BRUCE A. HUNGATE
CURRICULUM VITAE

Education:

Ph.D., Integrative Biology, University of California, Berkeley, 1995. *Carbon and Nitrogen Cycling in California Grasslands under Carbon Dioxide Enrichment*
B.S., Biological Sciences, Stanford University, 1990.
B.A., Music and English, with honors, Stanford University, 1990.

Professional Experience:

Director, Center for Ecosystem Science & Society, Northern Arizona University, 2013-
Director, Colorado Plateau Stable Isotope Laboratory, 2001-
Regents' Professor, Department of Biological Sciences, Northern Arizona University, 2015-
Professor, 2006-2015
Associate Professor, 2002-2006
Assistant Professor, 1998-2002
Director, Western Regional Center, National Institute for Climatic Change Research, 2005-2012
Postdoctoral Associate, Stanford University, and Visiting Scientist, Centro Internacional de Mejoramiento de Maìz y Trigo, 1997-1998
Postdoctoral Fellow, Smithsonian Environmental Research Center, 1995-1997
Graduate Student Fellow and Instructor, University of California, Berkeley, 1992-1995
Researcher, Microbiology of Bioremediation, Stanford University, 1989-1990
Researcher, Environmental Microbiology, University of Washington, 1985-1989

Honors

American Academy of Microbiology, 2016
Phi Kappa Phi 2007
Beques de recerca per a professors i investigators visitants a Catalunya 2005-2006 (fellowship for research in Catalunya)
Aldo Leopold Leadership Fellow, 2004
Sigma Xi, 1999
Department of Energy Alexander Hollaender Distinguished Postdoctoral Fellowship, 1996
Smithsonian Institution Postdoctoral Fellowship, 1995
National Science Foundation Postdoctoral Fellowship, 1995 (declined)
National Science Foundation Doctoral Dissertation Improvement Grant, 1993-1995
National Defense Science and Engineering Graduate Fellowship, 1992-95
Phi Beta Kappa, 1990

Teaching

Courses Taught at Northern Arizona University:
UC 101, Culture and Environment on the Colorado Plateau, Fall 1999
BIO 184, Introductory Botany, Fall 1998
BIO 300, Environmental Cycling and Global Change, Fall 2000, 2001
BIO 326, Ecology, Fall 2001, 2002, 2003, 2004, 2006, 2007, 2008, 2009
BIO 326L, Ecology Laboratory (coordinator, Fall & Spring 2001-present)

BIO 471 & 571, Microbial Ecology, Spring 1999, 2001, 2003, 2005, 2007, 2009, 2011
BIO 479 & 579, Ecosystem Ecology: Case Studies on the Colorado Plateau, Spring 2000, 2002, 2004, 2010
BIO 479 & FOR 479: Ecosystems and Climate Change
BIO 497, Interdisciplinary Climate Mitigation (interdisciplinary course with Business, Engineering, and Philosophy), also listed as BIO, Mechanical Engineering, Business, and Philosophy 485: Climate Change Mitigation: a case study at Northern Arizona University, spring 2007, spring 2008, spring 2009
BIO 497, Climate Change Research (6 students, Fall-Spring 2010-2011, 12 students Fall 2011; 6 students Spring 2012)
BIO 498 & 680, Stable Isotope Applications, Spring 2000
BIO 698, Global Change, Spring 1999
BIO 698, Design and Analysis of Ecological Experiments, Fall 2000
BIO 698, Stable Isotope Applications in Ecology and Environmental Biology, Spring 2001
BIO 698, Ecosystem Physiology, Spring 2002, 2003, 2004
BIO 698, Climate Change, co-leader, Spring 2005
BIO 698, Merriam Powell Research Design and Analysis Seminar, every semester, Fall 2006-Spring 2011
BIO 698, Graduate Seminar in Ecosystem Science, every semester, Fall 2014-present
ENV 698, Climate Science and Solutions, Fall 2010, Spring 2011, Fall 2011

Additional Education Activities at Northern Arizona University:
National Science Foundation, CCEP-I: Climate Change Science and Solutions: Creating innovative education tools for Native Americans and other rural communities on the Colorado Plateau
National Science Foundation, SMP: A Professional Science Master's in Climate Science and Solutions for Northern Arizona University
National Aeronautics and Space Administration, Global Climate Change Education: Research Experiences, Teaching and Learning
National Science Foundation Course, Curriculum, and Laboratory Improvement Grant to redesign laboratories for General Ecology, Ecosystem Ecology, and Microbial Ecology
National Science Foundation CAREER Grant to support laboratory courses and to fund undergraduate research projects in ecosystem responses to global change along the C. Hart Merriam Elevational Gradient
National Science Foundation SGER Grant to support undergraduate involvement in research on nitrogen fixation and trace gas fluxes

Grants

50. “Microbes Persist: Systems Biology of the Soil Microbiome”, Biological Systems Science Division (BSSD), Science Focus Area, US Department of Energy, subcontractee, ~$150,000/year (2017-2020)
49. Transcription Factors Regulating the N Cycle, $480,000. USDA. Dijkstra is lead PI with Hungate and Schwartz co-PIs (2017-2020)
48. Litter quality and stream food webs: a new paradigm for understanding interactions between microbes and invertebrates. $1,042,853. National Science Foundation. Marks is lead PI with Wymore, B Koch, Schwartz, and Hungate co-PIs (2017-2020)

