

## Donald R. Zak

### Work:

School of Natural Resources & Environment  
University of Michigan  
430 E. University Ave.  
Ann Arbor, MI 48109-1115  
(734) 763-4991  
Email: drzak@umich.edu

### Home:

201 W. Henry St.  
Saline, MI 48176  
(734) 429-0123

**Date of Birth:** 16 July, 1958

### Education:

1987 Ph.D., Michigan State University  
1983 M.S., University of Idaho  
1981 B.S. *Cum Laude*, Ohio State University

### Academic Appointments:

2017 to Present	Arthur F. Thurnau Professor, University of Michigan
2012 to 2017	Associate Dean for Academic Programs, School of Natural Resources & Environment, University of Michigan
2009 to Present	Burton V. Barnes Collegiate Professor of Ecology, School of Natural Resources & Environment, University of Michigan
2004 to Present	Professor, Department of Ecology and Evolutionary Biology, University of Michigan
2004 to Present	Adjunct Professor, Department of Earth & Environmental Science University of Michigan
2000 to Present	Professor, School of Natural Resources & Environment University of Michigan
1994 to 2000	Associate Professor, School of Natural Resources & Environment, University of Michigan
1988 to 1994	Assistant Professor, School of Natural Resources & Environment, University of Michigan
1987 to 1988	Post-Doctoral Research Associate, Department of Soil Science, and Department of Ecology, Evolution, and Behavior University of Minnesota
1983 to 1987	Graduate Research Assistant, Michigan State University

### Awards and Honors:

Fellow, American Association for the Advancement of Science – for outstanding contributions to the fields of terrestrial and microbial ecology, particularly for experimental work identifying mechanisms of ecosystem response to environmental change - 2017.

Francis Clark Lectureship: Frontiers in Soil Biology – Awarded by the Soil Science Society of America for research excellence in soil microbiology and biochemistry - 2009

Students for SNRE Outstanding Faculty Teaching Award – 2006-2007; 2011-2012

Best Paper Award, Division S-7, Soil Science Society of America Annual Meeting, 1993, Cincinnati, OH.

Best Paper Award, Division S-7, Soil Science Society of America Annual Meeting, 1986, New Orleans, LA.

Graduate Research Fellowships, Michigan State University, 1984, 1985.

Virginia Mowery Graduate Scholarship, University of Idaho, 1982.

Sigma Xi, Xi Sigma Pi, Gamma Sigma Delta

#### **Books and Refereed Edited Volumes:**

Barnes, B.V., D.R. Zak, S. Denton. and S.H. Spurr. 1998. *Forest Ecology*, 4<sup>th</sup> Edition. John Wiley & Sons, New York, New York.

Curtis, P.S., E.G. O'Neill, J.A. Teeri, D.R. Zak, and K.S. Pregitzer (eds.) 1995. *Belowground Responses to Rising Atmospheric CO<sub>2</sub>: Implications for Plants, Soil Biota, and Ecosystem Processes*. Kluwer Academic Publishers, The Netherlands.

#### **Refereed Journal Articles** (in chronological order):

Zak, D.R., G.E. Host, and K.S. Pregitzer. 1986. Landscape variation of nitrogen mineralization and nitrification. *Canadian Journal of Forest Research* 16:1258-1263.

Zak, D.R. and K.S. Pregitzer. 1988. Nitrate assimilation by herbaceous ground flora in late successional forests. *Journal of Ecology* 76:537-546.

Zak, D.R., G.E. Host, and K.S. Pregitzer. 1989. Regional variability in nitrogen mineralization, nitrification, and overstory biomass in northern Lower Michigan. *Canadian Journal of Forest Research* 19:1521-1526.

Zak, D.R., P.M. Groffman, K.S. Pregitzer, S. Christensen, and J.M. Tiedje. 1990. The vernal dam: plant-microbe competition for nitrogen in northern hardwood forests. *Ecology* 71:651-656.

Zak, D.R., and K.S. Pregitzer. 1990. Spatial and temporal variability of nitrogen cycling in northern Lower Michigan. *Forest Science* 36:367-380.

Zak, D.R., D.F. Grigal, S. Gleeson, and D. Tilman. 1990. Carbon and nitrogen cycling during secondary succession: constraints on plant and microbial biomass. *Biogeochemistry* 11:111-129.

Updegraff, K., D.R. Zak, and D.F. Grigal. 1990. The nitrogen budget of a hybrid poplar plantation in Minnesota. *Canadian Journal of Forest Research* 20:1818-1822.

Zak, D.R., A.B. Hairston, and D.F. Grigal. 1991. Topographic influences on nitrogen cycling within an upland pin oak ecosystem. *Forest Science* 37: 45-65.

Johnson, N.C., D.R. Zak, D. Tilman, and L.F. Pflieger. 1991. Dynamics of vesicular-arbuscular mycorrhizae during old field succession. *Oecologia* 86:349-358.

Zak, D.R., and D.F. Grigal. 1991. Nitrogen mineralization, nitrification, and denitrification in upland and wetland ecosystems. *Oecologia* 88:189-196.

Merrill, A.G., and D.R. Zak. 1992. Factors controlling denitrification in upland and wetland forests. *Canadian Journal of Forest Research* 22:1597-1604.

- Randlett, D.L., D.R. Zak, and N.W. MacDonald. 1992. Sulfate adsorption and microbial immobilization in northern hardwood forests along an atmospheric deposition gradient. *Canadian Journal of Forest Research* 22:1843-1850.
- Zak, D.R., K.S. Pregitzer, P.S. Curtis, J.A. Terri, R. Fogel, and D.L. Randlett. 1993. Elevated atmospheric CO<sub>2</sub> and feedback between C and N cycles. *Plant and Soil* 151:105-117.
- Zak, D.R., D.F. Grigal, and L. Ohmann. 1993. Kinetics of microbial respiration and nitrogen mineralization in Lake States forests. *Soil Science Society of America Journal* 57:1100-1106.
- Groffman, P.M., D.R. Zak, S. Christensen, A. Mosier. 1993. Early spring nitrogen dynamics in a temperate forest landscape. *Ecology* 74:1579-1585.
- Holmes, W.E., and D.R. Zak. 1994. Microbial biomass dynamics and net nitrogen mineralization in northern hardwood forests. *Soil Science of America Journal* 58:238-243.
- Babbar, L.I., and D.R. Zak. 1994. Nitrogen cycling in coffee agroecosystems: net nitrogen mineralization and nitrification in the presence and absence of shade trees. *Agriculture, Ecosystems, and Environment* 48:107-113.
- McFadden, J.P., N.W. MacDonald, J.A. Witter, and D.R. Zak. 1994. Fine-textured soil bands and oak forest productivity in northwestern lower Michigan, U.S.A. *Canadian Journal of Forest Research* 24:928-933.
- Gonzalez, O.J. and D.R. Zak. 1994. Geostatistical analysis of soil properties in a tropical dry forest, St. Lucia, West Indies. *Plant and Soil* 163:45-54.
- Toland, D. and D.R. Zak. 1994. Soil respiration in intact and clearcut northern hardwood forests. *Canadian Journal of Forest Research* 24:1711-1716.
- Zak, D.R., D. Tilman, R.R. Parmenter, C.W. Rice, F.M. Fisher, J. Vose, D. Milchunas, and C.W. Martin. 1994. Plant production and soil microorganisms in late-successional ecosystems: a continental-scale study. *Ecology* 75:2333-2347.
- Curtis, P.S., D.R. Zak, K.S. Pregitzer, and J.A. Teeri. 1994. Above- and belowground response of *Populus grandidentata* to elevated atmospheric CO<sub>2</sub> and soil N availability. *Plant and Soil* 165:45-51.
- Curtis, P.S., E.G. O'Neill, J.A. Teeri, D.R. Zak, and K.S. Pregitzer. 1994. Belowground responses to rising CO<sub>2</sub>: Implications for plant, soil biota and ecosystem processes. *Plant and Soil* 165:1-6.
- MacDonald, N.W., D.R. Zak and K.S. Pregitzer. 1995. Temperature effects on the kinetics of microbial respiration and the net mineralization of N and S. *Soil Science Society of America Journal* 59:233-240.
- Babbar, L.I. and D.R. Zak. 1995. Nitrogen loss from coffee agroecosystems in Costa Rica: leaching and denitrification in the presence and absence of shade trees. *Journal of Environmental Quality* 24:227-233.
- Curtis, P.S., C.S. Vogel, K.S. Pregitzer, D.R. Zak, and J.A. Teeri. 1995. Interacting effects of soil fertility and atmospheric CO<sub>2</sub> on leaf area growth and carbon gain physiology in *Populus euramericana*. *New Phytologist* 129:253-263.

