December 2010

CURRICULUM VITAE (ABBREVIATED)

LARS O. HEDIN
Professor

Department of Ecology and Evolutionary Biology, and
Princeton Environmental Institute, Princeton University
Princeton, NJ 08544-1003

telephone: (609) 258-7325
Fax: (609) 258-7892
email: lhedin@princeton.edu

General Interests:

Biogeochemistry of terrestrial ecosystems, with emphasis on the role of forests in the global earth-climate system.

Education:

Ph.D., Biogeochemistry and Ecosystem Studies, Yale University, New Haven, Connecticut, 1989.
M.S., Biogeochemistry and Ecosystem Studies, Yale University, New Haven, Connecticut, 1986.
B.S., Ecology and Evolutionary Biology, Cornell University, Ithaca, New York, 1983.

Ph.D. Advisor: Gene E. Likens, Institute of Ecosystem Studies, Millbrook, NY.

Professional Experience:

Professor, Dept. of Ecology and Evolutionary Biology, and Princeton Environmental Institute, Princeton University, 2001-present.
Associate Professor, Dept. of Ecology and Evolutionary Biology, Cornell University, 1997-2001.
Assistant Professor, Dept. of Ecology and Evolutionary Biology, Cornell University, 1994-1997.
Assistant Professor, W. K. Kellogg Biological Station and Department of Zoology, Michigan State University, 1990-1994.
Adjunct Professor, Department of Geological Sciences, Michigan State University, 1992-1994.
Research Associate, Institute of Ecosystem Studies, The New York Botanical Garden, 1988-1990.

Professional Awards:

Named *Thompson Reuters* as person with highest percent increase in citation in the field of Environment and Ecology in 2009.
Ecological Society of America's *Elizabeth Sulzman Award* to Duncan Menge (Ph.D. student advised by Hedin), for outstanding publication by a graduate student. 2008.
Allan Cox Visiting Fellow, School of Earth Sciences, Stanford University, and Department of Global Ecology of Carnegie Institution. 2007.
Ecological Society of America's *Gene Likens Award* to Benjamin Houlton (Ph.D. student advised by Hedin), in recognition of an outstanding paper published in the field. 2007.
Ecological Society of America's *Murray F. Buell Award* to Steven S. Perakis (Ph.D. student advised by Hedin), for best graduate student research project in. 1998.
Recipient of George Mercer Award, Ecological Society of America for "outstanding paper in the science of ecology during the year 1995-96" (for Hedin et al. 1995. *Ecology* 76:493-509), 1996.

Selected External Activities and Service:

Member of Editorial Board, Annual Review of Ecology, Evolution and Systematics, 2005-2010.
Member of NOAA Review Panel, Washington, D.C. 2008.
External Advisor and Reviewer, Search for Assistant Professor, Uppsala University SLU, Sweden, 2008.
Organizer, Symposium on Multiple Resource Limitation in Terrestrial and Aquatic Ecosystems, Annual Meeting of the Ecological Society of America, Memphis, TN, August 2006.
Member of Editorial Board, Faculty 1000, 2005-2007.

Member, Governing Council of the Ecological Society of America. 2004-2006.
Chair and Co-Founder, Biogeosciences section of the Ecological Society of America, 2003-2008.
Co-organizer, international conference on "Resiliency and Change in Ecological Systems," Santa Fe Institute, Santa Fe, New Mexico, October 2003.
Chair and Lead Author, "Linking Ecological Biology and Geoscience: Challenges for Terrestrial Environmental Science," White Paper Report Invited by the National Science Foundation. (In response to this report, the NSF has now established a new funding program in "Biogeosciences.") August, 2002.
Invited Member of High Panel, The Stockholm Water Symposium, Stockholm, Sweden, August 2002.
Panel Member, National Science Foundation, Biocomplexity Evaluation Panel, Division of Earth Sciences, Washington DC, May, 2002
Testified to National Research Council/National Academy of Sciences Panel on the Geologic Record of Biosphere Dynamics Committee, Washington, DC. June 2002.
Organizer and Chair, Workshop sponsored by the National Science Foundation, Division of Earth Sciences, on "Linking Ecological Biology and Geosciences," Madison, WI, August 2001.
Invited Plenary Speaker, Gordon Conference on Modern Developments in Thermodynamics, Ventura, California, "Thermodynamic Constraints on Nutrient Fluxes in Complex Ecological Systems." March 2001.
Chair and Lead Author, Report to the Provost on the Future of Environmental Biology at Cornell University, Ithaca, NY. (Based on this report, Cornell University established a new initiative in "Biogeochemistry and Biocomplexity," including four new faculty lines and more than $3 million in university support.) February-August 2001.
Invited Participant, North American Carbon Program Workshop, Boulder, CO, September 2001.
Panel Member, National Science Foundation, Biocomplexity Evaluation Panel, Division of Earth Sciences, Washington, DC. 2001.
Invited Participant and Co-author of Final Report, National Science Foundation Workshop on the Terrestrial Carbon Cycle, Washington, DC, June 2000.
Invited Plenary Speaker, 2nd Chapman Conference on Global Biogeochemistry and the Gaia Hypothesis, Valencia, Spain, June 2000.
Invited Plenary Speaker, Gordon Conference on "Ten Years of Catchment Science: What Progress in Predictive Ability?" New Hampshire, August 1999.
Invited Keynote Speaker, Joint 7th Stockholm Water Symposium and 3rd International Conference on the Environmental Management of Enclosed Seas (EMECS), Stockholm, Sweden, 1997.
Representative for the Ecological Society of America in joint planning group on "Enhancing Integrated Science," with the Geological Society of America and United States Geological Survey, 1997-1998.
Invited Representative, White House sponsored conference on "policy goals and related science questions to evaluate the health of our Nation's environmental resources." National Science and Technology Council, Washington, D.C., 1996.
Invited Participant, International Scientific Committee on Problems of the Environment (SCOPE) meeting on "Comparative Analysis of Nitrogen Cycling in the Temperate and Tropical Americas," Chile, 1996.

