

# Nate G. McDowell

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Born in Seattle Washington, December 26, 1971

## **Education**

Ph.D., *Forest Ecology* - April 2002

Dept. of Forest Science, College of Forestry, Oregon State University, Corvallis, OR

M.Sc., *Forest Resources* - August 1998

College of Forest, Wildlife and Range Sciences, University of Idaho, Moscow, ID

B.Sc., *Biology* - December 1994

College of Literature, Science and Arts, University of Michigan, Ann Arbor, MI

## **Positions**

2004 - current	Adjunct Professor	University of New Mexico
2004 - current	Staff Scientist	Los Alamos National Laboratory
2003 - 2004	Postdoctoral Fellow	Los Alamos National Laboratory
1998 - 2002	Graduate Research Asst.	Oregon State University
1996 - 1998	Graduate Research Asst.	University of Idaho
1996	Field Botanist	Oregon State University
1995-1996	Field Technician	University of Michigan

## **Research interests**

Physiological ecology: Physiological and environmental controls over plant carbon-water balance, productivity, survival, and distribution; responses to extrinsic forcing; hydraulics; allometry; integration across fields via theoretical and model analyses.

Ecosystem ecology: Physiological and environmental controls over ecosystem carbon-water balance and productivity; response to extrinsic forcing including climate, trace gases, anthropogenic and “natural” disturbances; scaling processes from  $\mu$ meters to hectares; soil organic matter decomposition; integration across fields with theory development and model analyses.

Isotope ecology: Applying stable isotopes as a tool to 1) interpret plant and ecosystem carbon-water balance, and 2) understand biosphere-atmosphere exchange of carbon, water and energy. Integration of results and interpretations across fields.

**Journal Associate Editor** *Canadian Journal of Forest Research, Tree Physiology*

**Journal Reviewer** *Agricultural and Forest Meteorology, Annals of Forest Science, Biogeochemistry, Atmospheric Chemistry and Physics Discussions, Canadian Journal of Forestry, Ecological Applications, European Journal of Soil Science, Forest Science, Forest Ecology and Management, Global Change Biology, Journal of Geophysical Research-Biogeosciences, New Phytologist, Oecologia, Plant Cell and Environment, Tree Physiology*

**Grant Reviewer**

DOE Office of Science, Program for Ecosystem Research  
DOE Office of Science, National Institute for Climate Change Research  
Laboratory Directed Science and Development, Exploratory Research

**Service and Advisory Committees**

LANL Energy, Climate and Infrastructure Science Team. (2008 - )

DOE-Carbon Cycling and Biosequestration: Informing Near-term Research Priorities for DOE's Genomics/GTL Program. (2008 - )

DOE-Exploring Science Needs for the Next Generation of Climate Change and Elevated CO<sub>2</sub> Experiments in Terrestrial Ecosystems. (2008 - )

Postdoc Advisory Committee, Earth and Environmental Science Division. (2007 - )

LANL Climate Change Working Group. (2006 - )

National Ecological Observatory Network-Stable Isotope Working Group. (2006 - )

LANL Biogeochemistry Working Group. (2006 - )

Earth and Environmental Sciences Division "Science and Engineering Leadership Team" (2005 - 2007)

Los Alamos National Laboratory-Laboratory and Field Safety Analyses Team. (2005)

Search Committee member for Department of Forest Science Richardson Chair. (2000)

Graduate Student Representative. Representative of the Forest Science Department graduate students to the department, college and university for policy. (1999-2000)

**Member (Past and Present)**

Ecological Society of America, American Geophysical Union, Society of American Foresters, International Union of Forestry Research Organizations

## **Awards**

Distinguished Mentor Award Winner (Entire Laboratory) (2008). Students' nomination letters available upon request.

Los Alamos National Laboratory Directors Fellowship. (2003)

Jimmy Dukes Fellowship. Forest Science Department, Oregon State University. (2000)

Outstanding Ph.D. Student of the Year Award. Forest Science Department, Oregon State University. (2000)

Best Student Poster Award. Physiological Ecology Section, The Ecological Society of America Conference. (1997)

Outstanding Graduate Student of the Year (entire University). University of Idaho. (1997)

The James R. Slater Award in Plant Systematics and Field Botany, Department of Biology, University of Michigan. (1994)

## **Grants**

United States Geological Survey-Western Ecological Research Center, Fort Collins Center, and Northern Rocky Mountain Science Center. (5-yr.). The Western Mountain Initiative: Vulnerability and Adaptation to Climate Change in Western Mountain Ecosystems. (N. Stephenson PI, 6 USGS co-I's, 13 partners). \$6,990,000 (\$90,000 for McDowell). 2008.

