Brunswick, ME, Assistant Professor (1996-1997)
DOE Global Change Distinguished Postdoctoral fellow, UC Berkeley, F. S. Chapin III advisor (1994-1996)

NATIONAL SERVICE:

President (elected), Physiological Ecology Section, Ecological Society of America (2009-2011)
Program Leaders group, SAMSI Sensor Networks, Forests, and Global Change Program, <http://www.samsi.info/programs/2007sensornetprogram.shtml> (2008)
Editorial Board Member, *Oecologia* (2005-)
National Science Foundation panel member, multiple panels: Doctoral Dissertation Improvement Grants, Ecology, Ecology and Evolutionary Physiology, Ecosystems, and TECO panels (1996, 2000, 2004, 2006, 2007, 2008)
Secretary (elected), Physiological Ecology Section, Ecological Society of America (2002-04)
Invited member of international panel to review the National Phytotron at Duke (2001)
Co-organizer of symposium "The Rhizosphere", sponsored by the Soil Ecology Section of ESA at annual national meetings of the Ecological Society of America (2000)
U.S. DOE panel, Alexander Hollaender Postdoctoral Fellowships (1998, 2000)
Ad hoc reviewer for grant proposals from NSF, NASA, NERC, University of Connecticut, USDA, Utah State University
Reviewer for *American Naturalist*, *Biogeochemistry*, *Ecological Applications*, *Ecology*, *Global Change Biology*, *Journal of Ecology*, *Journal of Environmental Quality*, *New Phytologist*, *Oecologia*, *Physiologia Plantarum*, *Plant and Soil*, *Plant Cell and Environment*, *Science*, *Soil Biology and Biochemistry*, *Wetlands*

SELECTED FELLOWSHIPS AND HONORS:

- Invited member of Program Leaders Committee for NSF-funded SAMSI program emphasizing statistics for control of wireless sensing networks and analysis of data streams from those networks.
- Editorial Board, *Oecologia* (2004-)
- Visiting scientist, Ecosystems Center, Marine Biological Laboratory (Fall Semester, 2003)
- Invited panelist, NSF "Frontiers in Belowground Carbon Cycling Research" workshop (2003)
- Sarah Blaffer Hrdy Fellow in Conservation Biology, Organismic and Evolutionary Biology Department, Harvard University (Fall Semester, 2002)
- Invited participant at Carey Conference IX, "Understanding Ecosystems: The Role of Quantitative Models in Observation, Synthesis, and Prediction", Institute of Ecosystem Studies (2001)
- Invited member of international review panel for the National Phytotron at Duke (2001)
- University of Connecticut University-wide Outstanding Faculty Advisor (1999)
- Department of Energy Global Change Distinguished Postdoctoral Fellowship (1993-95)
- National Defense Science and Engineering Graduate Fellowship (1990-93)
- Morrison Institute for Population Studies, Stanford Univ., travel award (1991-92)
- National Science Foundation Graduate Fellowship (1988-90)
- Phi Kappa Phi James R. Slater Fellow, for excellence in plant sciences (1988-89)
- Presidential Scholar (1983)
- National Merit Scholar (1983-87)