Invited Seminars, Talks and Symposia 2002-Present:

Invited Speaker, Tupper Seminar, Smithsonian Tropical Research Institute, Panama. *June 2010.*
Invited Speaker, EGGS seminar, Dept of Geosciences, Princeton University, Princeton, NJ. *March 2010.*
Invited Speaker, Geophysical Fluid Dynamics Laboratory, National Oceanographis and Atmospheric administration Climate Program, Princeton, NJ. *February 2010.*
Invited Speaker, Dept. of Civil and Environmental Engineering, Princeton University, *November 2009.*
Invited Speaker, Agouron Institute Meeting on Global Nitrogen Cycle, Scottsdale, AZ. *October 2009.*
Invited Speaker, Cornell University, Ithaca, NY. *April 2009.*
Invited Speaker, Brown University, Providence, RI. *November 2008.*
Invited Speaker, Stroud Water Research Center, Avondale, PA, *April 2007.*
Invited Speaker, Dept. of Biology, Virginia Polytechnic Institute, Blacksburg, VA, *January 2007.*

Invited Speaker, Center on Global Change and Nicholas School of the Environment, Duke University, Durham, NC, *December 2006.*
Invited Speaker, Department of Botany, University of Cape Town, South Africa, *August 2006.*
Invited Speaker, Symposium on Multiple Resource Limitation in Terrestrial and Aquatic Ecosystems, 91st Annual Meeting of the Ecological Society of America, Memphis, TN, *August 2006.*
Invited Speaker and Opponent Ph.D. thesis defense, Department of Ecology and Environmental Research, Swedish University of Agricultural Sciences. Uppsala, Sweden, *April 2006*.
Invited Speaker, Institute of Ecosystem Studies, Millbrook, NY, *April 2006*.
Invited Speaker, Department of Geophysical Sciences, University of Chicago, IL, *April 2006.*
Invited Speaker, Centre for Population Ecology, Silwood Park, Imperial College, England, *January 2006.*
Invited Speaker, Forest Science Department, Oregon State University, OR, *May 2005*.
Invited Speaker, Department of Global Ecology, Stanford University, CA, *April 2005*.
Invited Speaker, Symposium on Biogeochemistry: Nitrogen Dynamic, 90th Annual meeting of the Ecological Society of America, Montreal, Canada, *August 2005*.
Invited Participant, DOM International workshop: Dissolved Organic Matter and the Cycling of Carbon, Nutrients and Metals, Bayreuth, Germany, *October 2004.*
Invited Participant, NEON Biogeochemistry Workshop, American Institute of Biological Science, Boulder CO, *July 2004.*
Invited Participant, Annual Collaborators' Meeting for Hawaii Ecosystem Research Project, Hawaii, *June 2004.*
*Invited Speaker,*89th Annual meeting of the Ecological Society of America, Portland, Oregon, *August 2004*.
Invited Speaker, Department of Ecology and Evolutionary Biology, University of California, Irvine, California, *March 2004*.
Invited Speaker, Department of Biological Sciences. University of Calgary, Alberta, Canada, *February 2004*.
Invited Speaker, Smithsonian Environmental Research Center, Edgewater, MD, *October 2003*.
Symposium Organizer and Speaker, Symposium on "Future Developments in Biogeosciences," Annual meeting of the Ecological Society of America, Savannah, Georgia, *August 2003*.
Invited Lead Speaker, 40th Anniversary Meeting of the Hubbard Brook Ecosystem Study, Plymouth, New Hampshire, *July 2003*.
Invited Speaker, Department of Biology, University of New Mexico, Albuquerque, NM, *April 2003*.
Invited Speaker, Graduate Program in Ecology, Duke University, Durham, NC, *March 2003*.
Invited Speaker, Ecology and Evolution Graduate Program, Rutgers University, NJ, *January 2003*.
Invited Participant, North American Carbon Program Methane Workshop, University of New Hampshire, Durham, NH, *September 2002*.
Invited Speaker, Symposium on "Stoichiometry in Ecological Systems," Annual Meeting of the Ecology Society of America, Tucson, AZ, *August 2002.*
Invited Speaker, 4th Trilateral Meeting on "Biodiversity Across Scales," Hokkaido, Japan, *July 2002*.
Invited Speaker, The Marine Biological Laboratory at Woods Hole, The Ecosystem Center, Woods Hole, MA, *February 2002*.

Conferences and Workshops 2002-Present:

Invited Speaker, Agouron Institute Meeting on Global Nitrogen Cycle, Scottsdale, AZ. *October 2009.*
Invited Keynote Speaker, International Workshop: Dissolved Organic Matter and the Cycling of Carbon, Nutrients and Metals, University of Bayreuth, Germany, *September 2005*.
Invited Speaker, Gordon Research Conference on "The Metabolic Basis of Ecology," Lewiston, ME, *May 2004*.
Invited Participant, Biocomplexity in the Environment Awardees Meeting, National Science Foundation, Washington, DC, *September 2003*.
Invited Participant, Conference on Ecosystems and Evolution, Stockholm, Sweden, *July 2003*.
Invited Participant, Annual Collaborators' Meeting for Hawaii Ecosystem Research Project, Hawaii, *June 2003*.

Invited Participant, Conference on "Role of Interdisciplinary Studies in the Academy of the 21st Century," National Science Foundation, Washington, DC, *April 2003*.

Invited Participant, Annual Collaborators' Meeting for NASA Amazon Forest Research Project, Bloomington, IN, *January 2003*.

Invited Participant, Annual Collaborators' Meeting for Hawaii Ecosystem Research Project, Hawaii, *June 2002*.

Invited Participant, Santa Fe Institute Science Board Meeting, Santa Fe, NM, *March 2002*.

Princeton University Committees and Service:

Director of Program in Environmental Studies, Princeton Environmental Institute. *2010*

Member, Committee on the Course of Study. Princeton University. *2008-2010*.

Department Representative,. Department of Ecology and Evolutionary Biology. *2008-2010.*

Member, Faculty Search Committee, Department of Ecology and Evolutionary Biology. *2010.*

Undergraduate committee, Ecology and Evolutionary Biology. *2010.*

EEB522: Colloquium organizer. *2010*.

*Member,*Selection and Evaluation Committee for Grand Challenges Proposals, Princeton Environmental Institute. *2010.*

Associated Faculty, Department of Civil and Environmental Engineering. *2010*.

Faculty Fellow, Butler College. 2010.

Faculty Fellow, Princeton Ice Hockey Team. 2010.

Search Officer, Princeton Environmental Institute. 2010.

Member, Faculty Search Committee, Woodrow Wilson School STEP program, *2007-2009*.

Member, Graduate Student Selection Committee, Department of Ecology and Evolutionary Biology, Fall *2007*.

Faculty Lecture on "Environmental Science and Policy in a Changing World," Freshman Parents Weekend, October *2006*.

Affiliated Faculty, Princeton University Program in Science, Technology and Environmental Policy. *2006*.

Member, Graduate Student Selection Committee, Department of Ecology and Evolutionary Biology, Fall *2006*.

Reviewer, Hank Dobin Prize in Community-Based Independent Work, Princeton University Community Based Learning Initiative Program. Spring *2006*.

Faculty Representative, University Priorities Committee, *2005-2006*.

Chair Faculty Search Committee, Department of Ecology and Evolutionary Biology, *2005-2006*.

PI and lead coordinator (with Jaffe and Ward), NSF pre-proposal for PU graduate training program across EEB, GEO, CEE, and NOAA/GFDL on theme "IGERT: Coupling of hydrology and biogeochemical cycles: interdisciplinary and computational challenges." Outcome: invitation for full proposal, 2004.

PI and lead coordinator (with Zerba), Princeton University Sophomore Initiative Grant: "Developing a Novel Living Laboratory Teaching Model." *2004*.

Faculty Representative, University Committee on Examinations and Standings, Fall *2003*.

Faculty Fellow, Mathey College, Princeton University, *2003*.

Faculty Fellow, Forbes College, Princeton University, *2002-2003*.