- Pregitzer, K.S., D.R. Zak, P.S. Curtis, M.E. Kubiske, J.A. Teeri, and C.S. Vogel. 1995. Atmospheric CO<sub>2</sub>, soil nitrogen and fine root turnover. *New Phytologist* 129:579-585.
- Zak, D.R., D. Ringelberg, K.S. Pregitzer, D.L. Randlett, D.W. White, and P.S. Curtis. 1996. Soil microbial communities beneath *Populus grandidentata* Michx. growing at elevated atmospheric CO<sub>2</sub>. *Ecological Applications* 6:257-262.
- Zogg, G.P., D.R. Zak, A.J. Burton, and K.S. Pregitzer. 1996. Fine root respiration in northern hardwood forests in relation to temperature and nitrogen availability. *Tree Physiology* 16:719-725.
- Randlett, D.L., D.R. Zak, K.S. Pregitzer, and P.S. Curtis. 1996. Elevated atmospheric CO<sub>2</sub> and leaf litter chemistry: influences on microbial respiration and N mineralization. *Soil Science Society of America Journal* 60:1571-1577.
- Rothstein, D.E., D.R. Zak, and K.S. Pregitzer. 1996. Nitrate deposition in northern hardwood forests and the N metabolism of *Acer saccharum* Marsh. *Oecologia* 108:338-344.
- Gonzalez, O.J. and D.R. Zak. 1997. Composition and structure of tropical dry forest of St. Lucia, West Indies: the influence of edaphic properties and disturbance. *Biotropica* 28:618-626.
- Kubiske, M.E., K.S. Pregitzer, C.J. Mikan, D.R. Zak, J.L. Maziasz, and J.A. Teeri. 1997. *Populus tremuloides* photosynthesis and crown architecture in response to elevated CO<sub>2</sub> and soil N availability. *Oecologia* 110: 328-336.
- Klironomos, J.N., M.F. Allen, M.C. Rillig, D.R. Zak, and K.S. Pregitzer. 1997. Increased levels of aero-allergenic fungal propagules in response to elevated atmospheric CO<sub>2</sub>. *Canadian Journal of Botany* 75:1670-1673.
- Zogg, G.P., D.R. Zak, D.B. Ringelberg, N.W. MacDonald, K.S. Pregitzer, and D.C. White. 1997. Compositional and functional shifts in microbial communities related to soil warming. *Soil Science Society of America Journal* 61:475-481.
- Burton, A.J., G.P. Zogg, K.S. Pregitzer, and D.R. Zak. 1996. Latitudinal variation in sugar maple fine-root respiration. *Canadian Journal of Forest Research* 26:1761-1768.
- Klironomos, J.N., M.C. Rillig, M.F. Allen, D.R. Zak, M.E. Kubiske, and K.S. Pregitzer. 1997. Soil fungal-arthropod responses to *Populus tremuloides* grown under enriched atmospheric CO<sub>2</sub> under field conditions. *Global Change Biology* 3:473-478.
- Burton, A.J., G.P. Zogg, K.S. Pregitzer, and D.R. Zak. 1997. Effects of measurement CO<sub>2</sub> concentration on sugar maple root respiration. *Tree Physiology* 17:421-427.
- Burton, A.J., K.S. Pregitzer, G.P. Zogg, and D.R. Zak. 1998. Drought reduces root respiration in sugar maple forests. *Ecological Applications* 8:771-778.
- Pregitzer, K.S., M.J. Laskowski, A.J. Burton, V.C. Lessard, and D.R. Zak. 1998. Variation in northern hardwood root respiration with root diameter and soil depth. *Tree Physiology* 18:665-670.
- Kubiske, M.E., K.S. Pregitzer, C.J. Mikan, and D.R. Zak. 1998. Growth and C allocation of *Populus tremuloides* clones in response to atmospheric CO<sub>2</sub> and soil N availability. *New Phytologist* 140:251-260.

- Holmes, W.E., and D.R. Zak. 1999. Nitrogen dynamics following clear-cut harvest of northern hardwood ecosystems: microbial control over spatial patterns of N loss. *Ecological Applications* 9:202-215.
- MacDonald, N.W., D.L. Randlett, and D.R. Zak. 1999. Soil warming and carbon loss from a Lake States Spodosol. *Soil Science Society of America Journal* 63:211-218.
- Zak, D.R., W.E. Holmes, N.W. MacDonald, and K.S. Pregitzer. 1999. Soil temperature, matric potential, and the kinetics of microbial respiration and net N mineralization in northern hardwood forests. *Soil Science Society of America Journal* 63: 575-584.
- Mansfield, J.L., P.S. Curtis, D.R. Zak and K.S. Pregitzer. 1999. Genotypic variation for condensed tannin production in trembling aspen (*Populus tremuloides*) under elevated CO<sub>2</sub> and in high and low fertility. *American Journal of Botany* 86: 1154-1159.
- Iseman, T.M., D.R. Zak, W.E. Holmes, and A.G. Merrill. 1999. Nitrogen leaching from Lake States northern hardwood forests following clearcut harvest. *Soil Science Society of America Journal* 63: 1424-1429.
- King, J.S., K.S. Pregitzer, and D.R. Zak. 1999. Clonal variation in above- and below-ground growth responses of *Populus tremuloides* Michaux: influence of soil warming and nutrient availability. *Plant and Soil* 217: 19-130.
- Curtis, P.S., C.S. Vogel, X. Wang, K.S. Pregitzer, D.R. Zak, M.E. Kubiske, and J.A. Teeri. 2000. Gas exchange, leaf nitrogen, and growth efficiency of *Populus tremuloides* in a CO<sub>2</sub> enriched atmosphere. *Ecological Applications* 10: 3-17.
- Pregitzer, K.S., D.R. Zak, J. Maziasz, J. DeForest, P.S. Curtis, and J. Lussenhop. 2000. Interactive effects of atmospheric CO<sub>2</sub> and soil-N availability on fine roots of *Populus tremuloides*. *Ecological Applications* 10: 18-33.
- Zak, D.R., K.S. Pregitzer, P.S. Curtis, C.S. Vogel, W.E. Holmes, and J. Lussenhop. 2000. Atmospheric CO<sub>2</sub>, soil N availability, and the allocation of biomass and nitrogen in *Populus tremuloides*. *Ecological Applications* 10: 34-46.
- Zak, D.R., K.S. Pregitzer, P.S. Curtis, and W.E. Holmes. 2000. Atmospheric CO<sub>2</sub> and the composition and function of soil microbial communities. *Ecological Applications* 10: 47-59.
- Zogg, G.P., D.R. Zak, K.S. Pregitzer, and A.J. Burton. 2000. Microbial immobilization and the retention of anthropogenic nitrate in northern hardwood forests. *Ecology* 81: 1858-1866.
- Rothstein, D.E., D.R. Zak, K.S. Pregitzer, P.S. Curtis. 2000. Kinetics of nitrogen uptake by *Populus tremuloides* in relation to atmospheric CO<sub>2</sub> and soil nitrogen availability. *Tree Physiology* 20: 265-270.
- Zak, D.R., K.S. Pregitzer, J.S. King, and W.E. Holmes. 2000. Elevated atmospheric CO<sub>2</sub>, fine roots and the response of soil microorganisms: a review and hypothesis. *New Phytologist* 147: 201-222.
- Mikan, C.J., D.R. Zak, M.E. Kubiske, and K.S. Pregitzer. 2000. Combined effects of atmospheric CO<sub>2</sub> and N availability on the belowground carbon and nitrogen dynamics of aspen mesocosms. *Oecologia* 124:432-445.

- Wang, X.Z., P.S. Curtis, K.S. Pregitzer, and D.R. Zak. 2000. Genotypic variation in physiological and growth responses of *Populus tremuloides* to elevated atmospheric CO<sub>2</sub> concentration. *Tree Physiology* 20: 1019-1028.
- King, J.S., K.S. Pregitzer, D.R. Zak, M.E. Kubiske, J.A. Ashby, and W.E. Holmes. 2001. Chemistry and decomposition of litter from *Populus tremuloides* Michaux grown at elevated atmospheric CO<sub>2</sub> and varying N availability. *Global Change Biology* 7: 65-74.
- Myers, R.T., D.R. Zak, D.C. White, and A. Peacock. 2001. Landscape-level patterns of microbial community composition and substrate use in upland forest ecosystems. *Soil Science Society of America Journal* 65: 359-367.
- King J.S., K.S. Pregitzer, D.R. Zak D.F. Karnosky, I.G. Isebrands, R.E. Dickson, G.R. Hendrey, J. Sober. 2001. Fine root biomass and fluxes of soil carbon in young stands of paper birch and trembling aspen as affected by elevated atmospheric CO<sub>2</sub> and tropospheric O<sub>3</sub>. *Oecologia* 128:237-250.
- Rothstein, D.E. and D.R. Zak. 2001. Relationships between plant nitrogen economy and life history in three deciduous-forest herbs. *Journal of Ecology* 89:385-395.
- King, J.S., K.S. Pregitzer, D.R. Zak, M.E. Kubiske, W.E. Holmes. 2001. Correlation of foliage and litter chemistry of sugar maple, *Acer saccharum*, as affected by elevated CO<sub>2</sub> and varying N availability, and effects on decomposition. *Oikos* 94: 403-416
- Rothstein, D.E., and D.R. Zak. 2001. Photosynthetic adaptation and acclimation in three temperate, deciduous-forest herbs. *Functional Ecology* 15: 722-731.
- Fisk, M., D.R. Zak, and T.R. Crow. 2002. Nitrogen storage and cycling in old- and second-growth northern hardwood forests. *Ecology* 83:73-87.
- Phillips, R.L., D.R. Zak, and W.E. Holmes, and D.C. White. 2002. Microbial community composition and function beneath temperate trees exposed to elevated atmospheric CO<sub>2</sub> and O<sub>3</sub>. *Oecologia* 131:236-244.
- Kubiske, M.E., D.R. Zak, K.S. Pregitzer, Y. Takeuchi. 2002. Three years of photosynthetic acclimation to elevated atmospheric CO<sub>2</sub>: overstory *Populus tremuloides* and understory *Acer saccharum*: interactions with shade and soil N. *Tree Physiology* 22: 321-329.
- Saiya-Cork, K.R., R. L. Sinsabaugh, and D. R. Zak. 2002. The effects of long-term nitrogen deposition on extracellular enzyme activity in an *Acer saccharum* forest soil. *Soil Biology & Biochemistry* 34: 1309-1315.
- Davidson, E.A., K. Savage, P. Bolstad, D.A. Clark, P.S. Curtis, D.S. Ellsworth, P.J. Hanson, B.E. Law, Y. Luo, K.S. Pregitzer, J.C. Randolph, D.R. Zak. 2002. Belowground carbon allocation in forests estimated from litterfall and IRGA-based soil respiration measurements. *Forest and Agricultural Meteorology* 113: 39-51.
- Larson, J.L., D.R. Zak, and R.L. Sinsabaugh. 2002. Microbial activity beneath temperate trees growing under elevated CO<sub>2</sub> and O<sub>3</sub>. *Soil Science Society of America* 66:1848-1856.