47. Department of Energy, Systems Biology Enabled Research on the Role of Microbial Communities in Carbon Cycling: Scaling the Microbial Ecology of Soil Carbon, $2,474,070, 9/16-8/19
46. National Institutes of Health, $144,102, Microbial ecology of the nasal microbiome - implications for Staphylococcus aureus colonization, carriage, and infection, Hungate is a funded collaborator (subcontract from George Washington University)
45. Department of Energy, Systems Biology Enabled Research on the Role of Microbial Communities in Carbon Cycling: Multiple element isotope probes, NanoSIMS, and the functional genomics of microbial carbon cycling in soils in response to chronic climatic change, $1,430,493, 9/13-8/16
44. Department of Energy, Terrestrial Ecosystem Science Program: Biogeochemical responses and feedbacks to climate change: synthetic meta-analyses relevant to earth system models, $929,254, 9/13-8/16
43. Department of Defense, SERDP: Role of the soil microbial community in sagebrush *(Artemisia tridentata)* and squirreltail (*Elymus elymoides)* seedling establishment in cheatgrass-invaded habitats. $1,491,000, 1/13 – 12/17.
42. National Science Foundation, Dimensions: Collaborative Research: The taxonomic, genomic, and functional diversity of soil carbon dynamics, $1,487,750, 1/13 – 12/17.
41. National Science Foundation, Geosciences, Collaborative Research: Biological and mineralogical controls over soil carbon cycling across multiple ecosystems: a focus on the priming effect, $414,075, 9/11 – 8/13.
40. National Science Foundation, Collaborative Research: A new paradigm for understanding how leaf litter quality affects stream ecosystems, $750,249, 9/11 – 8/14
39. National Science Foundation, Partnerships in International Research and Education, Toward a holistic and global understanding of hot spring ecosystems, $63,623, June 2010-Dec 2017
38. National Science Foundation, A rapid Assessment of Post-fire Changes in Biophysical Variables, Carbon Stocks, and Soil Microbial Processes in the Tallest Angiosperm Forest $76,656, 6/10-5/11
37. National Aeronautics and Space Administration, Global Climate Change Education: Research Experiences, Teaching and Learning, $387,580, 2/10-1/13
36. National Science Foundation, SMP: A Professional Science Master's in Climate Science and Solutions for Northern Arizona University $698,733, 8/10-7/13
35. Department of Defense, Strategic Environmental Research and Development Program, Modeling the Carbon Implications of Ecologically-Based Forest Management, $1,058,000, 1/11-1/14
34. National Science Foundation, CCEP-I: Climate Change Science and Solutions: Creating innovative education tools for Native Americans and other rural communities on the Colorado Plateau, 9/10-8/12, $1,000,000
33. National Science Foundation, PIRE: Toward a holistic and global understanding of hot spring ecosystems: A US-China based international collaboration, 6/10-5/15, $3,750,000
32. National Science Foundation, LTREB: Progressive Responses to Climate Change Across Multiple Ecosystems, 6/10-5/15, $449,972
31. Department of Energy, National Institute for Climatic Change Research, Effects of Climate on Soil Carbon: A Meta-Analysis, 2010-2011, $155,575

30. Department of Energy, National Institute for Climatic Change Research, Climate Impacts of Land Cover Change in the Western US, 2007-2008, $131,575
29. Northern Arizona University, ERDENE: ClimateWise Solutions, LLC: developing a spin-off business based on the carbon market, 2007-2008, $80,000
28. National Science Foundation, Acquisition of Off-Axis Integrated-Cavity Output Spectroscopy Instruments for Ecological Research and Training at Northern Arizona University - $161,440
27. National Science Foundation, Collaborative Research: Ecosystem Consequences of Dynamic Geomorphology: an Experimental Approach, 2006-2011, $799,511
26. Northern Arizona University, ERDENE: Carbon Associates: Knowledge Transfer for Climate Mitigation, 2006-2007, $72,291
25. Department of Energy, Northern Arizona University: Home for the Western Regional Center of the National Institute for Climate Change Research, 2005-2010, $1,000,000, plus administration of nearly $10,000,000 to support climate change research in the western US
24. US Department of Agriculture, Predicting nitrogen mineralization from the ^{15}N signature of soil microbial biomass, 2005-2008, $350,000
23. National Science Foundation, NAU–IGERT Program - Integrative Bioscience: Genes to Environment - $2,869,440
22. National Science Foundation, Progressive Nitrogen Limitation in Terrestrial Ecosystems: Empirical Test of a Biogeochemical Paradigm, 2005-2008, $800,000
21. National Science Foundation, ^{15}N Natural Abundance of Soil Microbial Biomass as a Tool for Assessing Controls on N-cycling Processes in Ecosystems, 2004-2008, $450,000
20. Department of Energy, Can soil genomics predict the impact of precipitation on nitrous oxide (N_2O) fluxes from soil?, 2004-2008, $1,203,536
19. US Department of Agriculture, Carbon dioxide and methane fluxes in disturbed southwestern ponderosa pine forests, $739,000, 2004-2007
18. Northern Arizona University, ERDENE: NAU-BIORIN: BIOremediation Research Initiative, $114,119, 2004-2006
17. Northern Arizona University, Biotechnology: Stable Isotope Forensics: Emerging Biotechnology, 2004-2006, $234,000
16. National Science Foundation, IDEA: Large-Scale Wireless Sensor Networks for In Situ Observation of Ecosystem Processes, 2002-2005, $1,806,200
15. US Civilian Research and Development Foundation, Effects of Siberian tree species on greenhouse gas fluxes – a new challenge for global change science, 2003-2005, $81,000
14. National Science Foundation, A stable isotope and eddy covariance system for understanding ecosystem metabolism, 2002-2005, $398,716
13. National Science Foundation, Riparian plant genotype by environment interactions: effects on leaf quality, in-stream decomposition, and aquatic biodiversity, 2002-2005 $349,000
12. Northern Arizona University, Construction of a Virtual Environmental Learning Space, 2002-2003, $25,000
11. National Science Foundation, SGER: Undergraduate research in biogeochemistry: controls over the isotopic composition of nitrous oxide, 2001-2002, $90,176
10. National Science Foundation, CAREER award recipient, Ecosystem responses to rising CO_2 and climate change: feedbacks through the nitrogen cycle, 2001-2006, $781,574