Chair, Seminar Committee, Department of Ecology and Evolutionary Biology, Princeton University, *2002-2003*.

Associated Faculty Member, Princeton Environmental Institute, *2002-2006*.

Co-Principal Investigator, Center for Biocomplexity, Princeton Environmental Institute, *2002-2003*.

Chair, Graduate Education, Princeton Environmental Institute, *2002-2006*.

Chair, Provost Committee on Basic Environmental Science at Cornell University, *2001*.

Member, Steering Committee for the Program in Biogeochemistry and Environmental Change, Cornell University, *1997-2001*.

Member, Environmental and Natural Resources Planning Council, College of Agriculture and Life Sciences, Cornell University, *2000-2001*.

Co-chair, Search Committee for Plant Physiological Ecologist, Department of Ecology and Evolutionary Biology, Cornell University, *2001*.

Member and one of three founders, Steering Committee of the Cornell-Boyce Thompson Institute Stable Isotope Laboratory, Department of Ecology and Evolutionary Biology/Department of Geological Sciences/Center for the Environment, Cornell University, *1998-2001*.

Member, Steering Committee of the Science of Earth Systems (SES) Program, College of Agriculture and Life Sciences and College of Engineering, Cornell University, *1999-2001*.

Participant, Strategic Planning Groups in Biogeochemistry and Environmental Change; Ecosystem Biology; Environmental Microbiology; and Population and Community Ecology Programs, College of Agriculture and Life Sciences, Cornell University, *1999*.

Other Professional Activities:

International Field Course Taught in Hawaiian Islands, field course on Tropical Ecosystems in the Hawaiian Islands for 15 international students, co-sponsored by the A.W. Mellon Foundation and Organization For Tropical Studies, August *2001*. In collaboration with P.M. Vitousek (Stanford University) and O.A. Chadwick (University of California Santa Barbara).

Interviews and Press Coverage: National Public Radio "All Things Considered" and "Morning Edition", the New York Times, the Washington Post, Swedish TV (interview on Swedish Water Prize), Swedish Radio (interview), ScienceNOW, Science Magazine, Science Update in Nature, World Watch Magazine, BBC Worldwide News, Equinox Magazine, Science News, Svenska Dagbladet (Swedish daily newspaper), and several other U.S. daily newspapers.

Grant Reviewer: National Science Foundation, United States Department of Agriculture Competitive Grants Program, Environmental Protection Agency, Cottrell College Science Grants Program - Research Corporation, USDA, U.S. Forest Service.

Manuscript Reviewer: Biogeochemistry, BioScience, Canadian Journal of Forest Research, Ecology, Canadian Journal of Fisheries and Aquatic Science, Ecological Applications, Ecological Monographs, Ecosystems, Encyclopedia of Earth System Science, Environmental Science and Technology, Freshwater Biology, Global Biogeochemical Cycles, Holarctic Ecology, Hydrobiologia, Journal of the North American Benthological Association, Limnology and Oceanography, Nature, Oikos, Science, Tellus, Water, Air and Soil Pollution, among others.

Teaching (1990-Present):

Princeton University: ENV201, Fundamentals of Environmental Studies: Population, Land Use, Biodiversity, and Energy (2002-present; 130 students in 2007); EEB417 Ecosystems and Global Change (2002-present; 23 students in 2006); EEB533, Nitrogen and Phosphorus in Complex Ecological Systems (15 students in 2006); ENV202, Fundamentals of Environmental Studies: Climate, Air Pollution, Toxics, and Water (80 students); EEB Junior Tutorial (ecology section leader); EEB522 Fall semester colloquium (with M. Hau); EEB522 Spring semester colloquium (with M. Hau); ENV/GEO524 Environmental Seminar on “Population and the Environment” (18 students); ENV/GEO524 Environmental Seminar on “Media and the Environment” (20 students).

Cornell University: Ecosystem Biology (BioES 478; 4 credits); Principles of Biogeochemistry (BioES 668; 4 credits); Ecology and the Environment (BioES 261; 4 credits); Special Topics in Evolution and Ecology: Dynamics of Forest Ecosystems (BioES 760; 1 credit); Special Topics in Evolution and Ecology: Workshop in Biogeochemistry (BioES 760; 1 credit).

Graduate Students and Postdoctoral Scholars:

Jennifer Keisman	2009	Asst Research Scientist U.Md., Center for Environmental Science/EPA Chesapeake Bay Program.
Duncan Menge	2008	Recipient of ESA Elizabeth Sulzman Award; Postdoctoral Fellow, UCSB.
Alex Barron	2007	Congressional Staff Aide in the House Energy and Commerce Committee, Washington, DC.

Ben Houlton	2005	Assistant Professor, UCLA Davis, CA.
Joseph von Fischer	2002	Assistant Professor, Colorado State College.
Steven S. Perakis	2000	Recipient of ESA Buell Student Award; Ecologist USGS and Joint Faculty in Department of Forestry, University of Oregon, Corvallis, OR.
Jeanne DeNoyer	Current	Expected graduation, 2009.
Daniel Stanton	Current	Expected graduation, 2010.
Sarah Batterman	Current	Expected graduation, 2011
Carla Staver	Current	Expected graduation, 2012
Annette Trierweiler	Current	Expected graduation 2014
Cecilia Perez	2000	Assistant Professor, University of Chile.
Martin Kennedy	2001	Associate Professor, University of California, Riverside, CA.
Elizabeth Boyer	2002	Assistant Professor, Pennsylvania State College, State College, PA.
M. Todd Walter	2002	Assistant Professor, Cornell University, Ithaca, NY.
Melanie Vile	2003	Research Assistant Professor, Villanova University, Villanova, PA.
Tanguy Daufresne	2005	Faculty, INRS CEFS, France.
Megan McGroddy	2005	Assistant Professor, West Virginia University, WV.
Ford Ballantyne	2008	Assistant Professor, Univ. of Kansas, Lawrence, KS.
Susana Bernal	2009	Research Assistant Juan de la Cierva, Barcelona, Spain.
Jack Brookshire	2009	Assistant Professor, Montana State, MT.
Stefan Gerber	2010	University of Florida, Gainesville, FL.
Nina Wurzburger	2010	Odum School, University of Georgia, Athens, GA.
Sonja Keel	Current	Princeton University, Princeton, NJ.
Silvia Newell	Current	Princeton University, Princeton, NJ.

Grants (1990-Present):

2009-11 National Science Foundation (DEB-0989984): "Morphology and plant-soil feedbacks in foggy environments" (Hedin PI, $14,124)

2008-11 The A. W. Mellon Foundation: "Interactions of Nutrients, Rainfall and Grazing in Savanna Ecosystems: a large-scale experiment in Kruger National Park". (Hedin PI, $285,741).

2008-11 National Oceanic and Atmospheric Administration: "Improving climate predictions by reducing uncertainties in CO_2 fertilization of the terrestrial biosphere". (Hedin PI, $413,833).

2008-11 National Oceanic and Atmospheric Administration: "CICS: Modeling Nutrient Controls in the Terrestrial Biosphere". (Hedin PI, $213,000).

