

CINDY M. HALE

Center for Water and the Environment
Natural Resources Research Institute
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Education

- Ph. D. University of Minnesota, College of Natural Resources, Department of Forest Resources, St. Paul, MN
Major field of study: Forest Ecology, Minor field of study: Science Education – Department of Curriculum and Instruction, 2004 (dates attended: 1/1998 – 2004)
- M.S. Environmental Sciences, University of Minnesota - Duluth, Department of Biology, 1997
(dates attended: 3/1993 – 3/1997)
- B.S. Ecology-Individually Designed Program, University of Minnesota, College of Biological Sciences, 1988
(dates attended: 12/1983-6/1988)
- 1998-2001 *Preparing Future Faculty: teaching enrichment workshop series*, University of Minnesota, Center for Teaching and Learning Services including:
- The new paradigm: teaching for learning
 - Reducing anonymity in large lectures
 - Promises and perils of assigning and grading group work
 - What if I told you I liked grading?... alternative strategies
 - Ten learning assessment tool you can use tomorrow
 - Managing classroom dynamics: preventing classroom issues
 - Cultivating student responsibility and engagement
- 2010 *The Midwest School for Beginning Apple Growers*, a 3-day course related to tree fruit management through the Center for Integrated Agricultural Systems, UW-Madison.
- 2011 *Midwest Fruit IPM Course for consultants, extension agents and NRCS staff*, a multi-week course offered in 4 segments January through July 2011 providing intensive IPM training for tree fruits and vineyards, coordinated through the Center for Integrated Agricultural Systems, UW-Madison.

Current Position:

- 7/07 – curr. Natural Resources Research Institute
Research Associate:
Participate in ongoing research, education and collaborative activities related to my studies of exotic earthworm invasions and their impacts to native ecosystems of the Great Lakes region. This includes creation (in 2001) and ongoing directing of the Great Lakes Worm Watch Program <<http://www.greatlakeswormwatch.org>>, a web-based citizen science program to involve K-12 students and other interested citizens in conducting earthworm and habitat surveys while learning about hardwood forest ecosystems and how exotic earthworm invasions are changing them. Organize and lead statewide training workshops for formal and non-formal educators and natural resource professionals in collaboration with Environmental Learning Centers and other organizations statewide. Train and supervise graduate students in environmental education.
- 2009-curr. UMD Sustainable Agriculture Program <http://www.d.umn.edu/cscd/sap/main/about.php>
The Sustainable Agriculture Project (SAP) at UMD (SAP@UMD) is a collaborative effort on the part of UMD students, faculty, staff and area farmers to revitalize agricultural interest at the Research and Field Studies Center. Planning is underway to transform a ten acre field that was used

for Timothy Grass production into vegetable fields. I am currently leading a multi-year renovation of the Old Orchard (est. 1912, abandoned 1970) that seeks to salvage what was once the largest apple orchard in Northeast Minnesota on the former grounds of the Northeast Branch Experiment Station. The "UMD Heritage Orchard" will serve as a centerpiece for teaching, research and community collaboration to serve locally adapted tree fruit growers in the region.

Relevant Teaching and Science Education Experience:

- May 2008-11 University of Minnesota Duluth, Department of Biology
Developed and annually instruct: BIO 4803- **Field Ecology: Identification and Field methods for ecological study of terrestrial and aquatic animals and plants**, 3 credits.
Field identification of northern Minnesota terrestrial flora and fauna by sight and sound (trees, shrubs, forbs, birds, amphibians, and earthworms) and aquatic flora and fauna (macroinvertebrates, zooplankton and phytoplankton). Field methods for conducting ecological research and monitoring of plants and animals in terrestrial and aquatic ecosystems to assess presence and relative abundance of plants and animals. Sampling methods explored include using releves, variable radius plots, point-counts, random plots, line transects, calling surveys, dip nets and tow nets. Fieldwork includes techniques relevant to project design, data collection and basic statistical analysis.
- June 2007 University of Minnesota Duluth, department of Health, Physical Education and Recreation
Instructor: ENED 5495- **Special Topics: Field Methods for Citizen Science**, 3 credits.
This course was designed to introduce upper-level undergraduate environmental education students to a range of methods for site-based citizen science and monitoring efforts. As the need for biological monitoring rapidly outstrips the resources of governmental and regulatory agencies, interest in citizen science and monitoring is also growing rapidly. Environmental educators are increasingly being called upon to run such programs and they need the hands-on training and experience to prepare them for these professional responsibilities. The course was based at Boulder Lake Environmental Learning Center, and included a hands-on introduction to field methods for conducting citizen science and ecological monitoring integrated with interpretation of natural and cultural features including sampling organisms in terrestrial and aquatic ecosystems, study design, data collection and basic statistics. The course culminated with a civic engagement component where students worked side by side with professional naturalists and educators from across the region to learn about how exotic earthworm invasions are affecting native forest ecosystems and to design an earthworm monitoring program for their site including sampling design, earthworm sampling and earthworm identification which included identifying environmental needs; knowing the target audiences (project participants and data users); determining the scope and objectives of the monitoring effort; methods and tools for study design and sampling.
- 3/07 – curr. Graduate Fellows in K-12 Education
Co-PI and program manager for first 3 years: NSF funded project to train and support graduate fellows in Biology, Geology, Mathematics & Chemistry to teacher in the K-12 setting under the mentorship of an experience teacher with the primary objective of teaching the fellows the skills of communicating scientific concepts to non-technical audiences effectively. The project manager oversees fellow & teacher recruitment training and supervision throughout the project.
- 2006-2007 University of Minnesota Duluth, department of Health, Physical Education and Recreation
Instructor: ENED 3341 (fall) and ENED 3342 (spring) - **Field Interpretive Methods I & II**, 3 credits, one of two sections coordinated with other faculty.
Field Interpretive Methods is designed to provide the foundational skills, techniques, and knowledge involved in interpreting the natural history of the environments from on and around the North Shore of Lake Superior and northern Minnesota across the seasons. Fall term includes

autumn and early winter environments and covers phenology, basic glacial and volcanic geology, geomorphology, tree & plant identification, raptor identification, beaver ecology, exotic species, cultural history, and interpretive skills. Spring term includes winter and spring environments and covers winter survival of wildlife, tracking, forest ecology and management, and spring migration, anuran breeding, and wildflowers.

2005

Lake Superior College

Instructor: ENSC 1200-**Introduction to Environmental Science**, fall term, 4 credits

The relationship of humans to their environment from local, regional, and global perspectives.

Includes the study of natural ecosystems, the impact of human activity on natural resources and environmental quality, environmental ethics, and strategies to maintain a sustainable biosphere.

The laboratory component includes experiences in the scientific method, basic ecological and environmental field techniques and assessment, and selected field trips to local agencies, research facilities, and businesses. Fulfills general education requirement in Math/Science and serves as a foundational course in environmental in environmental studies/science programs.

2005

University of Minnesota Duluth, department of Biology

Instructor: BIOL 2802- **Ecology Lab**, fall term, 2 credits

8 sections, supervised and instructed 4 grad teaching assistants.

Students are to introduced a range of ecological field techniques used in terrestrial and aquatic ecosystems study. It serves to introduce students to field sampling problems, data processing and computer skills needed for ecological studies. In addition, because writing is a very important skill for any scientist, they learn to write good scientific papers. Focus on learning to organize data, look for interesting patterns in the data, and suggest explanations (hypotheses) with numerous opportunities for practice and attention to detail.

Relevant Ecological and Professional Experience:

8/06 – 6/07

Boulder Lake Environmental Learning Center, University of Minnesota Duluth

Created and established funding for the director position at Boulder Lake ELC. Served as director for one year and facilitated the establishment of a diverse formal and non-formal educational program through UMD at the Boulder Lake Environmental Learning Center (BLELC), a program of the Center for Environmental Education, in the department of Health, Physical Education and Recreation (HPER) which had formally been hosted by Minnesota Power (the property owners). The BLELC is dedicated to teach environmental education through forest ecology, natural resources management, sustainability of natural resources, and outdoor recreation. In addition, the position will teaches occasional courses in the Department of HPER relative to field interpretation techniques, outdoor, and environmental education, and/or ecological field research techniques. Major responsibilities include directing the organization, management, instruction, and planning of the operations of the BLELC, including supervision of graduate and undergraduate internship students in environmental education. I also facilitated the search for a permanent, full-time director.