- Percy, K.E., C. S. Awmack, R. L. Lindroth, M.E. Kubiske, B.J. Kopper, J.G. Isebrands, K.S. Pregitzer, G.R. Hendrey, R.E. Dickson, D.R. Zak, E. Oksanen, J. Sober, R. Harrington, & D.F. Karnosky. 2002. Altered performance of forest pests under CO<sub>2</sub>- and O<sub>3</sub> - enriched atmospheres. *Nature* 420: 403-407.
- Karnosky, D.F., D.R. Zak, K.S. Pregitzer, C.S. Awmack, J.G. Bockheim, R.E. Dickson, G.R. Hendrey, G.E. Host, J.S. King, B.J. Kopper, E.L. Kruger, M.E. Kubiske, R.L. Lindroth, W.J. Mattson, E.P. McDonald A. Noormets, E. Oksanen, W.F.J. Parsons, K.E. Percy, G.K. Podila, D.E. Riemenschneider, P. Sharma, A. Sober, J. Sober, W.S. Jones, S. Anttonen, E. Vapaavuori, and J.G. Isebrands. 2003. Tropospheric O<sub>3</sub> moderates responses of temperate hardwood forests to elevated CO<sub>2</sub>: A synthesis of molecular to ecosystem results from the Aspen FACE project. *Functional Ecology* 17:287-307.
- Zak, D.R., W.E. Holmes, D.C. White, A.D. Peacock, and D. Tilman. 2003. Plant diversity, microbial communities, and ecosystem function: are there any links? *Ecology* 84: 2042-2050.
- Williams, E.L., L.M. Walter, T.C.W. Ku, G.W. Kling, and D.R. Zak. 2003. CO<sub>2</sub> and nutrient availability effects on mineral weathering. *Global Biogeochemical Cycles* 17 (2): Art. No. 1041.
- Holmes, W.E., D.R. Zak, K.S. Pregitzer, and J.S. King. 2003. Nitrogen cycling beneath *Populus tremuloides*, *Betula papyrifera* and *Acer saccharum* growing under elevated CO<sub>2</sub> and O<sub>3</sub>. *Global Change Biology* 9: 1743-1750.
- Sinsabaugh, R.L., K. Saiya-Cork, T. Long, M.P. Osgood, D. Neher, D.R. Zak, and R.J. Norby. 2003. Soil microbial activity in a *Liquidambar* plantation unresponsive to CO<sub>2</sub>-driven increases in primary production. *Applied Soil Ecology* 24:263-271.
- Zak, D.R., W.E. Holmes, A.C. Finzi, R.J. Norby, and W.H. Schlesinger. 2003. Soil nitrogen cycling under elevated CO<sub>2</sub>: a synthesis of forest FACE experiments. *Ecological Applications* 13: 1051-1061.
- White, L.L., D.R. Zak and B.V. Barnes. 2004. Biomass accumulation and nitrogen availability in an 87-year-old *Populus grandidentata* chronosequence. *Forest Ecology & Management* 191: 121-127.
- DeForest, J.L., D.R. Zak, K.S. Pregitzer, and A.J. Burton. 2004. Experimental NO<sub>3</sub><sup>-</sup> additions alter microbial community function in northern hardwood forests. *Soil Science Society of America Journal* 68: 132-138.
- Pregitzer, K.S., D.R. Zak, A.J. Burton, and J.A. Ashby. 2004. Chronic nitrate additions dramatically increase the export of carbon and nitrogen in northern hardwood forests. *Biogeochemistry* 68: 179-197.
- Zak, D.R., K.S. Pregitzer, W.E. Holmes, A.J. Burton and G.P. Zogg. 2004. Anthropogenic N deposition and the fate of <sup>15</sup>NO<sub>3</sub><sup>-</sup> in a northern hardwood ecosystem. *Biogeochemistry* 69: 143-157.
- Burton, A.J., K.S. Pregitzer, J.N. Crawford, G.P. Zogg, and D.R. Zak. 2004. Chronic NO<sub>3</sub><sup>-</sup> additions reduce soil respiration in northern hardwood forests. *Global Change Biology* 10: 1080–1091.
- DeForest, J.L., D.R. Zak, K.S. Pregitzer, and A.J. Burton. 2004. Nitrate deposition and the microbial degradation of cellulose and lignin in a northern hardwood forest. *Soil Biology & Biochemistry* 36: 965-971.

- Waldrop, M.P., D.R. Zak, and R.L. Sinsabaugh. 2004. Microbial community response to nitrogen deposition in northern forest ecosystems. *Soil Biology & Biochemistry* 36: 1443–1451.
- Sinsabaugh, R.L., D.R. Zak, M. Gallo, C. Lauber, and A. Amonette. 2004. Nitrogen deposition and dissolved organic carbon production in northern temperate forests. *Soil Biology & Biochemistry* 36:1509-1515.
- Waldrop, M.P., D.R. Zak, R.L. Sinsabaugh, M. Gallo, and C. Lauber. 2004. Nitrogen deposition modifies soil carbon storage through changes in microbial enzyme activity. *Ecological Applications* 14: 1172-1177.
- Luo Y, B. Su, W. S. Currie, J. S. Dukes, A. Finzi, U. Hartwig, B. Hungate, R. McMurtrie, R. Oren, W. J. Parton, D. Pataki, R. Shaw, D. R. Zak, and C. Field. 2004. Progressive nitrogen limitation of ecosystem responses to rising atmospheric CO<sub>2</sub>. *BioScience* 54:731-739.
- Gallo, M., R. Amonette, C. Lauber, R.L. Sinsabaugh and D.R. Zak. 2004 Microbial community structure and oxidative enzyme activity in nitrogen-amended north temperate forest soils. *Microbial Ecology* 48: 218–229
- Hassett, J.E., and D.R. Zak. 2005. Aspen harvest intensity decreases microbial biomass, extracellular enzyme activity and soil nitrogen cycling. *Soil Science Society of America Journal* 69: 227-235.
- DeForest, J.L., D.R. Zak, K.S. Pregitzer and A.J. Burton. 2005. Atmospheric NO<sub>3</sub><sup>-</sup> deposition, declines in decomposition and increases in DOC: Test of a potential mechanism. *Soil Science Society of America Journal* 69: 1233-1237.
- Paoli, G.D., L.M. Curran and D.R. Zak. 2005. Phosphorus efficiency of aboveground productivity in lowland rain forest of Indonesian Borneo: A test of the unimodal nutrient response efficiency hypothesis. *Ecology* 86: 1548-1561.
- Karnosky, D.F., K.S. Pregitzer, D.R. Zak M.E. Kubiske, G.R. Hendrey, D. Weinstein, and K.E. Percy. 2005. Scaling ozone responses of forest trees to the ecosystem level. *Plant, Cell & Environment*. 28: 965-981.
- Allison, V.J., R.M. Miller, J.D. Jastrow, R. Matamala, R.1 and D.R. Zak. 2005. Changes in soil microbial community composition in a tallgrass prairie chronosequence. *Soil Science Society of America Journal* 69: 1412-1421.
- Gallo, M.E., C.L. Lauber, S.E. Cabaniss, M. Waldrop, R.L. Sinsabaugh and D.R. Zak. 2005. Soil organic matter and litter chemistry response to experimental N deposition in northern temperate deciduous forest ecosystems. *Global Change Biology* 11: 1514-1521.
- Chapman, J.A., J.S. King, K.S. Pregitzer, and D.R. Zak, 2005. Effects of elevated CO<sub>2</sub> and tropospheric O<sub>3</sub> on the decomposition of fine roots. *Tree Physiology* 25: 1501-1510.
- Sinsabaugh, R.L., M.E. Gallo, C. Lauber, M.P. Waldrop, and D.R. Zak. 2005. Extracellular enzyme activities and soil carbon dynamics for northern hardwood forests receiving simulated nitrogen deposition. *Biogeochemistry* 75: 201-215.
- Chung, H., D.R. Zak, and E.A. Lilleskov. 2006. Fungal community metabolism and composition are altered by plant growth under elevated CO<sub>2</sub> and O<sub>3</sub>. *Oecologia* 147: 143-154.