2006-10 National Science Foundation (DEB-0614116): "Biogeochemical Controls on Nitrogen Fixation in a Diverse Tropical Forest" (Hedin PI, $445,000, 3 years).

2006-09 National Science Foundation (DEB-0608267) Linking Theory and Mechanistic Experiments in Explaining How Nitrogen Fixation Strategies Influence Ecosystem Nitrogen Fertility (Hedin PI, $11,990)

2006-08 The A. W. Mellon Foundation: "Influence of Invasive Acacias on Nitrogen and Molybdenum Cycling in the South African Fynbos" (Hedin PI, $15,859, 2 years).

2006-08 National Science Foundation (DEB-0608267): "Linking Theory and Mechanistic Experiments in Explaining How Nitrogen Fixation Strategies Influence Ecosystem Nitrogen Fertility" (Hedin PI with S.A. Levin, $11,990, 2 years).

2004-07 Princeton University Sophomore Initiative Grant: "Developing a Novel Living Laboratory Teaching Model" (Hedin PI with E. Zerba, $ 105,945, 4 years).

2003-09 National Oceanic & Atmospheric Administration: "Modeling Terrestrial Nutrient Cycling." (Hedin, PI, $307,310).

2003-06 National Aeronautics and Space Administration: "Implications of Nitrogen and Phosphorus Losses Across Broad Geographic Variations in Ecosystem State Factors." (Hedin PI, $50,000, 2 years).

2001-02 National Science Foundation (EAR-0129162): "Workshop on Linking Ecological Biology and Geosciences." (Hedin PI, $83,081, 1 year).

2001-04 Environmental Protection Agency Star Graduate Fellowship (EPA graduate fellowship grant U-91595601-3, $68,000, 3 years).

2000-06 National Science Foundation (DEB-0083566): "Biocomplexity: The Emergence of Ecosystem Pattern" (Hedin Co-PI with S.A. Levin and others at Cornell, MIT, and University of Washington, $2,999,766, 5 years).

2000-05 The A.W. Mellon Foundation: "Thermodynamic Controls on Nitrogen Cycling and Trace Gas Emissions from Tropical Soils" (Hedin PI, $462,000, 3 years; additional support through a separate award to Pamela Matson at Stanford).

1999-02 National Aeronautics and Space Administration (NASA NGT5-30210): "Have We Grossly Underestimated Methane Production and Consumption? Application of A New Stable Isotope Technique to Measure Methane" (with Joseph von Fischer, $66,000, 3 years).

1996-01 National Science Foundation (BIR-9602261): "Research Training in Biogeochemistry and Environmental Change" (with R.W. Howarth [PI], $1,667,728; 5 years).

1996-00 The A.W. Mellon Foundation: "Biogeochemistry of Undisturbed Forest Ecosystems: Controls on Ecosystem-level Function" (Hedin PI, $361,000, 4 years).

1996-00 National Science Foundation (DEB-9630531): "Mechanisms of Base Cation Cycling in Forest Biogeochemical Systems: Application of a New Tool" (Hedin PI, with L.A. Derry [Co-PI], $255,000, 4 years).

1996-99 National Aeronautics and Space Administration (NASA ESF/96-0091): "The Internal Nitrogen Cycle of Temperate Forests: Patterns and Mechanisms in the Absence of Human Disturbance" (with Steven S. Perakis, $66,000, 3 years).

1996-99 National Science Foundation (BIR-9512240): "Acquisition of Mass Spectrometers for the Cornell Laboratory for Natural Abundance Isotope Analysis" (Hedin Co-PI, with R.W. Howarth [PI], T.E. Dawson, and J.T. Brenna, $1,064,170, 3 years).

1996-99 The A.W. Mellon Foundation: "Cornell Laboratory for Isotope Analyses" (Hedin Co-PI, with T.E. Dawson and R.W. Howarth, $700,000, 5 years).

1996-99 The A.W. Mellon Foundation: "Pathways, Mechanisms and Implications of Nutrient Loss During Development of Unpolluted Tropical Montane Rain Forests in Hawaii"

(Hedin PI, $141,000, 3 years; additional support by separate awards to Peter Vitousek and Pamela Matson at Stanford).

1993-96 The A.W. Mellon Foundation: "Nutrient Cycles in Undisturbed Temperate Forest Ecosystems" (Hedin PI, $323,563, 3 years).

1993-98 National Science Foundation, LTER: "Organisms in the Agricultural Landscape" (Hedin Co-investigator with G.P. Robertson [PI] and others). Funds supported soil-chemistry sampling at the Kellogg Biological Station LTER site.

1992-95 USDA Competitive Grants Program (USDA NRICGP 92-37102-74): "Speciation of Soil Solution Nitrogen Losses from Agricultural and Forested Landscapes" (Hedin PI, with G.P. Robertson [Co-PI], $174,010, 3 years).

1992-95 National Science Foundation (DEB92-08394): "Soil-stream Interfaces as Control Points for Speciation and Transformations of Nitrogen in a Heterogeneous Landscape" (Hedin PI, with N. Ostrom and G.P. Robertson [Co-PI's], $98,179, 3 years).

1992-94 Department of Energy: "Trace Gas Fluxes in the U.S. Midwest: Temporal Dynamics and Biospheric Feedbacks in Agricultural Ecosystems" (Hedin one of 2 Co-PI's, with G.P. Robertson [PI], $120,000, 2 years).

1991-96 National Science Foundation (DIR-9113598): "Research-based Training Group: Linking Levels of Ecological Organization" (Hedin one of 5 Co-PI's, with G.G. Mittelbach [PI], $1,513,000, 5 years).

1991-94 The A.W. Mellon Foundation: "Linking Streams and Watersheds: Comparative Studies of Nitrogen Dynamics" (Hedin PI, $120,000, 3 years).

1991-92 The Upjohn Company: "Remediation Properties of the Upjohn Groundwater Recharge Pond" (Hedin one of 9 Co-PI's, with M. Klug [PI], $35,385 awarded to Hedin, 1 year).

Meeting Abstracts (2000 – Present):

Wurzburger, N., J-P. Bellenger, A. Kraepiel, and L.O. Hedin. 2010. Mechanism of molybdenum and phosphorus limitation on asymbiotic nitrogen fixation in tropical forest soils. Abstract for the 2010 meeting of Ecological Society of America, Pittsburgh, PA.

Menge, D.N.L., S.W. Pacala, and L.O. Hedin, 2010. Alternative stable states of nitrogen and phosphorus limitation at multiple timescales in terrestrial ecosystems. Abstract for the 2010 meeting of Ecological Society of America, Pittsburgh, PA.

Gerber, S., L.O. Hedin, E. Shevliakova, S.W. Pacala, and S.G. Keel. 2010. Effects of nitrogen cycle on the historic land carbon sink. Abstract for the 2010 meeting of Ecological Society of America, Pittsburgh, PA.

Keel, S.G., S. Gerber, E. Shevliakova, and L.O. Hedin. 2010. Effects of CO_2 enrichment and nitrogen addition on forest productivity in a global land model. Abstract for the 2010 meeting of Ecological Society of America, Pittsburgh, PA.