9. Andrew W. Mellon Foundation: Conservation and Environment Program. The effects of mycorrhizae on fine root decomposition and soil carbon processing, 2001-2004, $290,000
8. Ecological Restoration Institute, Southwest Fire Initiative, Ecological Restoration and the Water and Carbon Budgets of Ponderosa Pine Forests, 2001-2003 $71,254
7. National Science Foundation, Course, Curriculum, and Laboratory Improvement Grant: The C. Hart Merriam Elevational Gradient: Toward a Unified Ecology Curriculum at Northern Arizona University, 2001-2003, $200,000
6. National Science Foundation, Hydrology of a Scrub-Oak Woodland Under Carbon Dioxide Enrichment, 1999-2002, $375,000
5.US Forest Service, Soil Health in the Flagstaff Wildland Urban Interface, 2000-2003, $140,000
4. Smithsonian Institution, Nitrogen Cycling in an Elevated CO_2 Environment, 1999-2004, $118,000
3. National Science Foundation and Northern Arizona University, An Isotope-Ratio Mass Spectrometer for Ecology and Environmental Biology at Northern Arizona University, 1998-2000, $390,500
2. Northern Arizona Organized Research, Stable Isotopes and Food Webs in Cuatro Ciénegas, Mexico, 2000-2001, $11,500
1. Northern Arizona Organized Research, The Stable Isotope Composition of the Soil Microbial Biomass, 1999-2000, $11,600

Publications (student and postdoc advisees indicated in italics)

1. Hungate BA, Danin A, Pellerin NB, Stemmler J, Kjellander P, Adams JB, and Staley JT, 1987. Characterization of manganese-oxidizing (MnII-MnIV) bacteria from Negev Desert rock varnish: implications in desert varnish formation. *Canadian Journal of Microbiology* 33:939-943
2. Hungate BA, J Canadell, and FS Chapin III, 1996. Plant species mediate changes in soil microbial N under elevated CO_2. *Ecology* 77:2505-2515
3. Hungate BA, Jackson RB, Field CB, and Chapin FS III, 1996. Detecting changes in soil carbon in CO_2 enrichment experiments *Plant and Soil* 187:135-145
4. Frank VM, Hungate BA, Chapin FS III, and Field CB, 1997. Effects of elevated CO_2 on litter decomposition: dependence on plant species and nutrient supply. *Biogeochemistry* 36:223-237
5. Garland JL, Cook KL, Loader CA, and Hungate BA, 1997. The influence of microbial community structure and function on community-level physiological profiles. In *Microbial Communities: Functional vs. Structural Approaches* (H Insam and A Ranger, eds.), Springer-Verlag, Heidelberg, pp 171-183.
6. Hungate BA, Chapin FS III, Holland EA, Zhong H, and Field CB, 1997. Stimulation of grassland nitrogen cycling under carbon dioxide enrichment *Oecologia* 109:149-153
7. Hungate BA, Jackson RB, Chapin FS III, Mooney HA, and Field CB, 1997. The fate of carbon in grasslands under carbon dioxide enrichment *Nature* 388:576-579
8. Hungate BA, Lund CP, Pearson HL, and Chapin FS III, 1997. Elevated CO_2 and nutrient addition alter soil N cycling and N trace gas fluxes with early season wet-up in a California annual grassland *Biogeochemistry* 37:89-109
9. Reynolds HL, Hungate BA, D'Antonio CM, and Chapin FS III, 1997. Soil heterogeneity and plant competition in an annual grassland. *Ecology* 78:2076-2090

10. Hungate BA, Dijkstra P, Johnson DW, Hinkle CR, and Drake BG, 1999. Elevated CO_2 increases nitrogen fixation and decreases soil nitrogen mineralization in Florida scrub oak *Global Change Biology* 5:781-790
11. Stiling P, Rossi AM, Hungate BA, Dijkstra P, Hinkle CR, Knott WM III, and Drake BG, 1999. Decreased leaf-miner abundance in elevated CO2: reduced leaf quality and increased parasitoid attack *Ecological Applications* 9:240-244
12. Hungate BA, 1999. Ecosystem responses to rising atmospheric CO_2: feedbacks through the nitrogen cycle. In *Carbon Dioxide and Environmental Stress* (Y Luo and HA Mooney, eds.), Academic Press, San Diego, pp. 265-285.
13. Hungate BA, Jaeger CH III, Gamara G, Chapin FS III, Field CB, 2000. Soil microbiota in two annual grasslands: responses to elevated CO_2 *Oecologia* 124:589-598
14. Loustau D, Hungate BA, Drake BG, 2001. Water, Nitrogen, Rising atmospheric CO_2 and Terrestrial Productivity. In J Roy, B Saugier, and HA Mooney, (eds): *Terrestrial Global Productivity* Academic Press, San Diego.
15. Johnson DW, Norby RJ, Hungate BA, 2001. Effects of Elevated CO_2 on Nutrient Cycling in Forests. In DF Karnowsky, R Ceulemans, GE Scarascia-Mugnozza (eds): *The Impact of Carbon Dioxide and Other Greenhouse Gases on Forest Ecosystems.* CAB International, pp. 237-252.
16. Cardon ZG, Hungate BA, Holland EA, Chapin FS III, and Field CB, 2001. Contrasting effects of elevated CO_2 on old and new soil carbon pools *Soil Biology and Biochemistry* 33:365-373
17. Johnson DW, Hungate BA, Dijkstra P, Hymus G, Drake BG, 2001. Effects of Elevated CO_2 on Soils in a Florida Scrub Oak Ecosystem. *Journal of Environmental Quality* 30:501-507
18. Hungate BA, Marks JC, 2002. Impacts of global change on terrestrial and aquatic ecosystems. In J Canadell and HA Mooney (eds.) *Encyclopedia of Global Change, Volume 2: The Earth system: biological and ecological dimensions of global environmental change*. John Wiley and Sons, Ltd.
19. Hungate BA, Koch GW, 2002. Global Environmental Change: Biospheric Impacts and Feedbacks. In J Holton, J Pyle, J Currie (eds.) *Encyclopedia of Atmospheric Science* Academic Press, Ltd. pp 876-885.
20. Stiling P, Cattell M, Moon DC, Rossi A, Hungate BA, Hymus G, Drake BG, 2002. Elevated atmospheric CO_2 lowers herbivore abundance but increases leaf abscission rates. *Global Change Biology* 8:658-667
21. Dijkstra P, Hymus G, Colavito D, Vieglais D, Cundari C, Johnson D, Hungate BA, Hinkle CR, Drake BG, 2002. Elevated atmospheric CO_2 stimulates shoot growth in a Florida scrub-oak ecosystem. *Global Change Biology* 8:90-103
22. Dukes JS, Hungate BA, 2002. Elevated CO_2 and litter decomposition in California annual grasslands: which mechanisms matter? *Ecosystems* 5:171-183
23. Hungate BA, Reichstein M, Dijkstra P, Johnson D, Hymus G, Tenhunen JD, Drake BG, 2002. Evapotranspiration and soil water content in a scrub-oak woodland under carbon dioxide enrichment. *Global Change Biology*, 8:289-298
24. Hymus GJ, Snead TG, Johnson DP, Hungate BA, Drake BG, 2002. Leaf mitochondrial respiration of scrub-oak leaves growing in elevated atmospheric CO_2. *Global Change Biology*, 8:317-328