Department of Energy-Program for Ecosystem Research (5-yr. renewal). Hydraulic mechanisms of survival and mortality in response to drought in piñon-juniper woodlands of southwestern USA. (N. McDowell and W. Pockman). \$4,403,000. 2008

DOE-EPSCOR- Experimental Program to Stimulate Competitive Research. Carbon, water and energy budget response of piñon-juniper woodlands to experimental, ecosystem-scale mortality. (M. Litvak, N. McDowell, T. Rahn, M. Ryan). \$210,000. 2008.

Laboratory Directed Research and Development, Exploratory Research (*ER*), Environmental and Biological Sciences (*DOE*). A visionary new approach to assess climate change impacts on vegetation survival and mortality. (N. McDowell and T. Ringler). \$900,000. 2008.

Laboratory Directed Research and Development, Reserve (*DOE*). Determining the ideal approach, parameters, and feedbacks to forecasting climate impacts on water availability (N. McDowell, Tim McPherson, Todd Ringler). \$105,000 (1 yr). 2008.

USDA Forest Service, Rocky Mountain Research Station. The response of piñon-juniper ecosystem carbon budgets to altered precipitation (N. McDowell, M.G. Ryan and W. Pockman). \$141,000. 2008.

Department of Energy-Small Business Innovation Research. A new Cavity Ring Down method for continuous, high precision monitoring of atmospheric CO<sub>2</sub>. (B. Richman, E. Crosson, N. McDowell, T. Rahn) \$98,500. 2007.

National Science Foundation: IOB Environmental and Structural Systems. Light enhanced <sup>13</sup>C enrichment of dark respired CO<sub>2</sub>: Implications for leaf internal CO<sub>2</sub> conductance and respiration in the light. (D. Hanson, N. McDowell, T. Rosenstiel). \$360,000. 2007.

Laboratory Directed Research and Development, Exploratory Research (*ER*), Biochemistry and Biophysical Sciences (*DOE*). A new approach to unravel complex microbial processes. (C. Kuske and N. McDowell). \$900,000. 2007.

Institute of Geophysics and Planetary Physics-Workshop Grant (University of California). Comparing high frequency measurements and models of the stable isotope composition of biosphere-atmosphere CO<sub>2</sub> exchange (N. McDowell). \$10,000. 2007

USDA Forest Service, Rocky Mountain Research Station. Implications of mortality on carbon balance of piñon-juniper woodlands (N. McDowell, M.G. Ryan and W. Pockman). \$73,000 (2 yr). 2006.

Department of Energy-Program for Ecosystem Research. Hydraulic mechanisms of survival and mortality in response to drought in piñon-juniper woodlands of southwestern USA. (N. McDowell and W. Pockman). \$2,006,000. 2005

Valle Caldera National Preserve-Los Alamos National Laboratory Collaborative Research Program. Physiologic and hydrologic response of a ponderosa pine ecosystem to silvicultural restoration. (N. McDowell). \$275,078 . 2005.

Laboratory Directed Research and Development, Distinguished Student Support Program. Development of the terrestrial isotopic flux program at *LANL*. (N. McDowell). \$31,000 (1 yr, 3 students). 2005.

Campus Laboratory Collaborations Program, University of California Office of the President. Measuring and Modeling the Isotopic Composition of Biosphere-Atmosphere CO<sub>2</sub> Exchange. (N. McDowell, C. Still, D. Baldocchi). \$112,000 (1 yr). 2004.

Laboratory Directed Research and Development, Exploratory Research (*ER*), Environmental and Biological Sciences (*DOE*). Testing model assumptions of terrestrial isotopic fluxes: Are

modeler's assumptions of the global carbon cycle correct? (N. McDowell and D. Breshears). \$1,280,000. 2004.

Institute of Geophysics and Planetary Physics Collaborative Research Program (University of California). Biosphere-atmosphere CO<sub>2</sub> exchange of terrestrial ecosystems: combining high resolution measurements and models to understand the global atmospheric carbon budget (N. McDowell, W. Pockman, D. Hanson, and J. Randerson). \$160,000. 2004

New Zealand-International S&T Linkages Fund. A new method for high-resolution measurement of biosphere-atmosphere carbon exchange (M. Barbour and N. McDowell). \$8500. 2004.

USA-Slovenia Cooperation in Science and Technology, 2004-2005 Grant. Carbon isotope content in tree rings as a signal of oak mortality (*Quercus robur*). (T. Levanič and N. McDowell). \$3305. 2004.

European Science Foundation, Biosphere-Atmosphere Stable Isotope Network, Travel Award for the Interlaken Switzerland meeting, "Partitioning of fluxes between the biosphere and atmosphere across spatial scales." \$2100. 2004.

Laboratory Directed Research and Development-Capital Equipment Grant. A Tunable Diode Laser for rapid analysis of the stable isotope composition of atmospheric CO<sub>2</sub>. (N. McDowell, J. Heikoop, M. Dubey, D. Breshears). \$112,000. 2003.