Hedin, L.O., S. Batterman, N. Wurzburger, D.N.L. Menge, S.G. Keel, and A.C. Staver. 2010. Why is nutrient co-limitation not more common in land ecosystems (or perhaps it is)? Abstract for the 2010 meeting of Ecological Society of America, Pittsburgh, PA.

Keel, S.G, S. Gerber, E. Shevliakova, L.O. Hedin. 2009. Resolution of biome-specific carbon dioxide fertilization effects in terrestrial ecosystems. Carbon Cycling in Tropical Ecosystems, 23rd New Phytologist Symposium. Guangzhou, China.

Gerber, S., L.O. Hedin, E. Shevliakova, S.W. Pacala, and M. Oppenheimer. 2009. Anthropogenic change and carbon-nitrogen feedbacks in the terrestrial biosphere. Abstract for 8th international Carbon Dioxide Conference, Jena, Germany

Hedin, L.O., S. Gerber, and E. Shevliakova. 2009. Emergence and dynamics of the global terrestrial nitrogen cycle. Abstract for 2009 meeting of Ecological Society of America, Milwaukee, WI.

Menge, D.N.L., S.A. Levin, and L.O. Hedin. 2009. Facultative versus obligate nitrogen fixation strategies and their ecosystem consequences. Abstract for 2009 meeting of Ecological Society of America, Milwaukee, WI.

Brookshire, J., L.O. Hedin. D.M. Sigman, and D. Newbold 2009. Patterns of nitrogen loss from neo-tropical rainforests. Abstract for 2009 meeting of Ecological Society of America, Milwaukee, WI.

Barron, A.R. and L.O. Hedin. 2008. Fixation by adult legume trees linked to soil nitrate in a lowland tropical forest. Abstract for 2008 meeting of Ecological Society of America, Milwaukee, WI.

Menge, D.N.L., S.A. Levin, and L.O. Hedin. 2007. Adaptive nitrogen fixation strategies with realistic tradeoffs allow persistent N limitation and N richness. Abstract for 2007 meeting of Ecological Society of America, San Jose, CA.

Barron, A.R., A. Kraepiel, and L.O. Hedin. 2007. Molybdenum limitation of tropical nitrogen fixation: A widespread phenomenon? Abstract for 2007 meeting of Ecological Society of America, San Jose, CA.

Hedin, L.O., and S.A. Levin. 2006. Scaling nutrient limitation from individuals to ecosystems: effects of spatial heterogeneity and Darwinian selection. Abstract for 2006 meeting of Ecological Society of America, Memphis, TN.

Gerber, S., Hedin, L.O., Pacala, S.W., Shevliakova, E. and M. Oppenheimer. 2006. The Emergence of Nitrogen Limitation in a Global Dynamic Coupled Terrestrial Carbon Nitrogen Model. Eos Trans. AGU, 87(52), Fall Meeting.

Barron, A. and L.O. Hedin. 2006. Facultative nitrogen fixation in a lowland tropical forest inferred by ^{15}N and direct measures. Abstract for 2006 meeting of Ecological Society of America, Memphis, TN.

Keisman, J. and L.O. Hedin. 2006. Species effects on soil microbial diversity and functioning: quantifying litter quality-bacterial community structure-nutrient cycling linkages. Abstract for 2006 meeting of Ecological Society of America, Memphis, TN.

Perring, M., Hedin, L.O., Levin, S.A., McGroddy, M. and C. de Mazancourt. 2006. Nitrogen deposition: effects on the phosphorus cycle and implications for ecosystems. Abstract for 2006 meeting of Ecological Society of America, Memphis, TN.

Strong, A., Barron, A., Wright, S.J., Harms, K., Yavitt, J., Hedin, L.O. 2006. Litter chemistry controls on heterotrophic nitrogen fixation in a lowland tropical forest, Panama. Abstract for 2006 meeting of Ecological Society of America, Memphis, TN.

Barron, A. and Hedin, L.O. 2005. Dynamic control of nitrogen fixation by Inga spp. in a lowland tropical forest, Panama. Abstract for the 2005 meeting of the Ecological Society of America, Montreal, Canada.

Hedin, L.O. 2005. Climate-dependence of forest nitrogen losses, worldwide. Abstract for the 2005 meeting of the Ecological Society of America, Montreal, Canada.

Houlton, B.Z., Hedin, L.O. and Sigman, D.M. 2005. Isotopic constraints on nitrogen acquisition by plant communities across tropical rainforest. Abstract for the 2005 meeting of the Ecological Society of America, Montreal, Canada.

McGroddy, M.E., Hedin, L.O., Moran, E. and Batistella, M. 2005. Leaching of essential nutrient cations and anions from undisturbed lowland forests across the Brazilian Amazon Basin. Abstract for the 2005 meeting of the Ecological Society of America, Montreal, Canada.

Menge, D. and Hedin, L.O. 2005. Patterns of nitrogen fixation along a long-term soil chronosequence in New Zealand rainforests. Abstract for the 2005 meeting of the Ecological Society of America, Montreal, Canada.

McGroddy, M.E., Hedin, L.O., Moran, E. and M. Batistella. 2005. Leaching of essential nutrient cations and anions from undisturbed lowland forests across the Brazilian Amazon Basin. LBA 4th Scientific Congress. 9th LBA-ECO Science Team Meeting São Paulo, Brazil.

Gerber, S., Hedin, L.O., Oppenheimer, M., Pacala, S.W. and Shevliakova, E. 2005. Sensitivity Analysis of a New Global Coupled Terrestrial Carbon-Nitrogen Model, abstract for the AGU Fall Meeting.

McGroddy, M.E., Baisden, W. and Hedin, L.O. 2004. Nutrient losses from undisturbed forests in New Zealand: Patterns of N and P loss along a gradient of parent material. Abstract for the 2004 meeting of the Ecological Society of America, Portland, OR.

Houlton, B.Z., Sigman, D.M. and Hedin, L.O. 2004. 15N/14N as a proxy for gaseous nitrogen losses across a forest rainfall gradient. Abstract for the 2004 meeting of the Ecological Society of America, Portland, OR.

Barron, A. and Hedin, L.O. 2004. Nitrogen fixation by Inga spp. and leaf litter heterotrophs in a lowland tropical forest, Panama. Abstract for the 2004 meeting of the Ecological Society of America, Portland, OR.

Baisden, W., McGroddy, M.E. and Hedin, L.O. 2004. Nutrient losses from undisturbed forests in New Zealand: C, N and P loss as a function of climate and soil properties. Abstract for the 2004 meeting of the Ecological Society of America, Portland, OR.

Hedin, L.O. McGroddy, M.E., Houlton, B.Z., Moran, E. and Battisella, M. 2004. Hydrologic losses from tropical forest soils– patterns and implications. Abstract for the 2004 LBA 3rd Scientific Congress, Brasilia, Brazil.