1/98 – 1/04

University of Minnesota, Department of Forest Resources, St. Paul

Graduate Research Assistant:

Independent research describing the patterns and mechanisms of impact on ecosystem processes and understory vegetation of hardwood forests resulting from the invasion of exotic earthworm species in Minnesota and the Great Lakes Region.

(Funding provided by the National Science Foundation, the Minnesota Department of Natural Resources and the Center for Hardwood Ecology – University of Minnesota)

3/93 - 4/96

The Natural Resources Research Institute, University of Minnesota-Duluth

Research Assistant:

Quantify & describe structural and compositional characteristics of old-growth Maple/Basswood, Red Oak and Black Ash Forests of Minnesota. Quantify decay rates and nitrogen dynamics of hardwood logs. Forest growth modeling to evaluate alternative management strategies. (funding provided by the Legislative Committee on Minnesota Resources).

8/95 - 10/95

Minnesota D.N.R., Trails & Waterways Unit, Two Harbors, MN

Independent Contractor:

Sensitive plant and habitat survey along 14 miles of a proposed extension to the Minnesota State Snowmobile Trail. Final report included a list of dominant species and habitats, descriptions and locations of unique plants or habitats and recommendations for routing of the trail. alternatives in different habitats present on the site.

3/92 - 8/92

U.S. Forest Service, Pacific Southwest Area, Arcata, CA

Wildlife Biologist:

Conducted research on the demography and reproduction of the Northern Spotted Owl in the south coastal range of Oregon. Included day and night surveys, identification and banding of adult and juvenile owls and nest monitoring to determine reproductive success.

9/91 - 3/92

U.S. Fish & Wildlife Service, North Central Area, Ely, MN

Field Technician:

Trapped, radio collared, monitored and recaptured northern gray wolves and white-tailed deer in northern Minnesota for studies of demography, predator-prey relationships, physiology and energetics. Collection and processing of biological samples including blood, tooth and tissue.

2/91 - 7/91

Wildlife International, Ltd., Baltimore, Maryland

Field Technician:

Agri-chemical toxicology studies required by the E.P.A. for re-certification of products, involving surveys of bird and mammal populations before and after application of various pesticides in potatoes fields of central Washington State and orange groves of central Florida. Field techniques included circular plots surveys, live trapping, mist netting, blood sampling, carcass searching, vegetation characterization and pesticide residue sampling.

Student Mentoring Experience:

Undergraduate Research Projects:

Marcie Powers, University of Minnesota Duluth

- Student coordinator of UMD Sustainable Ag. Project and recipient of a College of Liberal Arts Technology grant to establish an Integrated Pest Management (IPM) program for the UMD Heritage Orchard.

"Student for Sustainable Agriculture" UMD student organization

- Collaborate with and support organization efforts, special event and learning opportunities for and with student members

Kevin Krawiecki, University of Minnesota Duluth

- 2008 – "Effects of Invasive Earthworms on Forest Floor Invertebrates." Spring 2008 UROP award \$1,700.

Lindsey Pistner, University of Minnesota Duluth

- 2000 - "Allometric regressions for determining ash-free dry biomass from length measurements of preserved earthworm specimens"

Emily Beekman, University of Minnesota Duluth

- 2000 - "Soil organic matter content related to earthworm biomass across the gradient of an advancing leading edge of earthworm invasion"

Student Mentoring Experience: (Continued)

Graduate Research Mentorship:

- Zach Bennett, University of Minnesota Duluth, Integrated Biological Sciences M.S. Program, expected completion spring 2012 – "Catastrophic canopy disturbance on a continuum of non-native earthworm invasion: the interaction of forest floor removal and changes in light regime on the successional trajectories of hardwood forest plant communities in the western Great Lakes region"; serve as faculty sponsor and project supervisor.
- Ryan Hueffmeier, University of Minnesota Duluth, College of Education and Human Services, Master of Education, expected completion 2010 – "Using Citizen Science in Research – development of a rapid assessment tool to assess the level of earthworm invasion using visual indicators in common hardwood forest types of the western Great Lakes region"; supervise graduate assistantship and serve on graduate committee.
- John Geissler, University of Minnesota Duluth, College of Education and Human Services, Master of Education, 2007 – "Stormwater Planning Initiative Project: designing an educational web-based land use and stormwater planning map server," supervised graduate assistantship and served on graduate committee.
- Tiffany Smith, University of Minnesota Duluth, College of Education and Human Services, Master of Education, 2008 – "A Spiraling, Interdisciplinary K-6 School Forest Curriculum for South Terrace Elementary School," supervised 1st year of her graduate assistantship.
- Adriane Morabito, University of Minnesota Duluth, College of Education and Human Services, Master of Education, completion expected 2009, supervised 1st year of her graduate assistantship.

Volunteer Experience:

- 1995 - curr. Minnesota Academy of Science
Serve as a regional and state science fair judge for junior and senior student projects and research papers relating to environmental sciences, zoology, botany, ecology and related topics.
- 2008 - curr. Fond Du Lac Ojibwe School Science Fair
Serve as a science fair judge for junior and senior student projects relating to environmental sciences, zoology, botany, ecology and other science topics.
- 2001 – 2006 Duluth Township Planning Commission – Comprehensive Land-Use Plan Development
As a member of the Planning Commission and the citizen-based steering committee for Duluth Township I have been actively involved in the ongoing process of assessing and revising the Comprehensive Land-Use Plan for Duluth Township. In this process, the steering committee actively sought out and included input from township members, county officials, MPCA, EPA and consultants resulting in a renewed vision statement and a set of policies, strategies and tools the township has use to update our zoning maps, ordinances and procedures for variance or conditional use. The goal has been to be proactive in our attempts to achieve environmentally sensitive and controlled growth in an area now experiencing intense development pressure.
- 1999 ScienceWorks! Science CentrUM, University of Minnesota, University College
Program that pairs scientists with elementary and middle schools for development of the schools science programs.
- 1988 - 1989 The Raptor Center – University of Minnesota, St. Paul
Delivered prescribed medical treatment, feeding and cleaning for injured raptors. Fly birds for exercise and physical therapy.
- 1981-1982 California Wilderness Trainings Co., Palm Desert, CA
Facilitated weekend wilderness courses involving initiative events and high and low ropes courses for corporate, adult and family groups. Educational emphasis on personal development, communication and group dynamics.

Books:

- Hale, C.M. 2007. Earthworms of the Great Lakes Region. Kollath & Stensaas Publishing. 36 pages.