25. *Langley JA*, Hungate BA, Drake BG, 2002. Extensive belowground carbon storage supports roots and mycorrhizae in regenerating scrub-oaks. *Oecologia* 131:542-548 ***(NAU Biology, Best Student Paper Award, 2002)***
26. *Menyailo OV*, Hungate BA, Zech W, 2002. The effect of grassland conversion and single tree species on soil microbial activities related to C and N cycling in the Siberian artificial afforestation experiment. *Plant and Soil* 242: 183-196
27. *Menyailo OV*, Hungate BA, Zech W, 2002. Tree species mediated soil chemical changes in the Siberian artificial afforestation experiment. *Plant and Soil* 242: 171-182
28. Hungate BA, Dukes JS, Shaw MR, Luo Y, Field CB, 2003. Nitrogen and Climate Change. *Science* 302:1512-1513
29. Hungate BA, Vitousek PM, Stewart J, Victoria R, Kenichi S, Naiman RJ, Cole JJ, Apps M, Moldan B, 2003. Disturbance and Element Interactions. In J Melillo, CB Field, B. Moldan (eds.) SCOPE 61: *Interactions of the Major Biogeochemical Cycles*. Island Press
30. *Li J-H*, Dugas WA, Hymus GJ, Johnson DP, Hinkle CR, Drake BG, Hungate BA, 2003. Direct and indirect effects of elevated CO_2 on transpiration of *Quercus myrtifolia* in a scrub-oak ecosystem. *Global Change Biology* 9:96-105
31. *Langley JA*, Hungate BA, 2003. Mycorrhizal controls on belowground litter quality. Special Feature: Belowground Community Dynamics. *Ecology* 84:2302-2312
32. *Langley JA*, *Dijkstra P*, Drake BG, Hungate BA, 2003. Ectomycorrhizal colonization, biomass and production in a regenerating scrub-oak forest under elevated CO_2 *Ecosystems* 6:424-430
33. *Menyailo OV*, Hungate BA, Lehmann J, Gebauer G, Zech W, 2003. Tree species of the Central Amazon and soil moisture alter stable isotope composition of nitrogen and oxygen in nitrous oxide evolved from soil. *Isotopes in Environmental and Health Sciences* 39:41-52
34. *Menyailo OV*, Hungate BA, 2003. Interactive effects of tree species and soil moisture on methane consumption. *Soil Biology and Biochemistry* 35:625-628
35. Johnson DW, Hungate BA, Dijkstra P, Hymus G, Hinkle CR, Stiling P, Drake BG, 2003. The effects of elevated CO_2 on nutrient distribution in a fire-adapted scrub oak forest. *Ecological Applications* 13:1388-1399
36. *Dijkstra P*, *Williamson C*, *Menyailo OV*, *Doucett RR*, Koch GW, Hungate BA, 2003. Intra-plant variation of nitrogen isotope composition in a meadow and a forest understorey. *Isotopes in Environmental and Health Sciences* 39:29-39
37. Hungate BA, Stiling PD, Dijkstra P, Johnson DW, Ketterer ME, Hymus GJ, Hinkle CR, Drake BG, 2004. CO_2 elicits long-term decline in nitrogen fixation. *Science*, 304:1291.
38. Pendall E, Bridgham S, Hanson PJ, Hungate B, Kicklighter DW, Johnson DW, Law BE, Luo Y, Megonigal JP, Olsrud M, Ryan MG, Wan S, 2004. Belowground Process Responses to Elevated CO_2 and Temperature: A Discussion of Observations, Measurement Methods, and Models. *New Phytologist*, 162:311-322
39. Luo Y, Su B, Currie WS, Dukes JS, Finzi A, Hartwig U, Hungate BA, McMurtrie R, Oren R, Parton WJ, Pataki D, Shaw MR, Zak DR, Field CB, 2004. Progressive nitrogen limitation of plant and ecosystem responses to elevated CO_2. *Bioscience*, 54:731-739.
40. Chung KT, Hungate B, Russell JB, 2005. Robert E. Hungate. ASM News, 71:42
41. *Menyailo OV*, Hungate BA, 2005. Species Effects on Potential Production and Consumption of Carbon Dioxide, Methane, and Nitrous Oxide: The Siberian Afforestation Experiment. In, D Binkley, O Menyailo (eds.) *Tree Species Effects on*