Hedin, L.O., McGroddy, M.E., Houlton, B., Moran, E. and M. Battisella. Hydrologic losses from tropical forest soils–patterns and implications. LBA 3rd Scientific Congress. Brasilia, Brazil July 2004

Valdivia, M.V., Walter, M.T., Salmon, C.D., Hedin, L.O. and Walter, M.F. 2004. Hydrochemical modeling of dissolved organic carbon in a small, undisturbed forested watershed in southern Chile. Abstract for the 2004 meeting of the American Geophysical Union, San Francisco, CA.

McGroddy, M.E., Hedin, L.O., Moran, E. and Batistella, M. 2003. Regional patterns in inorganic nutrient losses across the central Amazon Basin: preliminary results. Abstract for a poster presentation at the 6th Annual LBA Business Meeting, Fortaleza CE, Brazil.

Levin, L., Pacala, S., Rodriguez-Iturbe, I., Morel, F., Hedin, L.O., Sigman, D., Daufresne, T., Loladze, I., McGroddy, M. and Robinson-Graham, R. 2003. Biocomplexity: The emergence of ecosystem patterns. Abstract for the National Science Foundation: Biocomplexity in the Environment Awardees Meeting, Washington DC.

McGroddy, M.E., Hedin, L.O. and Daufresne, T. 2003. Scaling of C:N:P: ratios in forest ecosystems world-wide. Abstract for the 2003 meeting of the Ecological Society of America, Savannah, GA.

Hedin, L.O. 2003. Global signatures in plant-nutrient interaction: Implications for terrestrial ecosystems. Abstract for the 2003 meeting of the Ecological Society of America, Savannah, GA.

Houlton, B.Z., Sigman, D.M. and Hedin, L.O. 2003. Stable isotope constraints on internal nitrogen cycles, input-output balances and N fertility of forests. Abstract for the 2003 meeting of the Ecological Society of America, Savannah, GA.

Vile, M.A., Matson, P.A., and Hedin, L.O. 2003. Thermodynamic controls on soil trace gas (CH4, CO2, N2O) fluxes from the Maui rainfall gradient. Abstract for the 2003 meeting of the Ecological Society of America, Savannah, Georgia.

Hedin, L.O., Levin, S.A., and Buttel, L. 2002. Magnification of ecosystem function by Darwinian selection on organism-nutrient interactions. Abstract for the 2002 meeting of the Ecological Society of America, Tucson, AZ.

Daufresne, T. and Hedin, L.O. 2002. Competition theory modified by stoichiometric ecosystem properties. Abstract for the 2002 meeting of the Ecological Society of America, Tucson, AZ.

von Fischer, J. and Hedin, L.O. 2002. Do soil microsites drive methane flux? Abstract for the 2002 meeting of the Ecological Society of America, Tucson, AZ.

Hedin, L.O., Walter, M.T., Weathers, K., Keene, B., and Brown, M. 2002. Watershed-based separation of Atmospheric input vectors from a remote old-growth forest in Chile. Abstract for 2002 meeting of the American Geophysical Union, San Francisco, CA.

Hedin, L.O. 2001. Thermodynamics of ecological systems. Invited abstract for Gordon Conference on Modern Developments in Thermodynamics, Ventura, CA.

Perakis, S.S., Compton, J. and Hedin, L.O. 2001. Non-linear nitrogen retention in an unpolluted old-growth temperate forest receiving a geometric range of experimental 15N additions. Abstract for the 2001 meeting of the Ecological Society of America, Madison, WI.

Vitousek, P.M., Chadwick, O., Crews, T., Heath, J., Hedin, L.O., Kurtz, A. and Matson, P.M. 2001. Element inputs and outputs across a substrate age gradient in the Hawaiian Islands. Abstract for the 2001 meeting of the Ecological Society of America, Madison, WI.

Hedin, L.O., Vitousek, P.M., Matson, P.M., Buttel, L., Levin, S., Pacala, S. and Durrett, R. 2001. Stoichiometric equilibration of N and P losses over four million years of tropical forest development. Abstract for the 2001 meeting of the Ecological Society of America, Madison, WI.

von Fischer, J.C., and Hedin, L.O. 2001. Do anaerobic microsites control soil methane flux? Abstract for the 2001 meeting of the American Geophysical Union, San Francisco, CA.

Walter, M.T., C.D. Salmon, Hedin, L.O. and M.G. Brown. 2001. Hydrologic controls of chemical export from an undisturbed old-growth Chilean forest. Abstract for the 2001 meeting of the American Geophysical Union, San Francisco, CA.

Hedin, L.O. 2000. The terrestrial nitrogen cycle: Nature of feedbacks and the emergence of macroscopic patterns. Invited abstract for Chapman Conference on the Gaia Hypothesis, University of Valencia, Spain.

Perakis, S.S., and L.O. Hedin. 2000. The regulation of nitrate loss from unpolluted, old-growth temperate forests: Region-wide patterns from southern Chile. Abstract for the 2000 meeting of the Ecological Society of America, Snowbird, UT.

Hedin, L.O., J.J. Armesto, C.A. Perez, and S.S. Perakis. 2000. Why does biodiversity not affect nitrogen losses from two unpolluted old-growth forest ecosystems? Abstract for the 2000 meeting of the Ecological Society of America, Snowbird, UT.

von Fischer, J.C., and L.O. Hedin. 2000. Application of a new methane pool dilution technique for measuring gross rates of methane production and consumption along rainfall gradients in the Hawaiian Islands. Abstract for the 200 meeting of the American Geophysical Society, San Francisco, CA.

Weathers, K.C., Keene, W.C., Moody, J., Lovett, G.M., Likens, G.E., Caraco, N.F., Galloway, J.N., Hedin, L.O. and J.J. Armesto. 2000. Atmospheric flux of organic and inorganic nitrogen to a remote, coastal forest in southern Chile. Abstract for the 200 meeting of the American Geophysical Society, San Francisco, CA.

Publications:

Barron, A.R., Purves, D.W. and L.O. Hedin. 2010. Facultative nitrogen fixation by canopy legumes in a lowland tropical forest. *Oecologia,* DOI 10.1007/s00442-010-1838-3

Gerber, S., L.O. Hedin, M. Oppenheimer, S.W. Pacala, and E. Shevliakova. 2010. Nitrogen cycling and feedbacks in a global dynamic land model. *Global Biogeochemical Cycles* **24**, GB1001, doi 10.1029/2008GB003336.

Reich, P.B., J. Oleksyn, I.J. Wright, K.J. Niklas, L. Hedin, and J.J. Elser. 2010. Evidence of a general 2/3-power leaf nitrogen to phosphorus scaling among major plant groups and biomes. *Proceedings of the Royal Society B.* **277**: 877-883.

Hedin, L.O., E.N.J. Brookshire, D.N.L. Menge, and A.R. Barron. 2009. The nitrogen paradox in tropical forest ecosystems. *Annual Review of Ecology, Evolution and Systematics* **40**:613-35.

Menge, D.N.L., S.A. Levin, and L.O. Hedin. 2009. Facultative versus obligate nitrogen fixation strategies and their ecosystem consequences. *American Naturalist* **174**: 465-477. Epub doi:10.1086/605377.