Biosphere-Atmosphere Stable Isotope Network Annual Meeting travel award, Banff, Alberta Canada. \$1500. 2002.

International Union of Forest Research Organizations, Canopy Processes Meeting Scholarship. \$1500. 2000

The Soil Science Society of America's "Soil Respiration Symposium" Travel Award. The National Science Foundation. \$300 1997

The University of Michigan Biological Station Research Grant: "Carbon Dioxide Sources and Sinks in *Taxus* (Yew): Implications of Global Warming and Elevated CO<sub>2</sub> levels on Taxol Biosynthesis" \$789 1994.

### **Teaching experience**

Invited Teacher, New Mexico High School Science Summer School (2007-2008)

Invited Lecturer, U. of New Mexico's Ecosystem Ecology course. (2007)

Teaching Assistant, Center for Analysis of Environmental Change, Oregon State University. Designed, implemented and instructed students on the use and interpretation of a model of ecosystem carbon storage driven by forest inventory data. (2000-2001)

Invited Lecturer, Physiology of Woody Plants, Department of Forest Science, Oregon State University (2000).

Teaching Assistant for FS 505, "Introduction to Oregon Forestry", Department of Forest Science, Oregon State University. Instructed incoming students to the College of Forestry on forest practices, regulations, and biology in western and eastern Oregon. (1999)

Developed course on plant physiological ecology during course FS629, Teaching Practicum (1999).

### **Graduate and Postdoc Advisees**

Heath Powers. MSc, University of New Mexico. Automated measurements of isotopic fluxes from soils, stems and foliage of a woodland ecosystem. (2005 - 2008)

Christopher Bickford. PhD, University of New Mexico. Leaf level measurements of isotopic discrimination using tunable diode laser spectroscopy. (2005 - 2009)

Enrico Yopez-Gonzales. Postdoc, University of New Mexico. Mechanisms of survival and mortality during drought in piñon-juniper woodlands. (2006 - 2008)

Sandra White. MSc, University of New Mexico. Ecosystem carbon budgets of piñon-juniper woodlands in response to climate change manipulations. (2006 - 2008)

Jennifer Plaut. PhD, University of New Mexico. Hydraulic response of piñon-juniper woodlands to climate change manipulations. (2006 - )

Toby Gass. PhD, Colorado State University. Production and carbon sequestration response of piñon-juniper woodlands to altered precipitation regimes. (2007 - )

Laura Marshall. Ph.D., University of Arizona. Fire exclusion and climatic effects on growth, survival and carbon isotope discrimination by ponderosa pine over the last four centuries. (2007 - )

Stephanie Eichorst, postdoc, LANL. A new approach to unraveling metabolic behavior of complex microbial communities. (2007 - )

Rosie Fisher, postdoc, LANL. A new, mechanistic approach to assess regional climate impacts on vegetation survival and mortality. (2009 - )

Sara Rauscher, postdoc, LANL. Fine-mesh regional climate modeling with revised coupling to land surface dynamics. (2009 - )

Nathan English, postdoc, LANL. Carbon and oxygen isotopic variability in succulent plants and their spines: a new tool for climate and ecosystem studies in desert regions. (2009 - )

Robert Pangle, postdoc, University of New Mexico. Water relations response to precipitation manipulations and mortality in a piñon-juniper woodland. (2009 - )

### **Undergraduate Advisees**

Nathan Gehres. Oregon State University, Biochemistry. Soil water availability under old and young white oak stands. Poster presented at the Ecological Society of America in 2000. (1999, 2000).

Eric Watrud. Oregon State University, Forest Resources. Seasonal variation of soil water availability in three different aged stands of Douglas-fir. Poster presented at the Ecological Society of America in 1999. (1998, 1999)

*All students listed below were mentored solely by myself at LANL, and all LANL students presented posters at the LANL student symposium (at a minimum).*

Phillipe Levy, UC Berkeley. Soil CO<sub>2</sub> efflux in a post-mortality piñon–juniper woodland. (2007, 2008).

Samantha Stutz, University of Wyoming. Tree ring growth and carbon isotope discrimination records drought-associated tree mortality. (2007, 2008).

Angela Torney. Stanford University. Nitrogen availability is more limiting to tree growth than water stress in over-stocked ponderosa pine stands (2007, 2008).

Krista Gray. University of Oregon. Understory vegetation response to climate and piñon mortality in two piñon –juniper woodlands. (2007).

Samantha Slutzky. New Mexico Technological University. Understory vegetation response to climate and piñon mortality in two piñon –juniper woodlands. (2006, 2007, 2008). Samantha is lead author on a manuscript in preparation.

Tim Durham. University of Florida. Real-time crop threat assessment using Tunable Diode Laser Spectroscopy. (2006).