- Paoli, G.D., L.M. Curran and D.R. Zak. 2006. Soil nutrients and beta diversity in the Bornean Dipterocarpaceae: evidence for niche partitioning by tropical rain forest trees. *Journal of Ecology* 94: 157-170.
- Zak, D.R., W.E. Holmes, M.J. Tomlinson, K.S. Pregitzer, and A.J. Burton. 2006. Microbial cycling of C and N in northern hardwood forests receiving chronic atmospheric  $\text{NO}_3^-$  deposition. *Ecosystems* 9:242-253.
- Zak, D.R., C.B. Blackwood, and M.P. Waldrop. 2006. A molecular dawn for biogeochemistry. *Trends in Ecology & Evolution* 21: 288-295.
- King, J.S., K.S. Pregitzer, D.R. Zak, W.E. Holmes, and K. Schmidt. 2006. Fine root chemistry and decomposition in north-temperate tree species show little response to elevated atmospheric  $\text{CO}_2$  and varying soil N availability. *Oecologia* 146: 318-328.
- Pregitzer, K.S., W.M. Loya, M.E. Kubiske, and D.R. Zak. 2006. Soil respiration in northern forests exposed to elevated atmospheric carbon dioxide and ozone. *Oecologia* 148: 503-516.
- Bandeuff, J.M., K.S. Pregitzer, W.M. Loya, W.E. Holmes, and D.R. Zak. 2006. The effects of elevated atmospheric  $\text{CO}_2$  and  $\text{O}_3$  on understory species composition and nitrogen acquisition. *Plant and Soil* 282: 251-259.
- Waldrop, M.P., D.R. Zak, C. Blackwood, C.D. Curtis, and D. Tilman. 2006. Resource availability controls fungal diversity across a plant diversity gradient. *Ecology Letters* 9: 1127-1135.
- Smemo, K.A., D.R. Zak, and K.S. Pregitzer. 2006. Chronic  $\text{NO}_3^-$  deposition reduces the retention of fresh leaf litter-derived DOC in northern hardwood forests. *Soil Biology & Biochemistry* 38: 1340-1347.
- Zak, D.R. and G.W. Kling. 2006. Microbial community composition and function across an arctic tundra landscape. *Ecology* 87: 1659-1670.
- Sefcik, L.T., D.R. Zak and D.S. Ellsworth. 2006. Photosynthetic responses to understory shade and elevated  $\text{CO}_2$  in four northern hardwood tree species. *Tree Physiology* 25: 1589-1599.
- Waldrop, M.P, and D.R. Zak. 2006. Microbial mechanisms controlling dissolved organic carbon production in response to elevated atmospheric nitrogen deposition. *Ecosystems* 9: 921-933
- Antibus, R.K., C. Lauber, R.L. Sinsabaugh, and D.R. Zak. 2006. Responses of Bradford reactive soil protein to experimental nitrogen addition in three forest communities in northern Lower Michigan. *Plant and Soil* 288: 173-187.
- Holmes, W.E., D.R. Zak, K.S. Pregitzer, and J.S. King. 2006. Elevated  $\text{CO}_2$  and  $\text{O}_3$  alter soil nitrogen transformations beneath trembling aspen, paper birch, and sugar maple. *Ecosystems* 9: 1354-1363.
- Sefcik, L.T., D.R. Zak and D.S. Ellsworth. 2007. Seedling survival is increased by elevated atmospheric  $\text{CO}_2$ . *Global Change Biology* 13: 132-146.
- Blackwood, C.B., M.P. Waldrop, D.R. Zak and R.L. Sinsabaugh. 2007. Molecular analysis of fungal communities and laccase genes in decomposing litter reveal differences among forest types but no impact of N deposition. *Environmental Microbiology* 9: 1306-1316.

- Chung, H., D.R. Zak, D.S. Ellsworth, and P.B. Reich. 2007. Plant diversity, elevated CO<sub>2</sub> and atmospheric N deposition alter microbial community composition and function. *Global Change Biology* 13: 980-989.
- Allison, V.J., T.K. Rajaniemi, D.E. Goldberg, and D.R. Zak. 2007. Quantifying direct and indirect effects of fungicide on an old-field plant community: an experimental null-community approach. *Plant Ecology* 190: 53-69.
- Blackwood, C.B., D.E. Hudleston, D.R. Zak and J.S. Buyer. 2007. Interpreting ecological diversity indices applied to T-RFLP data: insights from simulated microbial communities. *Applied and Environmental Microbiology* 73: 5276-5283.
- Zak, D.R., W.E. Holmes, K.S. Pregitzer, J.S. King, D.S. Ellsworth, and M.E. Kubiske. 2007. Belowground composition and the response of developing forest communities to atmospheric CO<sub>2</sub> and O<sub>3</sub>. *Global Change Biology* 13: 2230-2238.
- Finzi, A.C., R.J. Norby, C. Calfapietrac, A. Gallet-Budyneka, B. Gielend, W.E. Holmes, M.R. Hoosbeek, C.M. Iversen, R.B. Jackson, M.E. Kubiske, J. Ledford, M. Liberloo, R. Oren, A. Polle, S. Pritchard, D.R. Zak, and R. Ceulemans. 2007. Increases in nitrogen uptake rather than nitrogen-use efficiency support high rates of temperate forest productivity under elevated CO<sub>2</sub>. *Proceeding of the National Academy of Sciences* 104: 14014-14019.
- Smemo, K.A., D.R. Zak, K.S. Pregitzer, and A.J. Burton. 2007. Characteristics of DOC exports from northern hardwood forests receiving chronic atmospheric NO<sub>3</sub><sup>-</sup> deposition. *Ecosystems* 10: 369-379.
- Zak, D.R., W.E. Holmes, and K.S. Pregitzer. 2007. Atmospheric CO<sub>2</sub> and O<sub>3</sub> alter the flow of <sup>15</sup>N in developing forest ecosystems. *Ecology* 88: 2630-2639.
- Blackwood, C.B., D.R. Zak and J.S. Buyer. 2007. Tilting at windmills: a response to a recent critique of terminal restriction fragment length polymorphism data - Reply. *Appl. Environ. Microbiol.* 73: 8141-8042.
- Hofmockel, K.S., D.R. Zak and C.B. Blackwood. 2007. Does atmospheric N deposition alter the abundance and activity of lignolytic fungi in forest soils? *Ecosystems* 10: 1278-1286.
- Pregitzer, K.S., A.J. Burton, D.R. Zak, and A.F. Talhelm. 2008. Simulated chronic N deposition increases carbon storage in northern temperate forests. *Global Change Biology* 14: 142-153.
- Lesaulnier, C., D. Papamichail, S. McCorkle, B. Ollivier, S. Skiena, S. Taghavi, D.R. Zak, and D. van der Lelie. 2008. Elevated CO<sub>2</sub> affects soil microbial diversity associated with trembling aspen. *Environmental Microbiology* 10: 926-941.
- Eddy, W.E., D.R. Zak, W.E. Holmes, and K.S. Pregitzer. 2008. Chronic NO<sub>3</sub><sup>-</sup> deposition does not induce NO<sub>3</sub><sup>-</sup> use by *Acer saccharum* Marsh. *Ecosystems* 11: 469-477.
- Edwards, I.P., R.A. Upchurch, and D.R. Zak. 2008. Isolation of fungal cellobiohydrolase I genes from sporocarps and forest soils by PCR. *Applied and Environmental Microbiology* 74: 3481-3489.
- Pregitzer, K.S., A.J. Burton, J.S. King and D.R. Zak. 2008. Soil respiration, root biomass, and root turnover following long-term exposure of northern forests to elevated atmospheric carbon dioxide and tropospheric ozone. *New Phytologist* 180: 153-161.

- Sinsabaugh, R.L., C.L. Lauber, M.N. Weintraub, B. Ahmed, S.D. Allison, C. Crenshaw, A.R. Contosta, D. Cusack, S. Frey, M. E. Gallo, T. B. Gartner, S.E. Hobbie, K. Holland, B.L. Keeler, J.S. Powers, M. Stursova, C. Takacs-Vesbach, M.P. Waldrop, M. Wallenstein D.R. Zak, L.H. Zeglin. 2008. Stoichiometry of soil enzyme activity at global scale. *Ecology Letters* 11: 1252-1264.
- Lauber, C.L., R.L. Sinsabaugh, and D.R. Zak. 2008. Laccase gene composition and relative abundance in oak forest soil is not affected by short-term nitrogen fertilization. *Microbial Ecology* 57: 50-57.
- Dybzinski, R., J.E. Fargione, D.R. Zak and D. Tilman. 2008. The fertility effect: resource supply increases across an experimental plant species diversity gradient. *Oecologia* 158: 85-93.
- Grandy, A.S., R.L. Sinsabaugh, J.C. Neff, M. Stursova, and D.R. Zak. 2008. Nitrogen deposition effects on soil organic matter chemistry are linked to variation in enzymes, ecosystems and size fractions. *Biogeochemistry* 91: 37-49.
- Zak, D.R., W.E. Holmes, A.J. Burton, K.S. Pregitzer and A.F. Talhelm. 2008. Atmospheric  $\text{NO}_3^-$  deposition increases soil organic matter by slowing decomposition in a northern hardwood ecosystem. *Ecological Applications* 18: 2016-2027.
- Hassett, J.E., D.R. Zak, C.B. Blackwood, and K.S. Pregitzer. 2009. Are basidiomycete laccase gene abundance and composition related to reduced lignolytic activity under elevated atmospheric  $\text{NO}_3^-$  deposition in a northern hardwood forest? *Microbial Ecology* 57: 728-739.
- Kellner, H., and D.R. Zak. 2009. Expression of fungal type I polyketide synthase genes in a forest soil. *Soil Biology and Biochemistry* 41: 1344-1347.
- Chung, H., D.R. Zak, and P.B. Reich. 2009. Microbial assimilation of new photosynthate is altered by plant species richness and nitrogen deposition. *Biogeochemistry* 94: 233-242.
- Talhelm, A.F., K.S. Pregitzer, and D.R. Zak. 2009. Species-specific responses to atmospheric  $\text{CO}_2$  and  $\text{O}_3$  mediate changes in soil carbon. *Ecology Letters*. 12: 1-10.
- Edwards, I.P., and D.R. Zak. 2010. Phylogenetic similarity and structure of *Agaricomycotina* communities across a forested landscape. *Molecular Ecology* 19: 1469-1482.
- Eisenlord, S.D., and D.R. Zak. 2010. Chronic simulated atmospheric N deposition alters actinobacterial community composition in forest floor and surface soil. *Soil Science Society of America Journal* 74: 1157-1166.
- McGuire, K.L., D.R. Zak, I.P. Edwards, C.B. Blackwood and R. Upchurch. 2010. Ectomycorrhizal maintenance of overstory monodominance in a tropical rainforest *Oecologia* doi 10.1007/s00442-010-1686-1.
- Kellner, H., D.R. Zak, and M. Vandenbol. 2010. Fungi unearthed: transcripts encoding lignocellulolytic and chitinolytic enzymes in forest soil. *PLoS ONE* 5: e10971. doi:10.1371/journal.pone.0010971
- Schwietzer, J.A., D.G. Fischer, B.J. Rehill, S.C. Wooley, S.A. Woolbright, R.L. Lindroth, T.G. Whitham, D.R. Zak, and S.C. Hart. 2011. Forest gene diversity influences the composition and function of soil microbial communities. *Population Ecology* 53:35-46

