Global Systems Science – Concept Paper

Managing Landscapes to Meet Emerging Global Challenges

Initial Participating Faculty:

Brian Badgley, Assistant Professor
Crop & Soil Environmental Sciences (CALS)

W. Lee Daniels, Professor - *Lead*
Crop & Soil Environmental Sciences (CALS)

Susan Day, Associate Professor
Horticulture (CALS) / Forest Res. and Env. Conservation (CNRE)

Matt Eick, Professor
Crop & Soil Environmental Sciences (CALS)

Erik Ervin, Professor
Crop & Soil Environmental Sciences (CALS)

Meredith Steele, Assistant Professor
Crop & Soil Environmental Sciences (CALS)

Ryan Stewart, Assistant Professor
Crop & Soil Environmental Sciences (CALS)

Brian Strahm, Associate Professor
Forest Res. and Env. Conservation (CNRE)

Kang Xia, Professor
Crop & Soil Environmental Sciences (CALS)

Carl Zipper, Professor
Crop & Soil Environmental Sciences (CALS)

May 15, 2017

1. Vision: Our vision is to create a program dedicated to accelerating innovation that improves the quality, efficiency, and resilience of human dominated landscapes, including our cities, farms, and industrial lands. Humans dramatically alter and manipulate the global landscape for food and fiber production, mineral extraction, urban development, waste disposal and many other purposes. Impacts to essential ecosystem functions and values range from local (e.g. mining and land development) to global (e.g. carbon emissions) with a clear need for development of appropriate management systems for their mitigation. By using a systems approach that interfaces environmental scientists and ecologists with relevant disciplines, this proposed signature area within Global Systems Science (GSS) will build upon existing group strengths in soil remediation, water quality, hydrology, urban soils, land reclamation, agroecosystem management, forest ecology, wetland restoration, soil-waste management and integrated modeling across multiple spatial and temporal scales to develop a more holistic approach to landscape management. We will also develop new collaborations with the human, health and social sciences to integrate essential transdisciplinary topics such as social acceptance and socioeconomic impact of changes in land use practices and comparative effects of existing and/or new policies and practices on human and ecosystem health. This program will interface with developing undergraduate majors in the new School of Plant and Environmental Sciences (SPES) and with existing majors in Forest Resources and Environmental Conservation (FREC). New interdisciplinary graduate courses and programs would also be developed over time.

This program will leverage existing national and internationally recognized research and outreach programs in the areas listed above, identify new collaborators both within and outside of Virginia Tech, and identify critical new positions to fully complement our existing expertise. Our overall goal is to develop a highly collaborative research and education team that focuses on optimal and sustainable human management of the landscape from all perspectives including soil/plant/water quality, biodiversity preservation, economic feasibility, policy implications, and overall social viability. Results will be directly and immediately applicable to remediating and managing regional land use impacts, and will be extended to national and global scales via spatial analyses, modeling and other approaches where appropriate.

2. Relevance: The global population will soon reach 9 billion people. Serving this population will require global urban land area to triple 2000 levels by 2030; by 2050, an estimated 78% of this population will live in cities and towns. These urban populations depend on local and regional natural resources, including surface waters for drinking and recreation and food and fiber provided by agricultural and forested lands. Agricultural and range land covers nearly half of the United States while forest lands under varying levels of management cover another one-third. Cities, rural agricultural communities, and industrial landscapes are intricately intertwined as complex socio-ecological systems sharing material and energy flows, physical space and natural resources within the landscapes they inhabit. Equitably and sustainably managing these flows and the systems that surround them represents one of the most critical emerging global challenges that we will face.