Ted Hickey. Carlton College. Leaf area index of a juniper woodland in northern New Mexico. (2005, 2006, 2007)

Suzanne Kern. Colorado College. Calibration accuracy of a tunable diode laser for ecosystem-scale stable isotope measurements. (2005).

Geoffrey House. Carlton College. Understory vegetation diversity and seasonal dynamics at a juniper woodland in northern New Mexico (2005).

Sandra White. New Mexico Technological University. Canopy transpiration across a steep climatic gradient in the Jemez Mountains of Northern New Mexico. (2005). This became a publication in 2008.

Laura Marshall. University of California. Fire exclusion and climatic effects on carbon isotope discrimination by ponderosa pine over the last century. (2004, 2005, 2006). Co-authored manuscript currently in review.

Gretchen Miles. Alfred University. Physiological and environmental controls over carbon isotope discrimination of fast-growing tropical *Eucalyptus* plantations. (2004).

Sarah Reed. St. Cloud State University. Foliage  $\delta^{13}\text{C}$  of different plant functional types across a climatic transect in Oregon. (2002).

Claire Lunch. University of Chicago. Controlling factors over the oxygen-18 content of ecosystem respiration. (2001).

Mark Martin. Oregon State University. Undergraduate thesis. Soil  $\text{CO}_2$  flux across a steep climatic gradient in Oregon. (2000-2001).

Claire Lunch. U. of Chicago. Xylem hydraulic properties along a chronosequence of Douglas-fir trees. Co-authored a 2002 publication. (2000).

## **Publications**

*Committed*-----

Yepez, E.A., J.A. Plaut, S.A. White, J.P. Hill, J. Johnson, W.T. Pockman, and **N.G. McDowell**. Evapotranspiration flux components in piñon-juniper woodlands as influenced by monsoon rains. *Journal of Arid Environments*. Invited feature to the special issue on: Land Surface Ecohydrology of North American Monsoon System, intended publication summer 2009.

**McDowell, N.G.** B.J. Bond, M.G. Ryan. Mechanistic relationships between climate, tree height, leaf  $\delta^{13}\text{C}$ , hydraulics and productivity. In: F.C. Meinzer and U. Niinemets, eds, *Size and age related changes in tree structure and function*. Springer Publishing, submittal commitment Fall 2009.

**McDowell, N.G.**, L. Marshall, D. Falk. Tree mortality within unmanaged, high-density forests is associated with nutrient starvation, not water stress.



**N McDowell**, S. Slutzky, A. White, C. Meyer, D. Breshears, P. Droyer, P. Rich. Understory vegetation response to climate and piñon mortality in four piñon –juniper woodlands. *Ecosystems*.

Bickford, C.P, D.T. Hanson, **N.G. McDowell**. Influence of diurnal variation in internal conductance on modeled  $^{13}\text{C}$  discrimination: results from a field study. *New Phytologist*

Bickford, C.P, **N.G. McDowell**, D.T. Hanson. Linkages between leaf water potential and internal conductance during drought in two isohydric species. *Journal of Experimental Botany*

*In review*-----

Hanson, PJ, A Classen, L Kueppers, Y Luo, **N. McDowell**, J Morris, P Thornton, J Dukes, M Goulden, J Melillo and Workshop Participants. The Need for Next Generation Ecosystem Experiments to Understand Climate Change Impacts on Ecosystems and Feedbacks to the Physical Climate. *Frontiers in Ecology and Environment*, in review.

Allen, CD, A. Macalady, H. Chenchouni, D. Bachelet, **N. McDowell**, M. Vennetier, P. Gonzales, T. Hogg, A. Rigling, D. Breshears, R. Fensham, Z. Zhang, T. Kitzberger, J. Lim, J. Castro, G. Allard, S. Running, A. Semerci, N. Cobb. Climate-induced forest mortality: a global overview of emerging risks. *Forest Ecology and Management*, in review.

White, S.A., M.G. Ryan, E.A. Yopez, **N.G. McDowell**, W.T. Pockman. Vegetation and environmental controls on soil respiration in a piñon-juniper woodland. *Global Change Biology*, in review.

Powers, H.H., J. Hunt, D.T. Hanson, **N.G. McDowell**. A dynamic soil chamber system coupled with a tunable diode laser for online measurements of  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  of soil respired  $\text{CO}_2$ . *Rapid Communications in Mass Spectrometry*, in review.

Hanson, D.T., C. Bickford, K. Brown, H. Powers, **N.G. McDowell**. Real-time measurement of photosynthetic carbon isotope fractionation using a tunable diode laser: Insights into on-line estimation of mesophyll conductance. *Plant, Cell and Environment*, in revision.