- Edwards, I.P., and D.R. Zak 2011. Fungal community composition and function after long-term exposure of northern forests to elevated atmospheric CO<sub>2</sub> and O<sub>3</sub>. *Global Change Biology* 17: 2184-2195.
- Pregitzer, K.S., D.R. Zak, A. Talhelm, A.J. Burton, and J. Eikenberry. 2011. Nitrogen turnover in the leaf litter and fine roots of sugar maple. *Ecology* 91: 3456-3462.
- Fornara D.A., R. Bardgett, S. Steinbeiss, D. R. Zak, G. Gleixner, and D. Tilman 2011. Plant effects on soil N mineralization are mediated by the composition of multiple soil organic fractions. *Ecological Research* 26: 201-208.
- Hofmockel, K.S., D.R. Zak, and J.D. Jastrow. 2011. Change in forest soil organic matter pools after a decade of elevated CO<sub>2</sub> and O<sub>3</sub>. *Soil Biology & Biochemistry* 43: 1518-1527.
- Edwards, I.P., D.R. Zak, H. Kellner, S.D. Eisenlord and K.S. Pregitzer. 2011. Simulated atmospheric N deposition alters fungal community composition and suppresses lignocellulolytic gene expression in forest floor of a northern hardwood forest. *PLoS One* 6:e20421.
- Weber, C.F., D.R. Zak, B.A. Hungate, R.B. Jackson, R. Vilgalys, R.D. Evans, C.W. Schadt, J.P. Megonigal, and C.R. Kuske. 2011. Responses of soil cellulolytic fungal communities to elevated atmospheric CO<sub>2</sub> are complex and variable across five ecosystems. *Environmental Microbiology* doi:10.1111/j.1462-2920.2011.02548.x
- Zak D.R., K.S. Pregitzer, A.J. Burton, I.P. Edwards, and H. Kellner. 2011. Microbial responses to a changing environment: implications for the future functioning of terrestrial ecosystems. *Fungal Ecology* 4: 386-395.
- Zak, D.R., K.S. Pregitzer, M.E. Kubiske, and A.J. Burton. 2011. Forest productivity under elevated CO<sub>2</sub> and O<sub>3</sub>: positive feedbacks to soil N cycling sustain decade-long net primary productivity enhancement by CO<sub>2</sub>. *Ecology Letters* doi: 10.1111/j.1461-0248.2011.01692.x.
- Norby, R.J., and D.R. Zak. 2011. Ecological lessons from free-air CO<sub>2</sub> enrichment (FACE) experiments. *Annual Review of Ecology, Evolution & Systematics*. 42:181–203.
- Talhelm, A.F., K.S. Pregitzer, A.J. Burton and D.R. Zak. 2011. Air pollution and the changing biogeochemistry of northern forests. *Frontiers in Ecology and the Environment* 4: 386-395
- Burton, A.J., Jarvey, J.C., Jarvi M.P., D.R. Zak, and K.S. Pregitzer. 2011. Chronic N deposition alters root respiration: tissue N relationships in northern hardwood forests. *Global Change Biology* doi: 10.1111/j.1365-2486.2011.02527.x.
- Patterson, S.L., D.R. Zak, A.J. Burton, A.F. Talhelm, and K.S. Pregitzer. 2011. Simulated N deposition negatively impacts sugar maple regeneration in a northern hardwood ecosystem. *Journal of Applied Ecology* doi: 10.1111/j.1365-2664.2011.02090.x
- Zak, D.R., M.E. Kubiske, K.S. Pregitzer, and A.J. Burton. 2012. Atmospheric CO<sub>2</sub> and O<sub>3</sub> alter competition for soil nitrogen in developing forests. *Global Change Biology* 18: 1480-1488.
- Dunbar, J., S.A. Eichorst, L. Gallegos-Graves, S. Silva, G. Xie, D. Evans, D.A. Hungate, R.B. Jackson, J.P. Megonigal, C.W. Schadt, R. Vilgalys, D.R. Zak, and C.R. Kuske. 2012. Common bacterial responses in six ecosystems exposed to ten years of elevated atmospheric carbon dioxide. *Environmental Microbiology* doi:10.1111/j.1462-2920.2011.02695.x

- Whittinghill, K.A., W.S. Currie, D.R. Zak, A.J. Burton, and K.S. Pregitzer. 2012. Anthropogenic N deposition increases soil C storage by decreasing the extent of litter decay: analysis of field observations with a biogeochemical model. *Ecosystems* doi: 10.1007/s10021-012-9521-7
- Eisenlord, S.D., D.R. Zak and R.A. Upchurch. 2012. Dispersal limitation and the assembly of soil *Actinobacteria* communities in a long-term chronosequence. *Ecology and Evolution* doi: 10.1002/ece3.210
- Thomas, D.C., D.R. Zak, and T.R. Filley. 2012. Chronic N deposition does not alter the biochemical composition of forest floor and soil organic matter. *Soil Biology and Biochemistry* 54: 7-13.
- Templer, P.H. Mack, M.C., Chapin III, F.S., Christenson, L., Compton, J., Crook, H., Currie, W., Curtis, C., Dail, B., D'Antonio, C., Emmett, B.A., Epstein, H., Goodale, C., Gundersen, P., Hobbie, S.E., Holland, K., Hooper, D.U., Hungate, B.H., Kappel-Schmidt, H., Lamontagne, S., Nadelhoffer, K.J., Osenberg, C.W., Perakis, S., Schleppi, P., Schimel, J., Sommerkorn, M., Spoelstra, J., Tietema, A., Wessel, W.W., and D.R. Zak 2012. Sinks for nitrogen inputs in terrestrial ecosystems: a meta-analysis of enriched <sup>15</sup>N field tracer studies. *Ecology* 93: 1816-1829.
- Demers, J.D., J.D. Blum, and D.R. Zak. 2012. Hg cycling in a forested ecosystem: new insights into biogeochemical cycling and the global Hg cycle. *Global Biogeochemical Cycles* 27: 1-17.
- Eisenlord, S.D. Z. Freedman, D.R. Zak, K. Xue, Z. He, and J. Zhou. 2012. Microbial mechanisms mediating increased soil C storage under elevated atmospheric N deposition. *Applied and Environmental Microbiology* 79: 1191-1199.
- Gan, H., D.R. Zak and M.D. Hunter. 2013. Chronic atmospheric N deposition decreases microarthropod density in a northern hardwood ecosystem. *Ecological Applications* 23: 1311-1321.
- Van Diepen, L.T.A., D.R. Zak and E.M. Entwistle. 2013. Active arbuscular mycorrhizal fungal communities are altered by simulated N deposition in northern hardwood forests. *Applied Soil Ecology* 72: 62-68.
- Freedman, Z., S.D. Eisenlord, D.R. Zak, K Xue, X. He and J. Zhou. 2012. Chronic atmospheric N deposition suppresses functional genes mediating N cycling and causes assemblage dispersion in a northern hardwood forest ecosystem *Soil Biology and Biochemistry* 66: 130-138.
- Entwistle, E.M., D.R. Zak, and I.P. Edwards. 2013. Long-term simulated nitrogen deposition alters the composition of fungi active in forest floor. *Soil Science Society of America Journal* 77: 1648-1658.
- Gan, H., D.R. Zak and M.D. Hunter. 2014. Trophic stability of soil oribatid mites in the face of environmental change. *Soil Biology and Biochemistry* 68: 71-77.
- Cline, L.C. and D.R. Zak. 2014. Ecological factors structuring fungal biogeography and functional potential along a glacial chronosequence in the Upper Great Lakes region. *Environmental Microbiology* doi:10.1111/1462-2920.12281.
- Kellner, H., P. Luis, M.J. Pecyna, D. Kapturska, D. Krüger, D.R. Zak, R. Marmeisse, M. Vandenbol and M. Hofrichter. 2014 Widespread occurrence of expressed fungal secretory peroxidases in forest soils. *PLoS One* 9: e95557.