Soils: Implications for Global Change. Kluwer Academic Publishers. Dordrecht / Boston / London
42. Barnard R, Leadley PW, Hungate BA, 2005. Global change, nitrification and denitrification: a review. *Global Biogeochemical Cycles*, 19, GB1007, doi:10.1029/2004GB002282.
43. Hall MC, Stiling P, Hungate BA, Drake BG, Hunter MD, 2005. Effects of elevated CO_2 and herbivore damage on litter quality in a scrub oak ecosystem. *Chemical Ecology*, 31:2343-2356.
44. Reich P, Hungate BA, Luo Y, 2006. Carbon-Nitrogen Interactions in Response to Rising Atmospheric CO_2. *Annual Reviews of Ecology, Evolution, and Systematics*, 37:611-636.
45. *Menyailo OV*, Hungate BA, 2006. Tree species and moisture effects on soil sources of N_2O: quantifying contributions from nitrification and denitrification with ^{18}O isotopes. *Journal of Geophysical Research*, doi:10.1029/2005JG000058.
46. Hungate BA, Johnson DW, Dijkstra P, Hymus GJ, Stiling P, Megonigal JP, Pagel A, Moan JL, Day F, Li J-H, Hinkle CR, Drake BG, 2006. Nitrogen cycling during seven years of atmospheric CO_2 enrichment. *Ecology*, 87:26-40.
47. *Goodman LF*, Hungate BA, 2006. Managing Alaska's Spruce Beetle-Impacted Forests: Effects on Nitrogen Availability and Forest Regeneration. *Forest Ecology and Management*, 227:267-274, DOI: 10.1016/j.foreco.2006.02.041.
48. *Dijkstra P*, *Menyailo OV*, *Doucett RR*, Hart, SC, Schwartz, E, Hungate, BA, 2006. C and N availability affects the ^{15}N natural abundance of the soil microbial biomass across a cattle manure gradient. *European Journal of Soil Science*, DOI:10.111/j.1365-2389.2006.00793.
49. *Dijkstra P*, *Ishizu A*, Doucett RR, Hart SC, Schwartz A, Menyailo O and Hungate, BA, 2006. ^{13}C and ^{15}N natural abundance of the soil microbial biomass. *Soil Biology and Biochemistry* 38:3257-3266.
50. Day FP, Stover DB, Pagel AL, Hungate BA, Dilustro JJ, Herbert BT, Drake BG, Hinkle CR, 2006. Rapid root closure after fire limits fine root responses to elevated atmospheric CO_2 in a scrub oak ecosystem in central Florida, USA. *Global Change Biology*, doi: 10.1111/j.1365-2486.2006.01148.x.
51. *Menyailo OV*, Hungate BA, 2006. Stable isotope discrimination during soil denitrification: Production and consumption of nitrous oxide, Global Biogeochemical Cycles, 20, GB3025, doi:10.1029/2005GB002527.
52. van Groenigen KJ, Six J, Hungate BA, van Kessel C, de Graff MA, van Breemen N, 2006. Element interactions limit soil carbon storage *U.S. Proceedings of the National Academy of Sciences*, 103:6571-6574, DOE:10.1073/pnas.0509038103.
53. *Menyailo OV*, Hungate BA, 2006. Stable isotopes of carbon and nitrogen in northern forest soils. *Doklady Earth Sciences*. 409:747-749
54. *Barnard R*, Le Roux X, Hungate BA, Cleland EE, Blankinship JC, Barthes L, Leadley PW, 2006. Several components of global change alter nitrifying and denitrifying activities in an annual grassland. *Functional Ecology*, 20:557-564.
55. de Graaff MA, *Van Groenigen KJ*, Six J, Hungate BA, Van Kessel C, 2006. Interactions between plant growth and soil nutrient cycling under elevated CO_2: a Meta-Analysis. Global Change Biology 12:2077-2091. doi:10.1111/j.1365-2486.2006.01240.x

56. *Langley JA*, Chapman SK, Hungate BA, 2006. Ectomycorrhizal colonization slows root decomposition: the post-mortem fungal legacy. *Ecology Letters* 9:955–959. doi:10.1111/j.1461-0248.2006.00948.x
57. *Blankinship J*, Hungate BA, 2006. Belowground food webs in a changing climate. In, Newton PCD, Carran RA, Edwards GR, and Niklaus PA, editors, Agroecosystems in a changing climate. CRC Press.
58. Schwartz E, Blazewicz S, Doucett R, Hungate BA, Hart SC, Dijkstra P, 2007. Natural abundance $\delta^{15}N$ and $\delta^{13}C$ of DNA extracted from soil. *Soil Biology and Biochemistry*, 39, 3101-3107
59. *Doucett RR*, Marks JC, Blinn DW, Caron M, Hungate BA, 2007. Measuring Terrestrial Subsidies to Aquatic Food Webs Using Stable Isotopes of Hydrogen. *Ecology*, 88:1587-1592.
60. *Li J-H*, Johnson DP, Dijkstra P, Hungate BA, Hinkle CR, Drake BG, 2007. Elevated CO_2 mitigates the adverse effects of drought on daytime net ecosystem CO_2 exchange and photosynthesis in a Florida scrub-oak ecosystem. *Photosynthetica* 45:51-58.
61. Hungate BA, Hart SC, *Selmants PC*, Boyle SI, Gehring CA, 2007. Soil nitrogen responses to thinning and burning, increased precipitation, and nitrogen amendment in ponderosa pine forests. *Ecological Applications* 17: 1352–1365
62. *Li J-H*, Powell TL, Seiler TJ, Johnson DP, Anderson HP, Bracho R, Hungate BA, Hinkle CR, Drake BG, 2007. Impacts of hurricane Frances on a scrub-oak ecosystem under ambient and elevated CO_2: defoliation, net CO_2 exchange, and interactions with elevated CO_2. *Global Change Biology* 13:1101-1113
63. *Brown ALP*, Day FP, Hungate BA, Drake BG, Hinkle CR, 2007. Root biomass and nutrient dynamics in a scrub-oak ecosystem under the influence of elevated atmospheric CO_2. *Plant and Soil.* DOI 10.1007/s11104-007-9218-4
64. *Carney KM*, Hungate BA, Drake BG, Megonigal JP, 2007. Altered soil microbial community at elevated CO_2 leads to loss of soil carbon. *Proceedings of the National Academy of Sciences.* 104:4990-4995. DOI:10.1073/pnas.0610045104
65. *Selmants PC*, Hart SC, Boyle SI, Gehring CA, and Hungate BA, 2008. Restoration of a ponderosa pine forest increases soil CO2 efflux more than either water or nitrogen additions. *Journal of Applied Ecology*, 45:913-920
66. *Collins JG*, Dijkstra P, Hart SC, Hungate BA, Flood NM, Schwartz E, 2008. Nitrogen source influences natural abundance N-15 of Escherichia coli. *FEMS Microbiology Letters* 282:246-250.
67. Jackson, RB, JT Randerson, JG Canadell, RG Anderson, R Avissar, DD Baldocchi, GB Bonan, K Caldeira, NS Diffenbaugh, CB Field, BA Hungate, EG Jobbágy, LM Kueppers, MD Nosetto, DE Pataki, 2008. Protecting climate with forests. *Environmental Research Letters*. 3:44066
68. *Menyailo OV*, Hungate BA, Abraham W-R, and Conrad R, 2008. Changing land use reduces soil CH_4 uptake by altering biomass and activity but not composition of high-affinity methanotrophs. *Global Change Biology*, 14:2405-2419.
69. *Hurteau MD*, Koch GW, and Hungate BA, 2008. Carbon Protection and Fire Risk Reduction: Toward A Full Accounting of Forest Carbon Offsets. *Frontiers in Ecology and Environment*, 6, doi:10.1890/070187.