*Published*-----

40. **McDowell, N.G.**, C. Allen, L. Marshall. Growth, carbon isotope discrimination, and mortality across a ponderosa pine elevation transect. *Global Change Biology*, in press.

39. Engel, S., H.M. Lease, **N.G. McDowell**, B.O. Wolf. Resource use by a grasshopper community quantified using tunable diode laser spectroscopy to measure breath  $\delta^{13}\text{C}$ . *Rapid Communications in Mass Spectrometry*, in press.

38. Breshears D.D., O.B. Myers, C.W. Meyer, F.J. Barnes, C.B. Zou, C.D. Allen, **N.G. McDowell**, W.T. Pockman. 2008. Tree die-off in response to global-change-type drought: mortality insights from a decade of plant water potential measurements. *Frontiers in Ecology and Environment*, in press.
37. Bickford, C.P, **N.G. McDowell**, E. B. Eberhardt, D.T. Hanson. High resolution field measurements of diurnal carbon isotope discrimination and internal conductance in a semi-arid species, *Juniperus monosperma*. *Plant, Cell and Environment*, doi: 10.1111/j.1365-3040.2009.01959.x
36. **McDowell, N.G.**, S.A. White, W.T. Pockman. 2008. Transpiration and stomatal conductance across a steep climate gradient in the southern Rocky Mountains. *Ecohydrology*, 1: 193-204
35. Uehlein N., O. Beate, D. Hanson, **N.G. McDowell**, R. Kaldenhoff. 2008. Function of aquaporins as chloroplast gas pores challenges the concept of membrane CO<sub>2</sub> permeability. *Plant Cell* 10.1105
34. Kolb, T. and **N.G. McDowell**. 2008. Tree ecophysiology research at Taylor Woods. In: Oberding, SD, Moore, MM, eds, Fort Valley Experimental Forest-A Century of Research 1908-2008. USDA Forest Service General Technical Report, 408p.
33. Calva-Alvarado, J.C., **N. G. McDowell**, R.H. Waring. 2008. Allometric relationships to predict foliar biomass and leaf area:sapwood area ratio in relation to tree height for five wet tropical rain forest species in Costa Rica. *Tree Physiology*, 26: 1601-1608.
32. **McDowell, N.G.**, W. Pockman, C. Allen, D. Breshears, N. Cobb, T. Kolb, J. Plaut, J. Sperry, A. West, D. Williams, E. Yezpez. 2008. Tansley Review: Mechanisms of plant survival and mortality during drought: why do some plants survive while others succumb? *New Phytologist*, 178: 719-739.
31. **McDowell, N.G.**, D. Baldocchi, M.M. Barbour, C. Bickford, M. Cuntz, D.T. Hanson, A. Knohl, H.H. Powers, T. Rahn, J. Randerson, W.J. Riley, C. Still, K. Tu, A. Walcroft. 2008. Measuring and modeling the stable isotope composition of biosphere-atmosphere CO<sub>2</sub> exchange: where are we and where are we going? *EOS*, Trans, AGU 89: 94-95.
30. Breshears, D.D., **N.G. McDowell**, K.L. Goddard, K.E. Dayem, S.N. Martens, C.W. Meyer. 2008 Drought recovery via foliar absorption of intercepted rainfall bypasses soil water uptake. *Ecology*, 89: 41-47.
29. Kolb, T. E., Agee, J. K., Fule, P. Z., **McDowell, N.G.**, Pearson, K., Sala, A., Waring, R. H. Perpetuating old-growth ponderosa pine. 2007. *Forest Ecology and Management*, doi:10.1016/j.foreco.2007.06.002