- Dunbar, J., L. Gallegos-Graves, B. Steven, R. Mueller, C. Hesse, D.R. Zak and C.R. Kuske. 2014. Surface soil fungal and bacterial communities in aspen stands are resilient to eleven years of elevated CO<sub>2</sub> and O<sub>3</sub>. *Soil Biology and Biochemistry* 76: 227-234.
- Zak, D.R. 2014. Ecosystem succession and nutrient retention: Vitousek and Reiners' hypothesis. *Bulletin of the Ecological Society of America* 95:234-237.
- Talhelm, A.F., K.S. Pregitzer, M.E. Kubiske, D.R. Zak et al. 2014. Anthropogenic carbon dioxide and ozone offset ecosystem C storage in forests. *Global Change Biology* 20: 2492-2504.
- Freedman, Z., and D.R. Zak. 2014. A bacterial role in lignin decomposition under future rates of atmospheric N deposition. *Applied and Environmental Microbiology* 16: 1538-1548.
- Freedman, Z. and D.R. Zak. 2014. Soil bacterial communities are shaped by temporal and environmental filtering: Evidence from a long-term chronosequence. *Environmental Microbiology* doi :10. 1111/1462-2920.12762.
- Hesse, C.N., R.C. Mueller, M. Vuyisich, L.V. Gallegos-Graves, C.D. Gleasner, D.R. Zak, and C.R. Kuske. 2015. Forest floor community metatranscriptomes identify fungal and bacterial responses to N deposition in two maple forests. *Frontiers in Microbiology* 6: 337.
- Freedman, Z. and D.R. Zak 2015. Atmospheric N deposition alters co-occurrence in saprotrophic bacterial communities. *Molecular Ecology* 24: 3170-3180.
- Mueller, R.C., L. Gallegos-Graves, D.R. Zak, and C.R. Kuske. 2015. Assembly of activity in fungal and bacterial communities along a natural environmental gradient. *Microbial Ecology* doi 10.1007/s00248-015-0655-y
- Peschel, A.R., D.R. Zak, L.C. Cline, and Z. Freedman. 2015. Elk, sagebrush, and saprotrophs: indirect top-down control on microbial community composition and function. *Ecology* 96: 2383-2393.
- Freedman Z., R.Z. Upchurch, K.J. Romanowicz and D.R. Zak. 2015. Differential responses of total and active microbial communities to future rates of atmospheric N deposition. *Soil Biology and Biochemistry* 90: 275-282.
- Cline, L.C. and D.R. Zak. 2015. Initial colonization effects, community assembly and ecosystem function: fungal colonist traits and litter biochemistry mediate decay rate. *Molecular Ecology* 24: 5048-5058.
- Cline, L.C. and D.R. Zak. 2015. Resource availability structures soil microbial composition and function across an old-field chronosequence. *Ecology* 96: 3374-3385.
- Freedman Z., R.A. Upchurch, D.R. Zak and L.C. Cline. 2015. Lignocellulolytic bacteria foster soil C storage under anthropogenic N deposition. *Frontiers in Microbiology* 7:259.
- Romanowicz, K.J., Z. Freedman, R. Upchurch and D.R. Zak. 2016. Total and active soil microbial communities in forest soil are shaped by soil water and pH. *FEMS Microbial Ecology* 92:10
- Ibáñez, I., D.R. Zak, A.J. Burton and K.S. Pregitzer. 2016. Chronic N deposition alters allometric relationships in *Acer saccharum*: woody biomass production and ecosystem C storage. *Ecological Applications* 26: 913-925.

- Zak, D.R., Z.B. Freedman, R. Upchurch, M. Steffens, and I. Kögel-Knabner. 2016. Anthropogenic N deposition increases soil organic matter accumulation without altering its biochemical composition. *Global Change Biology* doi: 10.1111/gcb.13480
- Freedman, Z., R.A. Upchurch and D.R. Zak. 2016. Microbial potential for ecosystem N loss is increased by experimental N deposition. *PLoS One* 10: e0164531
- Argiroff, W.A., D.R. Zak, C.M. Lanser, and M.J. Wiley. 2016. Microbial community functional potential and composition are shaped by hydrologic connectivity in riverine floodplain soils. *Microbial Ecology* doi:10.1007/s00248-016-0883-9
- Cline, L.C., D.R. Zak, R.A. Upchurch, Z. Freedman and A.R. Peschel. 2017. Soil microbial communities and elk migratory behavior: implications for soil biogeochemical cycling in sagebrush steppe. *Ecology Letters* 20: 202-211.
- Norby, R.J., M.G. De Kauwe, A.P. Walker, C. Werner, S. Zaehle, and D.R. Zak. 2017. Comment on: Mycorrhizal association as a primary control of the CO<sub>2</sub> fertilization effect. *Science* 355:358b
- Pellitier, P.T., and D.R. Zak. 2017. Ectomycorrhizal fungi and the enzymatic liberation of nitrogen from soil organic matter: why evolutionary history matters. *New Phytologist* doi: 10.1111/nph.14598
- Romanowicz, K.J., and D.R. Zak. 2017. Activity of an introduced earthworm increases under future rates of atmospheric N deposition in a northern temperate forest. *Applied Soil Ecology* 120: 206-210.
- Ibáñez, I, D.R. Zak, A.J. Burton and K.S. Pregitzer. 2018. Anthropogenic N deposition ameliorates the decline in tree growth caused by a drier climate. *Ecology* doi: 10.1002/ecy.2095.
- Entwistle, E.E., D.R. Zak, and W. Argiroff. 2018. Anthropogenic N deposition increases soil C storage by reducing the relative abundance of lignolytic fungi. *Ecological Monographs* doi.org/10.1002/ecm.1288
- Entwistle, E.E., K.J. Romanowicz, W.A. Argiroff, Z. B. Freedman, J. J. Morris. and D.R. Zak 2018. Anthropogenic N deposition alter the composition of expressed class II fungal peroxidases. *Applied and Environmental Microbiology* doi: 10.1128/AEM.02816-17
- Gan, H., D.R. Zak, and M.D. Hunter. 2018. Scale dependency of dispersal limitation, environmental filtering and biotic interactions determine the diversity and composition of oribatid mite communities. *Pedobiologia in press*.
- Zak, D.R., W.A. Argiroff, Z.B. Freedman, R.A. Upchurch and E.M. Entwistle. 2018. Fungal gene expression underlies an increasing soil carbon sink in the Northern Hemisphere. *Nature Climate Change in revision*.
- Walker, W.P., M.G. De Kauwe, B. E. Medlyn, S. Zaehle, C. Iversen, S. Asao, B. Guenet, P.J. Hanson, A. Harper, T. Hickler, B. Hungate, A. Jain, Y. Luo, C. Lu, M. Lu, K. Luus, H. McCarthy, P. Megonigal, R. Oren, W.J. Parton, S. Shu, A. Talhelm, Y. Wang, J.M. Warren, C. Werner, J. Xia, D.R. Zak, R.J. Norby. 2018. A decade of atmospheric CO<sub>2</sub> enrichment increases biomass carbon-sequestration across multiple forests. *Nature Communications in revision*.

Xia, J., A.P. Walker, R.J. Norby, M. De Kauwe, B. Medlyn, S. Zaehle, Y. Wang, B. Guenet, C.M. Iversen, A.B. Harper, X. Lu, K. Luus, C. Werner, B. Hungate, J. Liang, L. Jiang, M. Lu, P. Megonigal, J.A. Morgan, R.S. Nowak, R. Oren, E. Pendall, Z. Shi, A. Talhelm, J.M. Warren, E. Weng, L. Yan, D.R. Zak, Y. Luo. 2018. Uncertainty in land carbon storage capacity of a future high CO<sub>2</sub> world equally due to carbon influx and residence time. *Proceedings of the National Academy of Science in review.*

### **Refereed Reports:**

Kling, G.W., K. Hayhoe, L.B. Johnson, J.J. Magnuson, S. Polasky, S.K. Robinson, B.J. Schuter, M.M. Wander, D.J. Wuebbles, and D.R. Zak. 2003. *Confronting Climate Change in the Great Lakes Region.* Union of Concerned Scientists, Cambridge, Massachusetts, and Ecological Society of America, Washington, D.C.

### **Refereed Book Chapters:**

Christensen, S., P.M. Groffman, A. Mosier, and D.R. Zak. 1991. Rhizosphere denitrification: a minor process but an indicator of decomposition activity. *In* (N.P. Revsbech and J. Sorensen, Eds.) *Denitrification in Soils and Sediments*, Plenum Press, NY.

Reed, D.D., G.D. Mroz, H.O. Liechty, K.S. Pregitzer, A.J. Burton, D.R. Zak, J.A. Witter, and N.W. MacDonald. 1994. Studying the effects of air pollution on forests along exposure gradients: Experiences in the United States and opportunities for cooperation. p 109-116. *In* *climate and atmospheric deposition studies in forests* (Solon, J., E. Roo-Sielinska, and A. Bytnerowicz, eds.) Institute of Geography and Spatial Organization, Polish Academy of Sciences Conference Papers 19.

Curtis, P.S., D.R. Zak, K.S. Pregitzer, J. Lussenhop, and J.A. Teeri. 1996. Linking above- and belowground responses to rising CO<sub>2</sub> in northern deciduous forest species. pp. 41-51 *In* (Koch, G.W., and H.A. Mooney, eds.) *Carbon Dioxide and Terrestrial Ecosystems*. Academic Press, NY.