Menge, D.N.L. and L.O. Hedin. 2009. Nitrogen fixation in different biogeochemical niches along a 120,000-year chronosequence in New Zealand, *Ecology* **90** (8): 2190-2201. Epub doi: 10.1890/08-0877.1

Menge, D.N.L., S.W. Pacala, and L.O. Hedin. 2009. Emergence and maintenance of nutrient limitation over multiple timescales in terrestrial ecosystems. *American Naturalist* **173** (2)**:** 164-175.

Barron, A.R., N. Wurzburger, J-P Bellenger, S.J. Wright, A.M. Kraepiel, and L.O. Hedin. 2009. Molybdenum limitation of asymbiotic nitrogen fixation in tropical forest soils. *Nature Geoscience* **2**:42-45. Epub doi:10.1038/ngeo366.

Menge, D.N., S.A. Levin, and L.O. Hedin. 2008. Evolutionary tradeoffs can select against nitrogen fixation and thereby maintain nitrogen limitation. *Proceedings of the National Academy of Sciences* **105** (5):1573-8.

Perring, M.P., L.O. Hedin, S.A. Levin, M. McGroddy and C. de Mazancourt. 2008. Increased plant growth from nitrogen addition should conserve phosphorus in terrestrial ecosystems. *Proceedings of the National Academy of Sciences*. **105**:1971-1976.

McGroddy, M.E., W.T. Baisden and L.O. Hedin. 2008. Stoichiometry and hydrological C, N, and P losses across climate and geology: an environmental matrix approach across New Zealand primary forests. *Global Biogeochemical Cycles,* **22***:* GB1026, doi:10.1029/2007GB003005.

Houlton, B, Sigman, D.M, Schuur, E.A.G. and Hedin, L.O. 2007. A climate-driven switch in plant nitrogen acquisition within tropical forest communities. *Proceedings of the National Academy of Sciences* **104**:8902-8906.

Perakis, S.S. and L.O. Hedin. 2007. State factor relationship of dissolved organic carbon and nitrogen losses from unpolluted temperate forest watersheds. *Journal of Geophysical Research Biogeosciences* **112**:G02010 APR 25 2007.

Hedin, L.O. 2007. Does the exception prove the rule? Reply. *Nature* **445**: E11.

von Fischer, J.C. and Hedin, L.O. 2007. Controls on soil methane fluxes: tests of biophysical mechanisms using stable isotope tracers. *Global Biogeochemical Cycles* **21**: GB2007 MAY 4 2007.

Hedin, L.O. 2006. Physiology: Plants on a different scale. *Nature* **439**:399-400.

Houlton, B., Sigman, D. and Hedin, L.O. 2006. Isotopic evidence for large gaseous nitrogen losses from tropical rainforests. *Proceedings of the National Academy of Sciences* **103:** 8745-8750.

Daufresne, T. and Hedin, L.O. 2005. Plant coexistence depends on ecosystem nutrient cycles: extension of the resource-ratio theory. *Proceedings of the National Academy of Sciences* **102**: 9212-9217.

Perakis, S.S., Compton, J.E., Hedin, L.O. 2005. Nitrogen retention across a gradient of N-15 additions to an unpolluted temperate forest soil in Chile. *Ecology*, **86**: 96-105.

Hedin, L.O. 2004. Global organization of terrestrial plant-nutrient interactions. *Proceedings of the National Academy of Sciences* **101**:10849-10850. (Invited commentary)

Jackson, R.B. and Hedin, L.O. 2004. Terrestrial and Freshwater Biogeochemistry. *Ecology*, **9**:2353-2354. (Special feature)

McGroddy, M.E., Daufresne, T., and Hedin, L.O. 2004. Scaling of C:N:P: stoichiometry in forest ecosystems worldwide: implications of terrestrial Redfield-type ratios. *Ecology*, **85**: 2390-2401. (Special feature)

Hedin, L.O., Vitousek, P.M. and Matson, P.A. 2003. Pathways and implications of nutrient losses during four million years of tropical forest ecosystem development. *Ecology* **84**(9):2231-2255.

Perakis, S.S., and Hedin, L.O. 2002. Nitrogen loss from unpolluted South American forests mainly via dissolved organic compounds. *Nature* **415**:416-419.

Perakis, S.S., and Hedin, L.O. 2002. Response to commentary on "Nitrogen loss from unpolluted South American forests mainly via dissolved organic compounds." *Nature* **418**:665-665.

Kennedy, M.J., Hedin, L.O. and Derry, L.A. 2002. Decoupling of unpolluted temperate forests from rock nutrient sources revealed by natural 87Sr/86Sr and 84Sr tracer addition. *Proceedings of the National Academy of Sciences* **99**: 9639-9644.

von Fischer, J.C. and Hedin, L.O. 2002. Separating methane production and consumption with a field-based isotope pool dilution technique. *Global Biogeochemical Cycles* **16**: 8-1 to 8-13.

Ostrom, N.E., Hedin, L.O., von Fischer, J.C. and Robertson, G.P. 2002. Nitrogen transformations and NO3- removal at a soil-stream interface: A stable isotope approach. *Ecological Applications* **12**: 1027-1043.

Hedin, L.O., Hobbie, S.E., Jackson, R.B. and Neff, J.C. 2002. What role will Ecology (and the ESA) play in the future of Earth Sciences? *The Bulletin of the Ecological Society of America* **83**:201-202.

Neff, J. and Hedin, L.O. 2002. Building a home for the biogeosciences: Challenges for understanding terrestrial ecosystems. *EOS* **83**:165-166.

Hedin, L.O., Chadwick, O., Schimel, J. and Torn, M. 2002. Linking Ecological Biology and Geoscience: Challenges for terrestrial environmental science. *Princeton Report to the National Scienc*e *Foundation*: 16 pp.

Perakis, S.S. and Hedin, L.O. 2001. Fluxes and Fates of Nitrogen in Soil of an Unpolluted Old-Growth Temperate Forest, southern Chile. *Ecology* **82**:2245-2260.

Salmon, C.D., Hedin, L.O., Walter, M.T. and Brown, M.G. 2001. Hydrological controls on chemical export from an undisturbed old-growth Chilean forest. *Journal of Hydrology* **253**:69-80.

Hedin, L.O. 2000. Deposition of nutrients and pollutants to ecosystems. In *Methods in Ecosystem Science*, Sala, O.E., Jackson, R.B., Mooney, H.A. and Howarth, R.W., eds., pp. 265-276 Springer Verlag, New York, N.Y.

Chadwick, O.A., Derry, L.A., Vitousek, P.M., Huebert, B.J. and Hedin, L.O. 1999. Changing sources of nutrients during four million years of ecosystem development. *Nature* **397**:491-497.

Cleveland, C.C., Townsend, A.R., Schimel, D.S., Fisher, H., Howarth, R.W., Hedin, L.O., Perakis, S.S., Latty, E.F., von Fischer, J.C., Elseroad, A. and Wasson, M.F. 1999. Global patterns of terrestrial biological nitrogen (N2) fixation in natural ecosystems. *Global Biogeochemical Cycles* **13**:623-645.