28. **McDowell, N.G.**, H.D. Adams, J.D. Bailey, and T.E. Kolb. 2007. The response of ponderosa pine growth efficiency and leaf area index to a forty-year stand density experiment. *Canadian Journal of Forest Research*, 37: 343-355.
27. Barbour, M.M., G.D. Farquhar, D. Hanson, C. Bickford, H. Powers, **N.G. McDowell**. 2007. A new measurement technique reveals temporal variation in  $\delta^{18}\text{O}$  of leaf respired  $\text{CO}_2$ . *Plant, Cell and Environment*, 30: 456-468.
26. Barbour, M.M., **N.G. McDowell**, G. Tcherkez, C. Bickford, D. Hanson. 2007. High frequency measurements reveal rapid post-illumination changes in the carbon isotope composition of leaf-respired  $\text{CO}_2$ . *Plant, Cell and Environment*, 30: 469-482.
25. Flexas J, M.Ribas-Carbó, D.T. Hanson, J.Bota, B. Otto, J. Cifre, **N.G. McDowell**, H. Medrano, R. Kaldenhoff. 2006. Tobacco aquaporin NtAQP1 is involved in mesophyll conductance to  $\text{CO}_2$  *in vivo*. *Plant Science*, 48, 427-439.
24. Newman, B.D., Wilcox, B.P., Archer S., Breshears, D.D., Dahm, C.N., Duffy, C.J., **McDowell, N.G.**, Phillips, F.M., Scanlon, B.R., and Vivoni, E.R. 2006. The ecohydrology of arid and semi-arid environments: a scientific vision. *Water Resources Research*. 42: W06302.
23. **McDowell, N.G.**, H.A. Adams, J.D. Bailey, M. Hess, and T.E. Kolb. 2006. Homeostatic maintenance of ponderosa pine gas exchange in response to stand density changes. *Ecological Applications*. 16(3) 1164-1182.
22. Roden, J., D.R. Bowling, **N.G. McDowell**, B.J. Bond, J.R. Ehleringer. 2005. Carbon and oxygen isotope ratios of tree ring cellulose along a precipitation transect in Oregon, USA. *Journal of Geophysical Research-Biogeosciences*, 110, doi:10.1029/2005JG000033.
21. **McDowell, N.G.**, J. Licata, and B.J. Bond. 2005. Environmental sensitivity of gas exchange parameters in different-sized trees. *Oecologia*. 145: 9-20
20. **McDowell, N.G.**, D.R. Bowling, A. Schauer, B.J. Bond, J. Irvine, B.E. Law, J.R. Ehleringer. 2004. Associations between the carbon isotope ratios of ecosystem respiration, water availability, and canopy conductance. *Global Change Biology* 10, 1767-1784.
19. Winner, W.E., Thomas, S., Berry, J., Bond, B.J., Cooper, C.E., Hinckley, T.M., Ehleringer, J.R., Fessenden, J.E. Lamb, B., McCarthy, S., **McDowell, N.G.**, Phillips, N., Williams, M. 2004. Canopy carbon gain and water use: Analysis of old-growth conifers in the Pacific Northwest. *Ecosystems*. 7, 482-497.
18. **McDowell, N.G.**, D.B. Bowling, B.J. Bond, J. Irvine, B.E. Law, P. Anthoni, and J.R. Ehleringer. 2004. Response of the carbon isotopic content of ecosystem, leaf and soil

respiration to meteorological and physiological driving factors in a *Pinus ponderosa* ecosystem. *Global Biogeochemical Cycles*. 18(1) 10.1029.

17. Phillips, N., B.J. Bond, **N.G. McDowell**, M.G. Ryan, A. Schauer. 2003. Leaf area compounds height-related hydraulic costs of water transport in Oregon white oak trees. *Functional Ecology*. 17: 832-840.

16. Bowling, D.R., **N.G. McDowell**, J.M. Welker, B.J. Bond, B.E. Law, and J.R. Ehleringer. 2003. Oxygen isotope content of CO<sub>2</sub> in nocturnal ecosystem respiration 1: Observations in forests along a precipitation transect in Oregon. *Global Biogeochemical Cycles*. 17(4).

15. Bowling, D.R., **N.G. McDowell**, J.M. Welker, B.J. Bond, B.E. Law, and J.R. Ehleringer. 2003. Oxygen isotope content of CO<sub>2</sub> in nocturnal ecosystem respiration 2. Short-term dynamics of foliar and soil component fluxes in an old-growth ponderosa pine forest. *Global Biogeochemical Cycles*. 17(4).

14. **McDowell, N.G.**, J.R. Brooks, S. Fitzgerald, and B.J. Bond. 2003. Carbon isotope discrimination and growth response of old ponderosa pine trees to stand density reductions. *Plant, Cell and Environment*. 26:631-644.

13. Brooks, J.R., P.J. Schulte, B.J. Bond, R. Coulombe, J.C. Domec, T.M. Hinckley, **N. G. McDowell**, N. Phillips. 2003. Does foliage on the same branch compete for the same water? Experiments on Douglas-fir trees. *TREES*. 17: 101-108.

12. Phillips N.G., M.G. Ryan, B.J. Bond, **N.G. McDowell**, T.M. Hinckley, and J. Cermak. 2002. Reliance on stored water increases with tree size in three species in the Pacific Northwest. *Tree Physiology*. 23: 237-245.

11. **McDowell, N. G.**, H. Barnard, B. J. Bond, T. Hinckley, R. Hubbard, H. Ishii, K. B., F. C. Meinzer, J. D. Marshall, F. Magnani, N. Phillips, M. G. Ryan, and D. Whitehead. 2002. The relationship between tree height and leaf area:sapwood area ratio. *Oecologia*. 132: 12-20.

10. **McDowell, N. G.**, N. Phillips, C. K. Lunch, B. J. Bond, and M. G. Ryan. 2002. Hydraulic limitation and compensation in large, old Douglas-fir trees. *Tree Physiology*. 22:763-774.