PUBLICATIONS**Peer-reviewed Journals:**

- Skogen, K.A., Holsinger, K.E., and Cardon, Z.G. Nitrogen deposition and the decline of a regionally threatened legume, *Desmodium cuspidatum*. Submitted.
- Herron, P.M., Gage, D.J., and Cardon, Z.G. Micro-scale water potential gradients visualized in soil around plant root tips using microbiosensors. *Plant, Cell, and Environment*, in press.
- Herron, P.M., Stark, J.M., Holt, C., Hooker, T., and Cardon, Z.G. (2009) Microbial growth efficiencies across a soil moisture gradient assessed using ¹³C-acetic acid vapor and ¹⁵N-ammonia gas. *Soil Biology and Biochemistry* 41: 1262-1269.
- Gage, D.J., Herron, P.M., Arango Pinedo, C., and Cardon, Z.G. (2008) Live reports from the soil grain – the promise and challenge of microbiosensors. *Functional Ecology* 22: 983-989.
- Cardon, Z.G., Gray, D.W., and Lewis, L. A. (2008) The green algal underground – evolutionary secrets of desert cells. *Bioscience* 58(2): 114-122.
- Gray, D.W., Lewis, L.A., and Cardon, Z.G. (2007) Photosynthetic recovery following desiccation of desert green algae (Chlorophyta) and their aquatic relatives. *Plant, Cell, and Environment*, 30: 1240-1255. (Journal cover image is from our work.)
- Gartner, T.L. and Cardon, Z.G. (2006) Site of leaf origin affects how mixed litter decomposes. *Soil Biology and Biochemistry*, 38: 2307-2317.
- Cardon, Z.G. and Gage, D.J. (2006) Resource exchange in the rhizosphere – molecular tools and the microbial perspective. *Annual Review of Ecology, Evolution, and Systematics*, 37: 459-88.
- Gray, D.W., Cardon, Z.G., and Lewis, L. A. (2006) Simultaneous collection of rapid chlorophyll fluorescence induction kinetics, fluorescence quenching parameters, and environmental data using an automated PAM-2000/CR10X data logging system. *Photosynthesis Research*, 87: 295-301.
- Zanne, A.E., Lower, S.S., Cardon, Z.G., and Orians, C.M. (2006) ¹⁵N fertilization of tomatoes: vascular constraints vs. tissue demand. *Functional Plant Biology* 33: 457-64.