Zak, D.R., and K.S. Pregitzer. 1998. Integration of ecophysiological and biogeochemical approaches to ecosystem dynamics. *In* (P.M. Groffman and M.L. Pace, eds.) *Successes, limitations, and frontiers in ecosystem science*. Springer-Verlag, Pub. Inc.

Pregitzer, K.S., D.R. Zak, W.M. Loya, N. J. Karberg, J.S. King and A.J. Burton. 2006. The contribution of roots systems to biogeochemical cycles in a changing world. *In* (Z. Cardon & J. Whitbeck, eds.) *The Rhizosphere – An Ecological Perspective*. Elsevier, The Netherlands.

### **Funded Research**

#### **Current Research Support - \$ 1,647,317**

- Principal Investigators: D.R. Zak  
Title: Atmospheric N deposition and microbial mechanisms enhancing soil carbon storage.  
Start Date: 9/1/13      End Date: 8/31/16  
Amount of Award/Sponsor: \$1,467,520/ DoE Biological and Environmental Research



2. Principal Investigator: D.R. Zak  
 Title: LTREB: Long-term ecosystem response to chronic atmospheric N deposition.  
 Start Date: 9/1/13 End Date: 8/31/18  
 Amount of Award/Sponsor: \$201,284/ NSF Ecosystems Panel

**Previous Research Awards (in chronological order) - \$17,774,909**

1. Principal Investigator: D.R. Zak  
 Title: Patterns of Carbon & Mineralization in Forest Ecosystems.  
 Start Date: 9/1/89 End Date: 8/31/90  
 Amount of Award/Sponsor: \$8,375/USDA-Forest Service
2. Principal Investigators: D.R. Zak and L. Babbar  
 Title: Biological Regulation of Nitrogen Cycling in Coffee Plantations.  
 Start Date: 5/1/89 End Date: 4/30/90  
 Amount of Award/Sponsor: \$19,084/UM Rackham and OVPR
3. Principal Investigator: D.R. Zak  
 Title: Nitrogen Loss and Retention in Northern Hardwood Forests.  
 Start Date: 10/1/89 End Date: 9/30/91  
 Amount of Award/Sponsor: \$59,819/USDA
4. Principal Investigators: J. Witter and D.R. Zak  
 Title: Effects of an Air Pollution Gradient on Hardwood Forests in the Great Lakes Region.  
 Start Date: 10/1/89 End Date: 9/30/91  
 Amount of Award/Sponsor: \$40,000/USDA
5. Principal Investigators: J. Witter and D.R. Zak  
 Title: Biological and Physio-Chemical Mechanisms on Sulfate Retention along an  
 Atmospheric Pollution Gradient.  
 Start Date: 4/11/89 End Date: 6/30/90  
 Amount of Award/Sponsor: \$5,000/UM Michigan Memorial-Phoenix Project
6. Principal Investigators: D.R. Zak and O. Gonzalez  
 Title: Spatial Variability of Tropical Soil Fertility.  
 Start Date: 5/1/90 End Date: 4/1/91  
 Amount of Award/Sponsor: \$4,000/UM Population-Environment Dynamics Program
7. Principal Investigator: D.R. Zak  
 Title: Global Change and Elevated Carbon Dioxide: Instrumentation to Measure Carbon Flux  
 Between Plants and Soil Microorganisms.  
 Start Date: 12/15/90 End Date: 2/15/91  
 Amount of Award/Sponsor: \$20,000/UM-OVPR
8. Principal Investigators: K.S. Pregitzer, D.R. Zak and P.S. Curtis  
 Title: Atmospheric CO<sub>2</sub> and Feedback in the Plant-Soil System.  
 Start Date: 10/1/90 End Date: 3/31/93  
 Amount of Award/Sponsor: \$188,000/USDA

9. Principal Investigators: D.R. Zak, B.V. Barnes, and R. Fogel  
Title: Climate Change and Elevated Atmospheric CO<sub>2</sub>: Shifts in Carbon Flux Between Plants and Soil Microorganisms.  
Start Date: 10/1/91 End Date: 9/30/93  
Amount of Award/Sponsor: \$46,586/USDA
10. Principal Investigators: J. Witter, D.R. Zak, K. Pregitzer, G. Mroz, and D. Reed  
Title: Climate and Pollutant Influences on Ecosystem Processes in Northern Hardwood Forests.  
Start Date: 8/1/91 End Date: 9/30/94  
Amount of Award/Sponsor: \$446,000/USDA-Forest Service
11. Principal Investigators: J. Teeri, D.R. Zak, K. Pregitzer, P. Curtis, and J. Lussenhop  
Title: Elevated CO<sub>2</sub> and Feedback in Terrestrial Ecosystems.  
Start Date: 6/15/90 End Date: 5/30/91  
Amount of Award/Sponsor: \$25,000/U of M Global Change Program
12. Principal Investigators: J. Teeri, D.R. Zak, K. Pregitzer, P. Curtis, and J. Lussenhop  
Title: Above and Below Ground Ecosystem Responses to Elevated Atmospheric CO<sub>2</sub>  
Start Date: 7/1/92 End Date: 6/30/96  
Amount of Award/Sponsor: \$1,250,000/DOE-National Institute for Global Environmental Change
13. Principal Investigators: K.S. Pregitzer, D.R. Zak, and R. Hendrick  
Title: Effects of Soil Temperature and Nitrate on Fine Root Dynamics in Northern Hardwood Forests.  
Start Date: 1/1/93 End Date: 12/31/96  
Amount of Award/Sponsor: \$491,998/NSF Ecosystems Panel
14. Principal Investigators: D.R. Zak and K.S. Pregitzer  
Title: Changes in the Flux of Carbon Between Plants and Soil Microorganisms at Elevated CO<sub>2</sub>: Physiological Processes with Ecosystem-Level Implications.  
Start Date: 8/15/93 End Date: 8/14/96  
Amount of Award/Sponsor: \$414,666/DOE-Program for Ecosystem Research
15. Principal Investigators: D.R. Zak, K.S. Pregitzer, and M.E. Kubiske  
Title: The Belowground Response of Plants and Soil Microorganisms to Elevated CO<sub>2</sub>: Physiological and Ecosystem-Level Processes.  
Start Date: 8/15/96 End Date: 8/14/99  
Amount of Award/Sponsor: \$733,555/DOE Program for Ecosystem Research
16. Principal Investigator: D. Karnosky  
Co-PI: D.R. Zak and 13 PI from universities in the Great Lakes region  
Title: FACTS II - A free atmospheric CO<sub>2</sub> release experiment in Lake States forests.  
Start Date: 7/1/95 End Date: 6/30/02  
Amount of Award/Sponsor: \$1,078,061/ NSF TECO  
Location: Rhinelander, WS

17. Principal Investigator: D. Karnosky  
Co-PI: D.R. Zak and 13 PI from universities in the Great Lakes region  
Title: FACTS II – Equipment acquisition for a free atmospheric CO<sub>2</sub> release experiment.  
Start Date: 7/1/95 End Date: 6/30/02  
Amount of Award/Sponsor: \$250,973/ NSF Academic Infrastructure Program
18. Principal Investigator: D. Karnosky  
Co-PI: D.R. Zak and 13 PI from universities in the Great Lakes region  
Title: FACTS II - A free atmospheric CO<sub>2</sub> release experiment in Lake States forests.  
Start Date: 7/1/95 End Date: 6/30/02  
Amount of Award/Sponsor: \$2,619,557/DOE Program for Ecosystem Research
19. Principal Investigators: K.S. Pregitzer, D.R. Zak, and A.J. Burton  
Title: Cycling of Nitrate in Northern Hardwood Forests: Regulation and Consequences of N Saturation.  
Start Date: 6/1/96 End Date: 9/15/99  
Amount of Award/Sponsor: \$758,643/NSF Ecosystems Panel
20. Principal Investigators: L. Walter, L. Ambriola, P. Meyers, G. Kling, D.R. Zak  
Title: Carbon Exchange Dynamics in a Temperate Forested Watershed: A Laboratory and Field Multidisciplinary Study.  
Start Date: 3/1/96 End Date: 9/15/99  
Amount of Award/Sponsor: \$800,000/US EPA
21. Principal Investigators: R.L. Sinsabaugh, D.L. Moorehead, and D.R. Zak  
Title: Biochemical enhancement of soil carbon storage by nitrogen deposition.  
Start Date: 8/1/03 End Date: 7/31/06  
Amount of Award/ Sponsor: \$600,000/DOE Carbon Sequestration Program
22. Principal Investigator: D.R. Zak  
Title: Acquisition of equipment to study the influence of global change of carbon and nitrogen cycling in terrestrial ecosystems.  
Start Date: 6/1/98 End Date: 5/30/00  
Amount of Award/Sponsor: \$ 300,000/OVPR-SNRE-DOE
23. Principal Investigators: D.R. Zak and K.S. Pregitzer  
Title: Belowground responses of early- and late-successional trees to elevated CO<sub>2</sub> and O<sub>3</sub>: Alteration of soil food webs and DOC production.  
Start Date: 8/14/99 End Date: 8/14/02  
Amount of Award/Sponsor: \$804,425/DOE Program for Ecosystem Research
24. Principal Investigators: K.S. Pregitzer, D.R. Zak and A.J. Burton  
Title: Nitrogen saturation: Mechanisms and consequences of altered ecosystem metabolism.  
Start Date: 9/1/03 End Date: 8/31/06  
Amount of Award/Sponsor: \$853,000/ NSF Ecosystems Panel
25. Principal Investigator: D.R. Zak  
Title: Plant diversity and ecosystem function are linked by microbial communities in soil  
Start Date: 9/1/03 End Date: 8/31/07