9. Phillips, N. P., B. J. Bond, **N. G. McDowell**, A. J. Schauer, and M. G. Ryan. 2002. Water flux and canopy conductance in young, mature, and old Douglas-fir forests. *Tree Physiology*. 22:205-211.

8. Bowling, D., **N. G. McDowell**, B.J. Bond, B.E. Law, and J.R. Ehleringer. 2002. <sup>13</sup>C content of ecosystem respiration is linked to precipitation and vapor pressure deficit. *Oecologia*. 131:113-124.

7. Ishii, H., **N.G. McDowell**. 2002. The role of epicormic branches in crown development of old Douglas-fir trees. *Forest Ecology and Management*, 169(3):257-270.
6. Waring, R. W., and **N. G. McDowell**. 2002. Estimating annual carbon balance of forests with widely available data using the 3-PG process model. *Tree Physiology*, 22:179-188.
5. **McDowell, N.G.**, N. Balster, J.D. Marshall. 2001. Belowground carbon allocation of Rocky Mountain Douglas-fir. *Canadian Journal of Forest Research*. 31(8):1425-1436.
4. **McDowell, N.G.**, J. D. Marshall, T. Hooker, and R. Musselman. 2000. Estimating CO<sub>2</sub> flux from snowpacks at three sites in the Rocky Mountains. *Tree Physiology* 20:745-753
3. McDowell, S. C. L., **N.G. McDowell**, J. D. Marshall, and K. Hultine. 2000. Carbon and nitrogen allocation to male and female reproduction in Rocky Mountain Douglas-fir (*Pseudotsuga menziesii* var. *glauca*, Pinaceae). *American Journal of Botany*. 87(4): 539-546.
2. Cernusak, L. A., **N. G. McDowell**, and J. D. Marshall. 2000. CO<sub>2</sub> diffusion in Douglas-fir bark: implications for measuring woody-tissue respiration with removable cuvettes. *Journal of Sustainable Forestry*. 10: 107-113.
1. **McDowell, N.G.**, J. D. Marshall, J. Qi, and K. Mattson. 1999. Direct inhibition of maintenance respiration in western hemlock roots exposed to ambient soil carbon dioxide concentrations. *Tree Physiology*. 19:599-605.

### **Invited Presentations**

31. **McDowell, N.G.** A perspective on future DOE research regarding causes and consequences of terrestrial climate change impacts. LANL's Frontiers in Geosciences Lecture, April 2009.
30. **McDowell, N.G.** Climate change impacts on terrestrial ecosystems. New Mexico Technological University, Department of Hydrology Seminar Series. March 2009.
29. **McDowell, N.G.** Ecosystem applications of high frequency isotope measurements. Chemistry, Life and Earth Sciences Directorate Mass Spectrometry Workshop, Los Alamos National Laboratory, September 2008.
28. **McDowell, N.G.** Lessons learned from graduate school onward. *Keynote presentation*, Graduate Student Symposium, Department of Forest Science, Oregon State University, May 2008.

27. Kolb, T.E., and **N.G. McDowell**. Tree ecophysiology research at Taylor Woods. A Celebration of Fort Valley Experimental Forest's Century of Research, 1908-2008. USDA Forest Service, August 2008.
26. **McDowell, N.G.** Advantages and knowledge gained from comparison of ecosystem models to laser based measurements of the stable isotope composition of biosphere-atmosphere CO<sub>2</sub> exchange: BASIN (Biosphere Atmosphere Stable Isotope Network) Annual meeting, San Francisco CA, December 2007.
25. **McDowell, N.G.** Laser measurements of stable carbon and oxygen isotope ratios of CO<sub>2</sub> exchanged at the leaf and soil surfaces. BASIN (Biosphere Atmosphere Stable Isotope Network) Annual meeting, San Francisco CA, December 2007.
24. **McDowell, N.G.** Climate change impacts on terrestrial ecosystems: current science questions and future research directions. Oak Ridge National Laboratory, Environmental Science Division, November 2007.
23. Ringler, T., M. McCabe, **N. McDowell**, E. Springer. Climate change in the southwest United States: an integrated approach to understanding ecological change. Portland, OR September 2007.
22. White, S. and **N.G. McDowell**. Climatic and physiological regulation of transpiration across a steep precipitation gradient in northern New Mexico. SAHRA (Sustainability of semi-Arid Hydrology and Riparian Areas, NSF) workshop, Valle Caldera National Preserve, August 2007.
21. **McDowell, N.G.** W. Pockman, J. Plaut, E. Yopez, S. White, C. Meyer. Mechanisms of survival and mortality during drought in plants. In: Climate induced forest die-back as an emergent phenomenon: patterns, mechanisms and projections. Ecological Society of America Annual Meeting, San Jose, CA, August 2007.
20. **McDowell, N.G.** Stable isotopes as indicators of canopy processes. Wind River Canopy Crane Workshop. Carson WA, June 2007.
19. **McDowell, N.G.** Climate-ecosystem interactions. In: The IGPP Climate Study Group. May 2007.
18. Powers, H.H. and **N.G. McDowell**. CO<sub>2</sub> Lasers. BASIN (Biosphere-Atmosphere Stable Isotope Network) annual meeting, San Francisco CA, December 2006.
17. **McDowell, N.G.**, and W. Pockman. Mechanisms of mortality and survival during drought. In: Drought Impacts on Regional Ecosystems Network (DIREnet, National Science Foundation) annual meeting, Flagstaff Arizona, July 2006.