Selected Peer-Reviewed Publications/Reports: *Invited

- *Hale, CM. 2008. Evidence for Human-Mediated Dispersal of Exotic Earthworms: support for exploring strategies to limit further spread. *Molecular Ecology Perspectives* **17**: 1165-1169.
- Hale, C. M., L.E. Frelich, P.B. Reich and J Pastor. 2008. Exotic earthworm effects on hardwood forest floor, nutrient availability and native plants: a mesocosm study. *Oecologia* **155**: 509-518.
- Hale, C. M., L. E. Frelich, P. B. Reich. 2006. Changes in cold-temperate hardwood forest understory plant communities in response to invasion by European earthworms. *Ecology* **87**(7): 1637-1649.
- Hale, C. M., L. E. Frelich, P. B. Reich and J. Pastor. 2005. Effects of European earthworm invasion on soil characteristics in northern hardwood forests of Minnesota, U.S.A. *Ecosystems* **8**(8): 911-927.
- Hale, CM and GE Host. 2005. Assessing the impacts of European earthworm invasions in beech-maple hardwood and aspen-fir boreal forests of the western Great Lakes region. National Park Service Great Lakes Inventory and Monitoring Network Report GLKN/2005/11.
- Hale, C. M., L. E. Frelich, P. B. Reich. 2005. Exotic European earthworm invasion dynamics in northern hardwood forests of Minnesota, U.S.A. *Ecological Applications* **15**(3): 848-860.
- Hale, C. M., L. E. Frelich, P. B. Reich. 2004. Allometric equations for estimation of ash-free dry mass from length measurements for selected European earthworm species (Lumbricidae) in the western Great Lakes region. *American Midland Naturalist* **151**(1): 179-185.
- Hale, C.M., J. Pastor, K. Rusterholz. 1999. Comparison of structural and compositional characteristics in old-growth versus mature hardwood forests of Minnesota, USA. *Canadian Journal of Forest Research* **29**: 1479-1489.
- Hale, C.M. and J. Pastor. 1998. Nitrogen content and decay rates of hollow versus solid hardwood logs. *Canadian Journal of Forest Research* **28**: 1276-1285.
- Bohlen, P. J., S. Scheu, C. M. Hale, M. A. McLean, S. Migge, P. M. Groffman and D. Parkinson. 2004. Non-native invasive earthworms as agents of change in northern temperate forests. *Frontiers in Ecology and the Environment* **2**(8): 427-435.
- Callahan, Mac A., Jr., Grizelle González, Cynthia M. Hale, Liam Heneghan, Sharon L. Lachnicht, and Xiaoming Zou. 2006. Policy and management responses to earthworm invasions. *Biological Invasions* **7**(6): 1317-1329.
- Frelich, Lee E., Cindy M. Hale, Stefan Scheu, Andy Holdsworth, Liam Heneghan, Patrick J. Bohlen, and Peter B. Reich. 2006. Earthworm invasion into previously earthworm-free temperate and boreal forests. *Biological Invasions* **7**(6):1235-1245.
- Hobbie, Sarah E., Peter B. Reich, Jacek Oleksyn, Megan Ogdahl, Roma Zytkowskiak, Cynthia Hale, and Piotr Karolewski. 2006. Species effects on litter chemistry and microenvironment regulate litter decomposition and forest floor dynamics in a common garden experiment with fourteen tree species. *Ecology* **87**(9): 2288-2297.
- Larson, E.R., K.F. Kipfmüller, C.M. Hale, L.E. Frelich, and P.B. Reich. (2010) Tree Rings Detect Earthworm Invasions and their Effects in Northern Hardwood Forests. *Biological Invasions* **12**(5):1053-1067.
- Reich, Peter.B., Jacek Oleksyn, Jerzy Modrzyński, Paweł Mrozinski, Sarah E. Hobbie, David M. Eissenstat, Jon Chorover, Oliver A. Chadwick, Cynthia M. Hale, Mark G. Tjoelker (2005). Linking litter calcium, earthworms and soil properties: a common garden test with 14 temperate tree species. *Ecology Letters* **8**: 811-818.
- Reynolds, J. W., D. R. Linden and C. M. Hale. 2002. The earthworms of Minnesota (Oligochaeta: Acanthodrilidae, Lumbricidae and Megascolecidae). *Megadrilogia* **8**(12): 86-100. Oligochaetology Laboratory, 18 Broadview Court, Kitchener, Ontario, Canada N2A 2X8.
- Tiunov, A. V., C. M. Hale, A. R. Holdsworth, T. S. Perel. 2006. Invasion patterns of Lumbricidae into the previously earthworm-free areas of north-eastern Europe and the western Great Lakes region of North America. *Biological Invasions* **7**(6): 1223-1234.