- Venterea, R.T., Rolston, D.E., and Cardon, Z.G. (2005) Effects of soil moisture, physical, and chemical characteristics on abiotic nitric oxide production. *Nutrient Cycling in Agroecosystems* 72:27-40.
- Hooker, B.A., Morris, T. F., Peters, R., and Cardon, Z.G. (2005) Long-term effects of tillage and corn stalk return on soil carbon dynamics. *Soil Science Society of America Journal*, 69 (1) : 188-196.
- Johnston, C. A., Groffman, P., Breshears, D. D., Cardon, Z. G., Currie, W., Emanuel, W., Gaudinski, J., Jackson, R. B., Lajtha, K., Nadelhoffer, K., Nelson Jr., D., Post, W. M., Retalack, G., and Wielopski, L. (2004) Carbon cycling in soil. *Frontiers in Ecology and the Environment*, 2(10): 522-528.
- Gartner, T. B. and Cardon, Z. G. (2004) Decomposition dynamics in mixed-species leaf litter — a review. *Oikos* 104: 230-246.
- Jones, C.S, Cardon, Z.G., and Czaja, A.D. (2003) A phylogenetic view of low level CAM in *Pelargonium* (Geraniaceae). *American Journal of Botany*, 90:135-142.
- Cardon, Z. G., Czaja, A. D., Funk, J. L., and Vitt, P. L. (2002) Periodic carbon flushing to roots of *Quercus rubra* saplings affects soil respiration and rhizosphere microbial biomass. *Oecologia*, 133: 215-223.
- Hooper, D. U., Cardon, Z. G., Chapin III, F. S., and Durant, M. (2002) Corrected calculations for whole ecosystem measurements of CO₂ flux using the LI-COR 6200 portable photosynthesis system. *Oecologia*, 132: 1-11.
- Bringhurst, R. M., Cardon, Z. G., and Gage, D. J. (2001) Galactosides in the rhizosphere: utilization by *Sinorhizobium meliloti* and development of a biosensor. *Proceedings of the National Academy of Sciences*, 98(8): 4540-4545.
- Cardon, Z. G., Hungate, B. A., Cambardella, C. A., Chapin III, F. S., Field, C. B., Holland, E. A., and Mooney, H. A. (2001) Contrasting effects of elevated CO₂ on old and new soil carbon pools. *Soil Biology and Biochemistry*, 33: 365-373.
- Lodding, C. C., Behling, J., and Cardon, Z. G. (2000) Water relations of *Betula cordifolia* and *Betula allegheniensis* rooted together on landslides in Franconia Notch, NH. *American Midland Naturalist*, 143: 321-329.
- Tsionsky, M., Cardon, Z.G., Bard, A.J., and Jackson, R.B. (1997) Photosynthetic electron transport in single guard cells as measured by scanning electrochemical microscopy. *Plant Physiology*. 113(3):895-901
- Cardon, Z.G. (1996) Effects of root exudation and rhizodeposition on ecosystem carbon storage under elevated CO₂. *Plant and Soil*. 87(2):277-288.
- Cardon, Z.G., Berry, J.A., and Woodrow, I.E. (1995). Fluctuating [CO₂] drives species-specific changes in water use efficiency. *Journal of Biogeography* 22:203-208.
- Jackson, R.B., Luo, Y., Cardon, Z.G., Chiariello, N.R., Sala, O.E., Field, C.B., and Mooney, H. A. (1995). Photosynthesis, growth, and density for the dominant species in a CO₂-enriched grassland. *Journal of Biogeography*. 22:221-225.
- Cardon, Z.G., Berry, J.A., and Woodrow, I.E. (1994a). Dependence of the extent and direction of average stomatal response in *Zea mays* and *Phaseolus vulgaris* on the frequency of fluctuations in environmental stimuli. *Plant Physiology* 105:1007-1013.
- Cardon, Z.G., Mott, K.A., and Berry, J.A. (1994b) Dynamics of patchy stomatal movements, and their contribution to steady-state and oscillating stomatal conductance calculated with gas-exchange techniques. *Plant, Cell, and Environment*. 17:995-1007.
- Mott, K.A., Cardon, Z.G., and Berry, J.A. (1993). Asymmetric patchy stomatal closure for the two surfaces of *Xanthium strumarium* L. leaves at low humidity. *Plant, Cell, and Environment*. 16:25-34.
- Cardon, Z.G., and Berry, J.A. (1992). Effects of O₂ and CO₂ concentration on the steady-state fluorescence yield of single guard cell pairs in intact leaf discs of *Tradescantia albiflora*. Evidence for Rubisco-mediated CO₂ fixation and photorespiration in guard cells. *Plant Physiology* 99:1238-1244.

Cardon, Z.G., and Mott, K.A. (1989). Evidence that ribulose 1,5-bisphosphate (RuBP) binds to inactive sites of RuBP carboxylase *in vivo* and an estimate of the rate constant for dissociation. *Plant Physiology* 89:1253-1257.

Volumes Edited, and Peer-Reviewed Contributions to Edited Volumes:

Cardon, Z.G. and Whitbeck, J.L. (eds) (2007) *The Rhizosphere: an Ecological Perspective*. Elsevier.

Whitbeck, J.L. and Cardon, Z.G. Introduction. (2007) IN: *The Rhizosphere: an Ecological Perspective*. Cardon, Z.G. and Whitbeck, J.L. (eds). Elsevier, San Diego. Pp. xv-xix.

Cardon, Z. G., and Herron, P. M. Sweeping water, oozing carbon: long distance transport and patterns of rhizosphere resource exchange. (2005) IN: *Vascular Transport in Plants*. Holbrook, N.M. and Zwieniecki, M.A. (eds). Academic Press, San Diego. Pp. 257-276.

Cottingham, K. L., Cardon, Z. G., D'Antonio, C. M., Dent, C. L., Findlay, S. E. G., Lauenroth, W. K., LoGiudice, K. M., Stelzer, R. S., Strayer, D. L. (2003) Increasing modeling savvy: strategies to advance quantitative modeling skills for professionals within ecology. In: *Models in Ecosystem Science*. 9th Cary Conference volume, Canham, C., Cole, J. and Lauenroth, W., eds. pp. 428-436.