16. **McDowell, N.G.** Using stable isotopes to understand biosphere-atmosphere carbon and water exchange. In: *EES Frontiers in Geoscience Colloquium*. April 2006.
15. **McDowell, N.G.** Ecosystem and leaf level applications of  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$ - $\text{CO}_2$  measurements via diode tunable diode laser spectroscopy. In: Stable isotope applications to agricultural and plant research. Special session of the Agronomy Society of America's annual meeting, Salt Lake City, Utah, November 2005.
14. **McDowell, N.G.** Ecohydrological applications of tunable diode laser absorption spectroscopy measurements of atmospheric  $\text{CO}_2$ . In: Measurement and monitoring methods in ecohydrology. Special session of the American Geophysical Union's Spring Session, New Orleans, Louisiana, May 2005.
13. **McDowell, N.G.** Applications of stable isotope measurements to studying the terrestrial carbon and water cycles. *Earth and Environmental Sciences Division Review*, April 2005.
12. **McDowell, N.G.**, H. Adams, J. Bailey, T.E. Kolb, D.A. Falk. Using stable isotopes of tree rings to assess physiological response to disturbance. In: Stable isotope analysis of trees: new methods, new uses. Special session of the American Association of Geography, Denver, Colorado, April 2005.
11. Bond, B.J., M.G. Ryan, N. Phillips, **N.G. McDowell**, F.C. Meinzer. Fresh perspectives on hydraulic and hydrostatic limitations to tree height and tree growth. 4<sup>th</sup> International Canopy Conference, Leipzig Germany, 2005.
10. **McDowell, N.G.** Carbon flux analysis in terrestrial ecosystems. US-Norway Summer School on Carbon Capture and Storage in Geologic Formations, St. Johns College, Santa Fe NM, 2004.
9. **McDowell, N.G.** and D. Breshears. A new tool to understand vegetation response to drought: Tunable Diode Laser Absorption Spectroscopy. "Identifying technologies to improve regional water stewardship", a conference hosted by the University of New Mexico Office for Policy, Security and Technology. 2004.
8. Bond, B.J., N. Czarnomski, K. Davis, N. Defrosses, K. George, N. Gehring, J. Licata, C. Lunch, **N.G. McDowell**, T. Ocheltree, N. Phillips, T. Pypker, S. Reed, A. Schauer, M. Ryan, M. Williams. Growth and photosynthesis at Wind River. Invited presentation at the Wind River Canopy Crane Research Facility Annual Meeting, Carson Washington. 2004.
7. **McDowell, N.G.** Stable carbon isotope composition from the leaf to the globe: current understanding and future prospects. University of New Mexico, Biology Department. 2003.

6. **McDowell, N.G.** Using tree-ring analysis to decipher water-use efficiency and growth rates of old *Pinus ponderosa* trees to disturbance. University of Arizona, Laboratory for Tree-Ring Research. 2003.

5. **McDowell, N.G.** Carbon isotope discrimination and growth response of old trees to stand density reductions. Northern Arizona University, Forest Science Department. 2003.

4. **McDowell, N.G.** Hydraulic constraints on tree growth. Oregon State University, Department of Forest Science. 2002.

3. Bowling D, Lai C-T, **McDowell N.G.** Short-term environmental effects on  $\delta^{13}\text{C}$  of ecosystem respiration, Stable Isotopes and Biosphere-Atmosphere Interactions International Workshop, Banff, Alberta. 2002.

2. Bond, B.J., M.G. Ryan, N. Phillips, **N.G. McDowell.** The Hydraulic Limitation Hypothesis: past, present and future. Terrestrial Carbon Sequestration Conference, Helsinki, Finland. 2001.

1. Bond, B.J., M.G. Ryan, N. Phillips, **N.G. McDowell** and R.M. Hubbard. Hydraulic constraints on productivity of old growth trees. Symposium #9: The Water Limitation: Issues in Plant, Community and Ecosystem Water Use. Ecological Society of America 85<sup>th</sup> Annual Meeting, Snowbird, Utah. 2000.

**I have authored or co-authored approximately 60 non-invited presentations and posters (available upon request).**