- Amount of Award/Sponsor: \$275,000/USDA Soil & Soil Biology
26. Principal Investigators: R.L. Sinsabaugh, D.L. Moorehead, and D.R. Zak  
Title: Biochemical enhancement of soil carbon storage by nitrogen deposition.  
Start Date: 8/1/06 End Date: 7/31/08  
Amount of Award/ Sponsor: \$600,000/DOE Carbon Sequestration Program
  27. Principal Investigators: K.S. Pregitzer, D.R. Zak and A.J. Burton  
Title: From Genes to Ecosystems: Mechanisms Controlling Long-Term Ecosystem Response to Nitrogen Deposition.  
Start Date: 9/1/06 End Date: 8/31/09  
Amount of Award/Sponsor: \$800,000/ NSF Ecosystems Panel
  28. Principal Investigators: D.R. Zak et al.  
Title: Impacts of elevated CO<sub>2</sub> and O<sub>3</sub>, alone and in combination, on the structure and functioning of a northern hardwood forest ecosystem: operating the aspen FACE experiment.  
Start Date: 6/1/08 End Date: 5/31/11  
Amount of Award/Sponsor: \$4,000,000 total; \$ 553,413 to Zak /DOE Program for Ecosystem Research
  29. Principal Investigators: D.R. Zak and K.S. Pregitzer  
Title: Ecosystem response to elevated CO<sub>2</sub> and O<sub>3</sub> is controlled by plant-microbe interactions in soil.  
Start Date: 8/15/05 End Date: 8/14/11  
Amount of Award/Sponsor: \$ 1,538,705/DOE Program for Ecosystem Research
  30. Principal Investigators: D.R. Zak, K.S. Pregitzer, and C. Kuske  
Title: Atmospheric N deposition and microbial mechanisms enhancing soil carbon storage.  
Start Date: 7/1/10 End Date: 6/30/13  
Amount of Award/Sponsor: \$1,789,756/ DoE Biological and Environmental Research
  31. Principal Investigator: D.R. Zak, K.S. Pregitzer, and A.J. Burton  
Title: LTREB: Long-term ecosystem response to chronic atmospheric N deposition.  
Start Date: 8/15/08 End Date: 8/14/13  
Amount of Award/Sponsor: \$201,284/ NSF Ecosystems Panel

**Post-Doctoral Scholars and Graduate Students Supervised (\*degree received/postdoc completed)**Post-Doctoral Scholars:

Melany Fisk\*  
 Gregory Zogg\*  
 Rebecca Phillips\*  
 Mark Waldrop\*  
 Kurt Smemo\*  
 Christopher Blackwood\*  
 Kirsten Hofmockel\*  
 Harald Kellner\*  
 Ivan Edwards\*  
 Kyle Whittinghill\*  
 Linda van Diepen\*  
 Zachary Freedman\*

Ph.D. Committee Chair:

Otto Gonzales\*  
 Liana Babbar\*  
 William Holmes\*  
 Gregory Zogg\*  
 Carl Mikan\*  
 David Rothstein\*  
 Jared DeForest\*  
 Haegun Chung\*  
 Krista McGuire\* (co-chair)  
 Lesley Sefcik\*  
 Lauren Cline\*  
 Huijie Gan (co-chair)\*  
 Elizabeth Entwistle\*  
 Peter Pellitier  
 Wesley Bickford (co-chair)  
 Will Argiroff

Master's Committee Chair:

David Jones\*  
 William Holmes\*  
 Amy Merrill\*  
 Diana Randlett\*  
 David Toland\*  
 Nancy French\*  
 David Rothstein\*  
 Thomas Iseman\*  
 Rachael Meyer\*  
 Jennifer Larson\*  
 Anne Finan\*  
 John Hassett\*  
 William Eddy\*  
 Sarah Eisenlord\*  
 Lauren Hoffman\*  
 Elizabeth Entwistle\*  
 Sierra Patterson\*  
 Dana Thomas\*  
 Amanda Garzio-Hadzick\*  
 Anna Peschel\*

Undergraduate Honors Thesis Chair:

Steve LuDuc\*  
 Casey Curtis\*  
 Kalub Fedak\*  
 Alaina Ritter\*  
 Lauren Cline\*  
 Kristen Kulik

**Courses Taught**

General Ecology – EEB 281

Undergraduate Honors Seminar – ENVIRON 399 & 499

Soil Ecology – NRE 430/EEB 489

Ecosystem Ecology – NRE 476/EEB 476

Biodiversity & Ecosystem Function: Are There Any Links? NRE 639-063 Graduate Seminar

Ecosystem Science in the Rockies – EARTH/ENVIRON 450

**Professional Societies and Service**Affiliations:

Ecological Society of America  
 Soil Science Society of America  
 International Society for Microbial Ecology  
 American Association for the Advancement of Science

Editorial Boards:

1998 to 2000 - *Forest Science*, Associate Editor – Ecology.  
 1998 to 2005 - *Soil Science Society of America Journal*, Associate Editor – Soil Biology and Biochemistry.  
 2001 to 2004 – *Ecology and Ecological Monographs*, Associate Editor – Microbial Ecology and Biogeochemistry  
 2008 to Present – *Ecological Applications, Ecosphere* Associate Editor – Microbial Ecology and Biogeochemistry  
 2008 to Present – *Nature* Reader Advisory Board  
 2012 to Present – *Elementa* Editor in Chief, Ecology Domain

Manuscripts Reviewed for:

Applied and Environmental Microbiology, Biological Conservation, Canadian Journal of Forest Research, Ecology, Ecological Applications, Ecosystems, Forest Science, Geoderma, Global Change Biology, Journal of Ecology, Journal of Environmental Quality, Mycological Research, Nature, Oecologia, Pedobiologia, Plant and Soil, Scandinavian Journal of Forest Research, Science, Soil Biology & Biochemistry, Soil Science Society of America Journal, Proceeding of the National Academy of Science

Review Panels:

NSF LTER Panel 2008  
 NSF Ecosystems Studies Program Panel 2001 - 2005  
 Scientific Advisory Committee, Duke FACE Experiment 2003-2006  
 NSF Site Review Team – National Phytotron Laboratory 1999  
 NSF Site Review Team – Toolik Lake and Bonanza Creek LTERs 2001  
 Terrestrial Carbon Processing Program, Dept. of Energy 1994, 1995

Grants Reviewed for:

National Science Foundation Ecosystems Panel and Ecology Panel, Department of Energy, U.S. Department of Agriculture, Kearney Foundation

National Advisory Boards

Science Advisory Board, Climate Change Program, Oak Ridge National Lab – 2009-2011  
 National Technical Advisory Committee, National Institute of Global Environmental Change (NIGEC), Department of Energy 2001-2003

Invited Presentations:

Ecology and Evolutionary Biology Program, Michigan State University - 1991  
 NSF/LTER Coordinating Committee Meeting, Rhinelander, WI -1992  
 Institute for Ecosystem Studies, New York Botanical Garden, Millbrook, NY - 1992  
 Forest Service University, USDA Forest Service, Milwaukee, WI - 1992  
 Forest Service University, USDA Forest Service, Chicago, IL-1993  
 Aspen Global Change Institute, Aspen, CO - 1990, 1991,1993  
 University of Michigan Biological Station - 1992, 1998, 2007  
 Annual Meeting of the Ecological Society of America, Climate Change Symposium, 1994

Global Change Program, University of Michigan - 1992, 1996  
Seventh Cary Conference, Institute of Ecosystems Studies - 1997  
*BIOGEMON*, 3<sup>rd</sup> International Sym. on Ecosystem Behavior, Villanova University- 1997  
Global Change and Terrestrial Ecosystems (GCTE) Program, Duke University- 1998  
GCTE Program - Climate Change and Litter Decomposition, Capri, Italy - 1998  
Plant Biology Council Seminar, University of Guelph - 1999  
Ecology Seminar Series, University of Illinois-Chicago, Chicago, IL - 1999  
Root Dynamics and Global Change, sponsored by *New Phytologist* and GCTE, Townsend, TN  
– 1999  
Department of Biology Seminar Series, University of Toledo -2001  
Program in Ecology Seminar Series, Duke University - 2002  
Ecology Seminar Series, University of California, Berkeley – 2002  
Dept. Environ., Pop. and Organismal Biology, Univ. of Colorado -- 2004  
Carnegie Institution, Stanford University – 2006  
Department of Biology, Notre Dame University – 2006  
Ecological Society of America Meeting - Invited Symposium – 2007  
Soil Science Society of America Meeting – Invited Symposium – 2007  
Plant Biology Symposium, Penn State University – 2009  
International Soil Organic Matter Dynamics Symposium, Colorado Springs, CO – 2009  
F.E.Clark Distinguished Lectureship in Soil Biology, SSSA Annual Meeting, Pittsburg --2009  
International Society for Microbial Ecology Meeting, Seattle, WA – 2010  
Microbial Ecology of Forest Soils Workshop – Plenary Address, Lund University, Lund  
Sweden -- 2011  
Soil Microbiology Conference, Czech Academy of Sciences, Plenary Address, Czech Academy  
of Sciences, Prague, Czech Republic – 2011  
Department of Ecology, Peking University, Beijing, China – 2011  
Fungal Genetics Meeting, Monterey CA - 2013