Walter, M.T., Mutch, P., Salmon, C.D., McCool, D.K. and Hedin, L.O. 1999. Digitizing chart recorder data: coordinate system conversion for rain gauges and similar recording instruments. *Journal of Atmospheric and Oceanic Technology* **16**:1138-1142.

Hedin, L.O., von Fischer, J.C., Ostrom, N.E., Kennedy, B.P., Brown, M.G. and Robertson, G.P. 1998. Thermodynamic constraints on nitrogen transformations and other biogeochemical processes at soil-stream interfaces. *Ecology* **79**:684-703.

Hedin, L.O. 1998. From landscapes to the sea: Challenges to understanding how humans influence aquatic ecosystems. In *Proceedings of the 7th Stockholm Water Symposium and 3rd International Conference on the Environmental Management of Enclosed Coastal Seas*, Stockholm, Sweden, Falkenmark, M. ed., pp. 33-44. The Stockholm International Water Institute and Arkpressen.

Ostrom, N.E., Knoke, K.E., Hedin, L.O., Robertson, G.P. and Smucker, A.J.M. 1998. Temporal trends in nitrogen isotope values of nitrate leaching from an agricultural soil. *Chemical Geology* **146**:219-227.

Perez, C.A., Hedin, L.O. and Armesto, J.J. 1998 Nitrogen mineralization in two unpolluted old-growth forests of contrasting biodiversity and dynamics. *Ecosystems* **1**:361-373.

Sobczak, W.V., Hedin, L.O. and Klug, M.J. 1998. Relationships between bacterial productivity and organic carbon at a soil-stream interface. *Hydrobiologia* **386**:45-53.

Vitousek, P.M., Hedin, L.O., Matson, P.A., Fownes, J.H. and Neff, J. 1998. Within-system element cycles, input-output budgets, and nutrient limitation. In *Successes, Limitations, and Frontiers in Ecosystem Science*, Pace, M. L. and Groffmann, P.M. eds., pp. 432-451. Springer-Verlag, New York.

Findlay, S., Likens, G.E., Hedin, L.O., Fisher, S.G. and McDowell, W.H. 1997. Organic matter dynamics in Bear Brook, Hubbard Brook Experimental Forest, New Hampshire, USA. *Journal of the North American Benthological Society* **16**:43-46.

Hedin, L.O. and Likens, G.E. 1996. Atmospheric dust and acid rain. *Scientific American* **275**:88-92.

Hedin, L.O. and Hetherington, E. 1996. Atmospheric and geologic constraints on the biogeochemistry of North and South American temperate rain forests. In *High-Latitude Rainforests and Associated Ecosystems of the West Coast of the Americas*, Lawford, R.G., Alaback, P.B. and Fuentes, E., eds., pp. 57-74. Springer-Verlag, New York.

Hedin, L.O., Armesto, J.J. and Johnson, A.H., 1995. Patterns of nutrient loss from unpolluted, old-growth temperate forests: Evaluation of biogeochemical theory. *Ecology* **76**:493-509.

Armesto, J.J., Villagrán, C., Aravena, J.C., Pérez, C., Smith-Ramirez, C., Cortés, M. and Hedin, L.O. 1995. Conifer forests of the Chilean coastal range. In *Ecology of the Southern Conifers*, Enright, N.J. and Hill, R.S. eds., pp. 156-170. Melbourne University Press, Melbourne, Australia.

Hedin, L.O. 1994. Stable isotopes, unstable forest. *Nature* **372**:725-726.

Hedin, L.O., Granat, L., Likens, G.E., Buishand, T.A., Galloway, J.N., Butler, T.J., and Rodhe, H. 1994. Steep declines in atmospheric base cations in regions of Europe and North America. *Nature* **367**:351-354.

Hedin, L.O. and Brown, M.B. 1994. Watershed-level coupling of nitrogen and sulfur in a heterogeneous landscape. *Verhandlungen der International Vereinungen Limnologie* **25**:1477-1482.

Hedin, L.O. and Campos, H. 1991. Importance of small streams in understanding and comparing watershed ecosystem processes. *Revista Chilena de Historia Natural* **64**:583-596.

Hedin, L.O. 1991. Cross-system comparisons of detritus food webs. In *Comparative Analyses of Ecosystems: Patterns, Mechanisms and Theories*, Cole, J.J., Lovett, G.M. and Findlay, S. eds., pp. 346-347. Springer Verlag, New York.

Hedin, L.O., Likens, G.E., Postek, K.M. and Driscoll, C.T. 1990. A field experiment to test whether organic acids buffer acid deposition. *Nature* **345**:798-800.

Hedin, L.O., Granat, L., Likens, G.E. and Rodhe, H. 1990. Strong similarities in seasonal concentration ratios of SO_4^{2-}, NO_3^-, and NH_4^+ in precipitation between Sweden and the northeastern United States. *Tellus* **42B**:454-462.

Likens, G.E., Bormann, F.H., Hedin, L.O., Driscoll, C.T. and Eaton, J.S. 1990. Dry deposition of sulfur: A 23-year record for the Hubbard Brook Forest ecosystem. *Tellus* **42B**:319-329.

Hedin, L.O. 1990. Factors controlling sediment community respiration in woodland stream ecosystems. *Oikos* **57**:94-105.

Likens, G.E., Hedin, L.O. and Butler, T.J. 1990. Some long-term precipitation chemistry patterns at the Hubbard Brook Experimental Forest: Extremes and averages. *Verhandlungen der International Vereinungen Limnologie* **24**:128-135.

Fox, T. D., Folley, L.S., Mulero, J.J., McMullin, T.W., Thorsness, P.E., Hedin, L.O. and Costanzo, M.C. 1990. Analysis and manipulation of yeast mitochondrial genes. *Methods in Enzymology* **194**:149-165.

Driscoll, C.T., Likens, G.E., Hedin, L.O., Eaton, J.S., and Bormann, F.H. 1989. Changes in the chemistry of surface waters. *Environmental Science and Technology* **23**:137-143.

Driscoll, C.T., Likens, G.E., Hedin, L.O. and Bormann, F.H. 1989. Response to letter by Chen and Gomez. *Environmental Science and Technology* **23**:754-789.

Driscoll, C.T., Likens, G.E., Hedin, L.O. and Bormann, F.H. 1989. Response to letter by Dillon. *Environmental Science and Technology* **23**:1028.

Driscoll, C.T., Likens, G.E., Hedin, L.O. and Bormann, F.H. 1989. Response to letter by Holdren and Church. *Environmental Science and Technology* **23**:1079-1080.

Hedin, L.O., Mayer, M.S. and Likens, G.E. 1988. The effect of deforestation on organic debris dams. *Verhandlungen der International Vereinungen Limnologie* **23**:1135-1141.

Hedin, L.O., Likens, G.E. and Bormann, F.H. 1987. Decrease in precipitation acidity resulting from decreased SO_4^{2-} concentration. *Nature* **325**:244-246.