GRANTS

Research grants:

NASA Exobiology, "Leaping to Land – Physiology and Phylogenetics of Desert Green Algae", Cardon PI, Louise Lewis and Harry Frank Co-Is, 9/2008-9/2011, \$531,978

Recipient of long-term, targeted support from anonymous, quasi-endowment to MBL to support "Women in Ecological Science", \$1,200,000, 3/08

Anonymous grant, "Hydraulic Redistribution of Water in Western Landscapes: Effects on Plant Fitness and Rhizosphere Function", Cardon PI, \$300,000, 3/08

DOI USGS Office of Groundwater Research, Branch of Geophysics, "USGS OGW BG-UCONN Cooperative Agreement", Cardon co-I, 8/2007-8/2012, \$220,632

Anonymous grant, "Hydraulic Redistribution of Water in Western Landscapes: Effects on Plant Fitness and Rhizosphere Function", Cardon PI, \$59,356, 4/1/07-3/31/08 (continued and augmented at MBL)

Connecticut Institute of Water Resources Grant, "Development of a New Generation of Sensitive, Fluorescence-based Nitrate Sensors for Use in Soil and Water", co-I with PI Shawn Burdette, 9/1/07-8/31/09, \$36,994

UConn Research Foundation Large Faculty Grant, "Desiccation Tolerance in Desert Green Algae", 1/06 – 1/07, \$16,677

NSF DDIG, Population Dynamics Program, "Nitrogen Deposition and Population Dynamics of a Declining Nitrogen-fixing Plant Species", co-PI, co-PI Krissa Skogen and PI Kent Holsinger, 6/1/06-7/31/08, \$11,993

NSF Ecosystems Program, "Desert Microbial Activity in the Rhizosphere Oasis", PI, co-PIs Daniel Gage and John Stark, 7/1/04 – 7/1/07, \$529,625

NSF REU supplements, summers of 2005, 2006, 2007, \$6000 each summer

NSF International Supplement, with Dr. Vit Gloser, Czech Republic, 7/04-'07, \$25,472

NSF DDIG, Ecosystems Program, "Dissertation Research: Does Hydraulic Redistribution Increase Microbial Activity in the Rhizosphere?", PI, co-PI Patrick Herron, 7/1/04-7/1/06, \$12,000

NASA Exobiology, "Phylogenetic diversity and comparative physiology of independently-evolved lineages of desert green algae (Chlorophyta)", co-PI with Louise Lewis, PI, \$380,876

NSF Ecosystems Program, SGER, "Developing a New Miniaturized Sensor for Detecting Glucose in Soil", PI with Dr. Francis Moussy co-PI, 5/02-5/03, \$25,053

- UConn Research Foundation Large Faculty Grant, "Effect of tillage and carbon input levels on soil organic carbon distribution" with Thomas Morris co-PI. 1/01-1/02, \$7881
- Andrew W. Mellon Foundation Grant, "Carbon fluxes from plant roots to soils -- how timing, quality, and quantity of fluxes affect rhizosphere microbial activity." PI 3/00-12/04, \$350,000
- UConn Research Foundation Large Faculty Grant, "Does Plant Phenology Influence Microbial Activity in the Rhizosphere?" PI, 6/98-5/99, \$17,609
- Andrew W. Mellon Foundation Grant, "Influence of Root Exudation and Rhizodeposition on Rhizosphere Processes in Natural Soils." PI, 4/96-12/99, \$180,000

Teaching grants:

- UConn Institute for Teaching and Learning Grant, "Biology as a quantitative science-- easing the path to computational ability and conceptual thinking." 6/99, \$6000
- NSF Instrumentation and Laboratory Improvement, "Analytical and Quantitative Understanding of Integrative Plant Biology through Coursework and Independent Student Research" 6/97-6/00, \$17,520

SELECTED INVITED PRESENTATIONS:

Departmental or Series Seminars:

- Michigan State University, graduate student invitee for MCB department, April 2010
- Boston University, Biology Department, Boston University, February 2010
- Brown University, Dept. of Geological Sciences, April 2009
- Bowdoin College, Biology Dept., November 2008
- The Ecosystems Center, Marine Biological Laboratory, July, 2007
- UMass Boston, Boston, MA, Department of Biology, April 2007
- MIT, ESI (Earth System Initiative) seminar series, March 2006
- Michigan State University, East Lansing, MI, Department of Plant Biology, Oct. 2005
- University of Massachusetts, Amherst, OEB Program, April, 2004
- Tufts University, Biology Department, March, 2004
- The Ecosystems Center, Marine Biological Laboratory, Dec. 2003
- Univ. of Michigan, Ecology and Evolutionary Biology Department, Nov. 2003
- MIT, Earth Atmosphere and Planetary Sciences Dept., April 2003
- MIT, Earth Atmosphere and Planetary Sciences Dept., February 2003
- Cornell University, Biogeochemistry and Biocomplexity Seminar Series, November 2002
- Biosphere II, Columbia University, Oracle, AZ May 2002
- University of Illinois, Dept. of Biology, Chicago and Argonne National Lab, April 2002
- Columbia Earth Institute (Lamont-Doherty Earth Science Colloquium), March 2002
- Harvard Organismic and Evolutionary Biology Department, February 2002
- Queens College, Department of Biology, December 2001
- Carnegie Institution of Washington, Department of Plant Biology, Stanford, CA, April, 2001
- The Ecosystems Center, Marine Biological Labs, Woods Hole, MA, February, 2001
- Institute of Ecosystem Studies, Millbrook, NY, February, 2001
- Boston University, Dept. of Biology, Boston, MA, December, 2000
- SUNY Albany, Atmospheric Sciences Research Center, October, 1998
- University of Connecticut, Dept. of Ecology and Evolution, Storrs, CT, March, 1997.
- University of New Hampshire, Dept. of Natural Resources. Durham, NH, November, 1996.
- The Ecosystems Center, Marine Biological Laboratory, Woods Hole. MA. May, 1996.
- University of Denver, Denver, Colorado. February, 1995.
- Bowdoin College, Brunswick, Maine. January, 1995
- University of California, Berkeley, Department of Integrative Biology. May, 1994.
- James Cook Univ. of North Queensland, Botany Dept., Townsville, Australia. May, 1992.
- Australian National University, RSBS, Canberra, Australia. May, 1992.

Symposia:

Ecological Society of America meetings, August 2009, organized oral session "Missing Links in the Root-Soil Organic Matter Continuum"
 Soil Science Society of America meetings, November 2006, symposium "Towards a Predictive Understanding of Belowground Ecosystem Responses to Global Change"
 Ecological Society of America (ESA) meetings, August 2006, organized oral session "Rhizosphere Functioning in Carbon and Nitrogen Cycles"
 ESA meetings, August 2005, organized oral session "Sensors and Sensor Networks"
 Soil Ecology Society Meeting "Resource Exchange in the Rhizosphere", keynote, May, 2005
 Harvard Forest Symposium, October, 2002, "Free trade, slave trade, or something in between: resource exchange in the rhizosphere", coauthor Arnold Bloom, UC Davis.
 Global Change in Terrestrial Ecosystems workshop "Carbon Below Ground", 1995, Oxford, UK.

STUDENTS MENTORED:

Graduate Major Advisor:

Patrick Herron (NSF DDIG recipient and EPA STAR fellow, examining water flow in the rhizosphere and its effects on nutrient cycling, PhD 2007)
 Bethanie Hooker (EPA STAR fellow and PEO Scholar, studying soil carbon storage in agroecosystems, PhD finished 2005, now at Mt Holyoke)
 Tracy Gartner (NSF graduate research fellow, focused on decomposition of mixed-species leaf litter; PhD finished December, 2003. Now an assistant professor at Carthage College, Wisconsin.)