70. Dijkstra P, LaViolette CM, Coyle JS, Selmants PC, Doucett RR, Schwartz E, Hart SC, and Hungate BA, 2008. ^{15}N enrichment as an integrator of the effects of C and N on microbial metabolism and ecosystem function. *Ecology Letters* 11:389-397.
71. Dore S, Kolb TE, Montes-Helu M, Sullivan BW, Winslow WD, Hart SC, Kaye JP, Koch GW, and Hungate BA, 2008. Long-term impact of a stand-replacing fire on ecosystem CO_2 exchange of a ponderosa pine forest. *Global Change Biology* 14, 1801-1820.
72. *Duval BD*, and Hungate BA, 2008. Scavenging for scrap metal. *Nature Geoscience*, 1:213-214.
73. Montes-Helu M, Kolb TE, Dore S, Sullivan B, Hart SC, Koch G, Hungate BA, 2009. Persistent effects of fire-induced vegetation change on energy partitioning and evapotranspiration in ponderosa pine forests of northern Arizona. *Agricultural and Forest Meteorology*, 149:491-500.
74. Stiling P, Moon D, Rossi A, Hungate BA, Drake BG, 2009. Seeing the forest for the trees: long term exposure to elevated CO_2 may increase herbivore densities. *Global Change Biology* 15: 1895-1902
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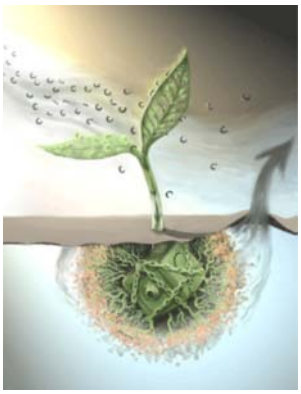
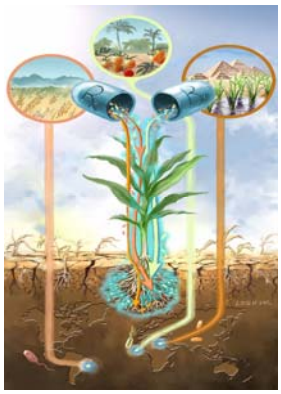
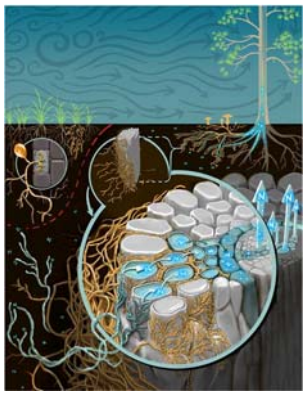
Non-peer reviewed

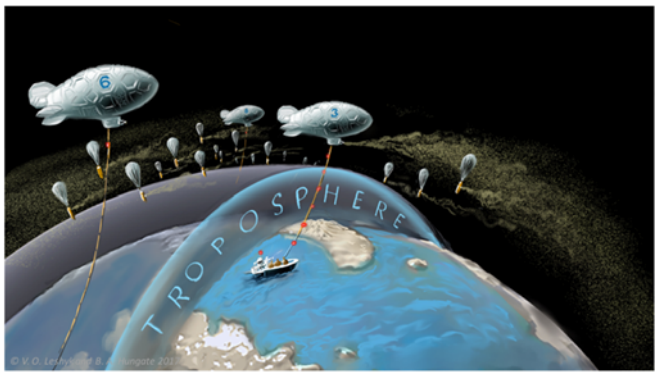
Clark Joelle, Marks Jane, Haden Carol, Bell Melinda, Hungate Bruce. 2012. The Carbon Cycle Game: A regionally relevant activity to introduce climate change. *The Earth Scientist* National Earth Science Teachers Association, Volume XXVIII Issue 3

Hungate BA, Cardinale BC, 2017. Biodiversity: What Value Should We Use? Frontiers in Ecology and the Environment, 15 (6) 283

Outreach & Selected Media Coverage

Ongoing collaboration with Victor Leshyk in the visual art of scientific communication (over a dozen images created for science communication and outreach). Examples:



Founder and Host of Ecoss Speaker Series, 1) Bill McKibben, *Oil and Honey: The Education of an Unlikely Activist*, High Country Conference Center, over 800 attendees, 22 April 2013, 2) Katharine Hayhoe, *Climate Change: Fact or Fiction?* Cline Library Auditorium, over 500 attendees, 17 September 2014; 3) Joe Romm, *Climate Change Communication*, Prochnow Auditorium, approximately 400 attendees, 23 April 2015

The Carbon Cycle Game: A Regionally Relevant Activity to Introduce Climate Change, 2012. Joëlle Clark, Jane Marks, Carol Haden, Melinda Bell, Darrell Kaufman, and Bruce Hungate. The Earth Scientist Volume XXVIII, Issue 3, Fall 2012.