Invited Academic and Professional Symposia / Workshop Presentations:

*Ecological Consequences of Exotic Earthworm Invasion: forest decline syndrome. 2008 Natural Areas Conference - October 14-17, 2008, Nashville, TN

*Management Recommendations To Limit The Continued Spread Of Exotic Earthworms In Working Forests. Minnesota IGERT (Integrated Graduate Education, Research and Training) Invasive Species Conference – March 3-5, 2008, Duluth, MN

*Earthworms of the Great Lakes. A two day workshop with the Biodiversity Alliance including the Cleveland Museum of Natural History, the Holden Arboretum, Cleveland Botanical Garden, and the Cleveland Zoo; the workshop involved three field trips for sampling of earthworms, 2 earthworm ID training sessions and a brown bag seminar. Sept. 12-13, 2007

*Citizen Science Toolkit Conference. Citizen science is a diverse and inherently interdisciplinary field. In June of 2007, scientists, educators, technology specialists, and other experts of varied backgrounds, gathered at the Laboratory of Ornithology in Ithaca, NY, to discuss how to best support new and existing projects. Ideas generated during the conference are being used to develop the Citizen Science Toolkit, and are also inspiring a broader conversation about collaborative research ventures. June, 2007 at the Laboratory of Ornithology in Ithaca, NY.

*Forest Decline Syndrome following exotic earthworm invasion. North Central Weed Science Conference, Dec 13-14, 2006. Hyatt Regency, Milwaukee, WI.

*Workshop on Exotic Earthworm Invasions. Institute of Ecology, University of Georgia, Athens, GA, USA. October 30-November 1, 2003.

*Ecological consequences of exotic invaders: interactions involving European earthworms and native plant communities in hardwood forests and management implications.

- 1) Wisconsin Department of Natural Resources, Division of Forestry Statewide meeting. Feb 12-14, 2002, Madison, WI.
- 2) University of Wisconsin at Madison –Arboretum, Winter Enrichment Lecture Series, Feb. 14, 2002
- 3) University of Wisconsin - Madison, Department of Botany, Biology Colloquium Lecture, Feb.14, 2002
- 4) St. Olaf College, Department of Biology, Northfield, MN, Biology Colloquium Lecture, Nov. 27, 2002

*Exotic earthworm impacts on the understory vegetation of hardwood forests.

- 1) Forest Health and Pathology Cooperator's Meeting. U.S. Forest service and Dept. of Agriculture, March 2001, St. Paul, MN
- 2) Forest Health discussion group, U.S. Forest service and Dept. of Agriculture and the University of Minnesota. March 31, 1999, St. Paul, MN

*Old-Growth and Mature Hardwood Forests: management strategies to enhance diversity. USDA Natural Resources Seminar. April 30, 1997. Grand Rapids, MN. (model results of LINKAGES for biodiversity and course woody debris under different harvesting scenarios over 200 years of rotation).

Peer Review of Professional Journals and Organizations:

Biological Invasions, Journal of Tropical Forest Science, Forest Science, Conservation Biology, Journal of Mammology, Landscape Ecology, Molecular Ecology, Ecosystems Ecology, Ecological Applications, Acta Oecologica, National Science Foundation, Northeastern Naturalist

Scholarships and Awards:

- 2006 Voted "Best non-student presentation" at the MN Society for Conservation Biology annual meeting, March 1-2, Brainerd MN.
- 2003 Department of Forest Resources departmental grant in acknowledgement of exceptional research, \$1,000
- 2003 Fulbright Fellowship for international study and research in Poland for academic year 2003-2004
- 2002 University of Minnesota - Doctoral Dissertation Fellowship for academic year 2002-2003, \$14,000
- 2000 Osborne Preserve Fellowship, University of Michigan Biological Station - \$1,300 summer research grant
- 1999 Alexander P. Anderson and Lydia Anderson Fellowship - \$6,000 summer stipend and research funds
- 1999 Philip C. Hamm Memorial Scholarship - \$750, spring 1999

Grants:

- 2010 "School Forest Carbon Sequestration Modeling Pilot." EPA Environmental Education Grants program. Co-PI's John Geissler, Director – Boulder Lake ELC and Amy Kay Kerber, MN DNR School Forest Program, 2 year project award amount \$49,795.
- 2010 'Workshopping' the Renovation of the Old South Orchard on the UMD Farm, Seed Grant, Center for Community and Regional Research, University of Minnesota Duluth. Co-PI's Randel Hanson and Stacey Stark, 1 year project, award amount \$3500. – Funded \$3,000
- 2010 "Reducing human-mediated spread of non-native earthworms in vulnerable northern hardwood forests," CSREES USDA-AFRI Biology of Weedy and Invasive Species in Agroecosystems. Co-PI's include David Andow (lead PI), Terry Hurley, George Host, and Rebecca Knowles. Proposed dates 1/11/2010 –1/10/2013, 3 year project, award amount \$491,000
- 2009 Legislative Citizen Commission on Minnesota Resources (LCCMR) – "Prevention and Early Detection of Asian Earthworms and Reducing the Spread of European Earthworms," 3 yr project, amount \$150,000.
- 2008 Minnesota Lake Superior's Coastal Program – "Exotic earthworm invasions: integrated research and education to achieve natural resource protection," 2 year award amount \$46,935.
- 2008 U.S.D.A. – "Acceleration Of Inorganic Nutrient Release And Mineral-Organic Matter Association By Soil Bioturbation Along An Earthworm Invasion Chronosequence," lead PI's Kyungsoo Yoo, University of Delaware and Anthony Aufdenkampe, Stroud Water Research Center, Maryland. 2 year subcontract award amount \$16,222.
- 2007 UMD Civic Engagement Grant – GLWW incorporated into Field Methods for Citizen Science summer course, award amount \$1985.
- 2007 "Graduate Fellows In K-12 Education" – 5 year program to support the training and placement of 10 graduate fellows annually from Biology, Geology & Mathematics in the K-12 environment, National Science Foundation (DGE 637027) award \$2,931,797
- 2006 Woodland Advisor Program, Minnesota Forest Stewardship Program - Boulder Lake ELC hosted a series of 19 Woodland Advisor workshops in 2006-2007 to inform and train private forest landowners on a range of natural resource management practices as demonstrated in the working forests of the Boulder Lake Management Area. Workshops illustrated the many social, biological, and economic benefits of a managed forest and may include such topics as "Methods for natural regeneration of White Pine and effective blister-rust management," "Strategies for managing your forest for multiple goals: wildlife and timber," "Monitoring the impacts of exotic pests in your forest," "Introduction to GIS and new online mapping tools," "Forest field tour: options for managing my forest lands," and "How to use a GPS receiver."
- 2006 Duluth Superior Area Community Foundation – annual support for the new director position at Boulder Lake Environmental Learning Center, award \$10,000.
- 2006 Stormwater Planning Initiative Project – stormwater management planning guide featuring landowner-friendly IMS website tool. Co-sponsored by Minnesota's Lake Superior Coastal Program STAR grant, 6 month award, \$ 4,255; Center for Community and Regional Research, University of Minnesota Duluth, 1 year award, \$ 4,800. (in cooperation with Drs. George Host and Rich Axler, The Natural Resources Research Institute, University of Minnesota Duluth).

- 2005 Minnesota Worm Watch: educational tools and training for non-formal educators in exotic earthworm invasion. National Science Foundation, 2 year awards, \$74,982 (in cooperation with Drs. Lee Frelich, University of Minnesota, Department of Forestry and Ken Gilbertson, University of Minnesota Duluth, Center for Environmental Education).
- 2003 Development of monitoring protocols to assess impacts of European earthworm invasions. Cooperative Ecosystems Studies Unit, Voyageurs and Pictured Rocks National Parks, 2 year award, \$ 64, 597 (in cooperation with Dr. George Host, The Natural Resources Research Institute, UMD).
- 2002 Minnesota Worm Watch Program – to host training workshops statewide and further develop web site resources. Minnesota Department of Natural Resources – Environmental Partnerships Grant. Award amount \$13,138.
- 2000 Minnesota Worm Watch Program – to develop science curriculum, web site and host pilot training workshops. North East Region Sustainable Development Partnership. Award amount \$11,750.
- 2000 Survey of European earthworms and native plant communities in hardwood forests of Minnesota. Minnesota Department of Natural Resources, Conservation Research Grant. Award amount \$8,500 .