Graduate Major Co-Advisor:

David Hoover (Geosciences program, MS 2008, now PhD student at Colorado State)

Graduate Committee Member:

Lindsay Bowerman (University of Connecticut, MS 2007)
 David Bryant (University of New Hampshire, PhD 2002)
 Kristina Catanese (University of Connecticut, MS expected 2009)
 Corie Cann (University of Connecticut, MS 2006)
 Robert Dunn (University of Connecticut, PhD 2003)
 Krista Fisk (University of Connecticut, MS 2007)
 Michael Gavin (University of Connecticut, PhD 2003)
 Courtney Hamler (University of Connecticut, MS 2007)
 Robin Kodner (Harvard University, PhD 2007)
 Sarina Lambert (University of Connecticut, MS 2007)
 Stacey Leicht (University of Connecticut, PhD 2006)
 Shirley Micallef (University of Massachusetts, Boston, PhD 2008)
 Nancy Ryan (University of Connecticut, MS 2003)
 Krissa Skogen (University of Connecticut, PhD 2008)
 Nava Tabak (University of Connecticut, MS 2005)

Undergraduate:

Kristina Catanese, honors thesis spring 2008
 Christine Quartararo – fall 2006
 David Hoover, UConn undergraduate researcher and post-graduate research assistant
 Naomi Avery, honors
 Corie Cann, graduated from UConn BS/MS program in Conservation Biology
 Andrew Czaja, honors (NSF and NDSEG graduate fellow, astrobiology program, UCLA; PhD 2006)
 Jeremy Draghi (now grad. student at Yale; NSF graduate fellowship honorable mention);

Matthew Dunn, honors

Jennifer Funk (UC Berkeley undergraduate, technician in my lab at UConn, NSF and EPA graduate fellow, Ecology and Evolution program, SUNY Stonybrook; National Parks Postdoc, Stanford University; now assistant professor at Chapman College)

Laura Pustell (researcher at Harvard Forest, MA; now pursuing a career in education)

Kristen Riley (now dietician counselor in Florida)

Multiple other undergraduate advisees through the honors program and the EEB dept.

At Bowdoin: Cynthia Lodding (senior research published in *American Midland Naturalist*)

Postdoctoral:

Claire Lunch (MBL, diversity and photophysiology in desert green algae), current

Patrick Herron (MBL, microbiosensors, microbial growth efficiency), 2008

Dennis Gray (UConn, photosynthesis in green algae from desert crusts), 2005-2007

Catalina Arango (UConn, developing genetically engineered microbiosensors for soil), 2007

Pati Vitt (UConn, now Conservation Botanist at the Chicago Botanic Garden), 1998-99

Jon Behling (Bowdoin College, now organic farmer in Wisconsin), 1996-97

COURSES TAUGHT:

Informal courses at MBL:

Organized weekly meetings for the "MicroEco" discussion group at MBL, a cross-Center group exploring links between microbial activity&diversity and ecosystem function (spring 2008 - current)

Organized weekly meetings for a "Chlorophyll Fluorescence" discussion group at MBL and WHOI, a cross-institution group examining what information chlorophyll fluorescence signatures (detected directly from samples or remotely at distance) can give about photosynthetic activity (June 2009 - current)

Regularly taught at UConn:

Introductory Biology (~300 first year students);

General Ecology "W" (~70-100 sophomores/juniors, writing intensive);

Organisms and Ecosystems (~10-20 seniors, graduate students);

Soil Degradation and Conservation (~10-15 seniors/graduate students)

Integrative Earth System Science (~6-10 graduate students, proposal-writing intensive core course for first-year students in the Center for Integrative Geosciences)

Taught irregularly at UConn:

Introduction to Undergraduate Research (~25-60 students)

Professional Development Seminar (~15 graduate students)

Seminars on The Rhizosphere, on Plant Evolution, on Plant Ecology, and on Plant Water Relations (~10-15 graduate students each)

Multiple independent study courses one-on-one with undergraduate and graduate students