Coconino County Democratic Women, Lecture Presentation, Flagstaff AZ, 8 October 2009

Participant, PBS video documentary, "A River Reborn: the story of Fossil Creek" © 2007, Northern Arizona University

The Guardian, We can't count on plants to slow down global warming, 9 May 2014 http://www.theguardian.com/environment/climate-consensus-97-per-cent/2014/may/09/cant-count-on-plants-slowing-global-warming

Arizona Daily Star, Don't count on soil as a carbon sink, 9 May 2014 http://azstarnet.com/news/blogs/desertblog/don-t-count-on-soil-as-a-carbon-sink-new/article_57a023f0-d7dc-11e3-a3fb-001a4bcf887a.html

The Arizona Daily Sun, 14 July 2011, "Climate Findings in NAU Review Grim" http://azdailysun.com/news/science/b5485d00-23cb-59b9-8ee3-34836e405a0d.html

Scientific American, Soils May Amplify Warming Power of Greenhouse Gases, 14 July 2011, http://www.scientificamerican.com/article.cfm?id=soils-may-amplify-power-of-greenhouse-gases (also covered in The Chicago Tribune, the Australian Broadcasting Company, Environment News Network, Climatewire, and other outlets)

National Public Radio, Living on Earth, 17 June 2011, The Fire and Climate Change Feedback Loop, http://www.loe.org/shows/segments.html?programID=11-P13-00024&segmentID=1

The Arizona Daily Sun, 9 September 2008, front page: "Saving the Planet 101"

The Arizona Daily Sun, 4 May 2008, front page: "Thin forests or let them burn", with followup editorial by the Daily Sun staff (later in May)

The Arizona Daily Sun, 30 September 2007, front page: "Quantifying the Carbon", coverage of interdisciplinary climate mitigation class

KNAU's Earthnotes, 2005 & 2007

Pine, NAU Alumni magazine, coverage of climate center, 2006

Horizons, NAU magazine, coverage of climate center, 2006

The Arizona Daily Sun, 2 August 2005, front page: "NAU lands climate center"

Channel 2 News, 1 August 2005, coverage of climate center

Washington Post (San Francisco Chronicle, Seattle Times, Christ Church), 2004

Baltimore Sun, 2004

Christian Science Monitor, 2004

Channel 2 News, 2003

Arizona Daily Sun, 2003

Invited, Plenary & Keynote Presentations

Graduate Student Invited Speaker, University of Colorado, Boulder, Department of Ecology and Evolutionary Biology, "Toward Quantitative Microbial Ecology", 6 Oct 2017, Boulder CO

Flagstaff Festival of Science, Northern Arizona University, "Geoengineering the Climate: Can We? Should We? 27 September 2017, Flagstaff AZ

Invited Speaker, Presidential Symposium, "Understanding the Chemistry of Our Planet", American Chemical Society's Annual Meeting in Washington, DC, 22 August 2017

Keynote Speaker, "Multi-Omics and the Microbial Ecology of Element Cycling in Ecosystems", Multi-Omics for Microbiomes Conference, Pacific Northwest National Laboratory, 2 July 2017

Invited Speaker, "The Biogeochemistry of Microbial Communities", Department of Energy, ESS PI meeting, April 2017

Invited Speaker, "Frontiers in Ecosystem Science: Microbial Ecology to Global Biogeochemistry", Carnegie Institution for Science, Department of Global Ecology, Stanford University, April 2017

"Molecules, Microbes, Math, and Meaning", University of New Mexico, March 2017

Climate change, what's new? Utah State University, November 2016

The Microbial Ecology of Soil Carbon, Utah State University, November 2016

The Microbial Ecology of Soil Carbon Across Scales, Department of Energy, Biological and Environmental Research Advisory Committee, October 2016

Plenary Speaker, Fifth International Symposium on Soil Organic Matter, "The Microbial Ecology of Soil Carbon", Göttingen, Germany, October 2014

Arizona State University, Hugh Hansen Invited Seminar Series, September 2014

Department of Energy, Integrated Climate Modeling Meeting, May 2014, Program Spotlight, "Scaling Carbon, Cell to Globe", Washington DC

Carnegie Department of Global Ecology, "The Microbial Ecology of Soil Carbon", May 2014, Stanford University

University of Arizona, Soil, Water, and Environmental Sciences, "Carbon: Microbial Ecology, Global Biogeochemistry", April 2014

Keynote speaker, Effects of Climate Change on Air Pollution and Response Strategies for European Ecosystems, annual meeting October 2012, Edinburgh, UK.

The University of Notre Dame, Invited Seminar, "Ecosystem Responses to Environmental Change: Biogeochemical Feedbacks and Interactions", April 2011

Brown University, Invited Seminar, "Responses of Ecosystems to Global Environmental Change", February 2011

University of Wageningen, 2010 invited lecture, "Biogeochemical Interactions in a Changing Climate"

Keynote Speaker, 2008 Annual Meeting of the Texas Plant Conservation Society, Corpus Christi, TX. "Confronting Climate Change"

Keynote Speaker, 2008 Annual Meeting of the Center for Plant Conservation, Joint Meeting with Florida Rare Plant Task Force, Miami, Florida. "Climate Change and Terrestrial Ecosystems"

Invited Guest, Conversations, Canyon Moon Theatre, "Global Climate, Going, Going… Gone" April 2008

Invited Speaker, Conference on Climate Change in Higher Education, Phoenix Arizona, November 2007.

Keynote Speaker, Rhizosphere 2, Montpellier, France. August 2007.

Invited Speaker, American Association for the Advancement of Science, Philip Hauge Abelson Advancing Science Seminar Series, October 2006. Microbe-atmosphere interactions and global change.

Invited Plenary Speaker, Joint Genomics: GTL Contractor-Grantee Workshop V, Metabolic Engineering Working Group Interagency Conference on Metabolic Engineering, & USDA-DOE Plant Feedstock Genomics for Bioenergy Joint Program Meeting, "From the globe to the cell and back: soil-atmosphere interactions in a changing climate." February 11-14, 2007, Bethesda, MD.

Advisees

Undergraduate Students: Ayla Martinez, Kirsten Grimm, Ben Moan, Melissa Smiglewski, Nathan Zorich, Jaina Moan, Jackson Leonard, Ayaka Ishizu, Melissa Reyes, Cory Helton, Matthias Hess, Laura Gray, Jesse Anderson, Patrick Reyes, Samantha Granum, Stephanie Belka, Christopher Williamson, Aresha Lee, Jesse Evans Schroeder, Rebecca Lara, Suzie Vogel

M.S. Students: J. Adam Langley (2001), Lilly Goodman (2002, employed by Alaska Fish & Game), Megan Hedlund (2002, currently employed by USFWS), Michael Allwright (2003, Environmental Consultant), Jeffrey Coyle (2007), Corinne LaViolette (2010), Jamie Brown (2011), Rebecca Mau (2012), Alessandra Zuniga (2017)

Ph.D. Students: J. Adam Langley (2005, currently faculty at Villanova University), Joseph Blankinship (2009, postdoc at UC Merced), Benjamin Duval (2010, postdoc at University of Illinois), Zhuoting Wu (2011, currently employed at USGS), Xiaojun Liu (2017, postdoc at the University of Massachusetts), Brianna Finley (current), Rachel Rubin (current), Alicia Purcell (current), Lindsey Jacobs (current)

Postdoctoral Advisees: Oleg V Menyailo (2002-2003, 2005), Jiahong Li (1999-2002, University of Central Florida), Paul Dijkstra (2001-2003, NAU Faculty), Richard Doucett (2005-2009, UC Davis Stable Isotope Lab), Mario Montes-Helu (2003-2006, New Mexico State University), Graham Hymus (2005-2006, private industry), Sabina Dore (2005-2007, private industry), Matthew Hurteau (2008-2011, faculty at University of New Mexico), Benjamin Koch (2013-2015, NAU Research Associate), Theresa McHugh (2013-2014, faculty at Colorado Mesa College), Natasja van Gestel (2013-2016, faculty at Texas Tech), Kees Jan van Groenigen (2010-2015, faculty at the University of Exeter), Ember Morrissey (2013-2015, faculty at West Virginia University), Junhui Li (2017-present)

Professional Activities:

Extramural service and activities:

Review Editorial Board, Frontiers in Terrestrial Microbiology, 2010-present

Associate Editor, Frontiers in Ecology and the Environment, 2008-present

Editorial Advisory Board, Global Change Biology, 2011-2013

Advisory Board, National Center for Ecological Analysis and Synthesis, 2006-2009

Associate Editor, Ecological Applications, 2004-2008

National Center for Ecological Analysis and Synthesis, Santa Barbara, CA, working group on Biodiversity and Ecosystem Functioning (2010-2012)

National Center for Ecological Analysis and Synthesis, Santa Barbara, CA, working group on Biogeochemical and Biophysical Effects of Terrestrial Ecosystems on Climate: Policy Implications (2008-2009)

Fixing Broken Ecosystems, The Science of Ecological Restoration: Special Session at the American Association for the Advancement of Science, SW Region Meeting, April 2004

SCOPE Element Interactions, Prague, Czech Republic, October 2002

Member, Committee of Visitors, Ecology Cluster, National Science Foundation March 2002

National Center for Ecological Analysis and Synthesis, Santa Barbara, CA, working group on ^{15}N Tracers in Terrestrial Ecosystems (2004-2005)

Progressive Nitrogen Limitation of Plant and Ecosystem Responses to Elevated CO_2 participant in May 2001 and May 2002 Working Groups, National Center for Ecological Analysis and Synthesis, Santa Barbara, CA

Microbial Processes in response to Elevated CO_2, Biogeosciences Special Session Co-Convener, American Geophysical Union Annual Meeting, San Francisco, CA, December 2000

Carbon Sequestration Under Elevated CO_2, Biogeosciences Special Session Co-Convener, American Geophysical Union Annual Meeting, San Francisco, CA, December 1999

Consulting Scientist, Smithsonian Environmental Research Center, 1997-1999

Journal Reviews: Science, Nature, Ecology, Ecology Letters, Journal of Ecology, Soil Science Society of America Journal, American Naturalist, Biogeochemistry, Global Change Biology, Plant and Soil, Oecologia, Ecological Applications, Proceedings of the US National Academy of Sciences, Journal of Experimental Botany, New Phytologist

Review Panels and Proposal Reviews: NASA graduate student fellowships in global change; National Science Foundation, USDA, EU, and NASA mail reviews, Department of Energy Review Panel (2005), over 300 pre-proposals and 80 proposals for the National Institute for Climatic Change Research

Global Change and Terrestrial Ecosystems workshop participant: Plant Acclimation to Elevated CO_2 (May 1996); Elevated CO_2 and Stress (May 1995); Transects Workshop (August 1993)

Professional Meeting Presentations: over 100 presentations at various professional meetings (primarily the Ecological Society of America, and the American Geophysical Union)

Intramural service at Northern Arizona University:

Northern Arizona University, Sustainability Committee, 2007-2009

Northern Arizona University, Colorado Plateau Analytical Laboratory, co-Founder and co-Director, 2005-present

Northern Arizona University, Water University, helped draft mission and vision statements, Spring 2005

Northern Arizona University, Strategic Alliance for Bioscience Research and Education, Executive Committee, ad hoc grant review committees

Northern Arizona University, Colorado Plateau Stable Isotope Laboratory, Director: 1998-present; Primary Operator: 1998-2000; http://www2.nau.edu/~bah/cpsil.html

Northern Arizona University, Merriam Powell Center for Environmental Research, Steering Committee: 1999-present

Northern Arizona University, Merriam Powell Center for Environmental Research, Executive Committee: 2001-2002

Northern Arizona University, Merriam Powell Center for Environmental Research, co-chair, Education Committee: 2001-2004
Northern Arizona University, Center for Sustainable Environments, Mission and Goals Committee: Fall, 1999
College of Engineering and Natural Sciences, Research Council, 2004-present
College of Arts and Sciences, Dr. Bob J. Barber Memorial Scholarship, *ad hoc* Review Committee, April 2001
Department of Biological Sciences, Academic Excellence Committee, 2007-present
Department of Biological Sciences, *ad hoc* Chair Replacement Committee, 2005
Department of Biological Sciences, Strategic Planning, Research Vision, 2005
Department of Biological Sciences, Faculty Status Committee: 2002-2004, 2006, 2008-present
Department of Biological Sciences, Chair, Microbial Ecology Search Committee, 2002
Department of Biological Sciences, Undergraduate Program Committee: 1999-2001
Department of Biological Sciences, Graduate Program Committee: 2001-2003, 2004-2006