This program is directly relevant to the GSS overview statement with particular focus on progressive degradation of environmental resources and declining resource abundance coupled with impacts of construction, food production and extractive technologies. Our existing faculty

are recognized nationally and internationally for both research findings and practice implementation in the areas of progressive soil degradation, pressure on forest ecosystems and watersheds, demands for raw materials, abundance and quality of fresh water, and supply and integrity of food. With university support, we would seek and develop new collaborators in essential disciplines such as atmospheric sciences, health sciences, and social systems and policy studies. Examples of collaborative areas to be further developed include:

- Sustainable intensification of agricultural systems to meet a growing world population's needs.

- Ecosystems for human health
    - Water quality/quantity/access (drinking/recreation) in rural and urban communities.
    - Livable ecosystems (street trees, green spaces, heat island mitigation, walkability).
    - Air quality for human health and climate maintenance.
    - Natural ecosystem preservation and restoration for recreation and psychological well-being.

- Sustainable economic and resource localization
    - Cross land-use material/resource flows (recycling, land application of wastes).
    - Thriving rural communities and strengthened urban-rural connections.
    - Localization of food-sheds.

- Human behavior and policy studies for development of strategies that will enable science-based landscape management to be achieved.

We will build upon over thirty years of well-supported research programs in areas such as environmental restoration following mining disturbances, agricultural and forest management, urban forestry, mitigation of impacts to upland/wetland/stream complexes, land application of wastes, and geospatial studies. However, we also recognize the clear need to identify and involve new collaborators in the human, health and social sciences and to thereby better integrate our combined scientific perspectives.

Formalization and university recognition of this "area of strength" would assist us in pursuit of funding from our current and historic research sponsors such as USDA, USEPA, NSF, VDOT/VDEQ/VDCR and the private sector; and to expand our efforts in pursuing private foundation and other non-governmental funding. Thus, a major goal will be to collaborate across scientific disciplines for development of new long-term research support opportunities.

This program would have clear linkages and potential collaborations with two Strategic Areas (Policy and Materials) and two other Destination Areas: Intelligent Infrastructure for Human Centered Communities (IIHCC) and Data Analytics and Decision Sciences (DADS. For the IIHCC Destination Area, we would focus efforts on determining and mitigating the impacts of human communities on landscapes and water quality; for the DADS Destination Area we would emphasize how remediation and management practices can be informed and improved via better understanding of human decision making, enhanced utilization of high-resolution and/or real-time data, and increased citizen inclusion in data-collection processes.

3. Curriculum Opportunities: The School of Plant and Environmental Sciences (SPES) is currently developing an Ecological Restoration major that will focus on human-dominated lands including industrial sites and urban and suburban land development systems. This major along with the existing Environmental Science major will guide the recovery of damaged ecosystems to re-establish their health, integrity, and sustainability. Additionally, new developed pathways minors in Ecological Cities, Global Food Security, and Civic Agriculture and Food Systems as well as an alternative pathway in Ecosystems, Human Well-Being, and Culture will train students across campus for future challenges related to human dominated landscapes.

The organization of the new SPES will also provide an opportunity for the development of new graduate degree programs once the merger is completed and existing degree programs are fully evaluated against future needs. We envision a new MS/PhD degree in the area of soil/landscape environmental interactions. We will also develop several new courses (or revise existing courses) to focus on interdisciplinary approaches to human impact management and remediation.

4. Description of Resource Needs: If selected for development, we propose that the first-year funds ($75,000) would be applied as follows: (A) Two to three months of faculty buy-out time to (i) allow for development of appropriate on-campus collaborations in human/health/social sciences, (ii) interaction with external regional and national programs with similar objectives, and (iii) finalize undergraduate curriculum proposal development. (B) Support for a 50% FTE Post-Doc or Research Associate to research potential funding sources and assist in proposal preparation. (C) Support for several workshops including one focused on inviting a panel of systems scientists to facilitate on-campus discussions and provide recommendations for which existing faculty resources should be utilized and to identify gaps to be addressed by future hires. (D) Initiation of new faculty hires in (i) soil/landscape/atmosphere interactions and (ii) urban restoration ecology (See Appendix; longer term funds needed). Additional faculty lines may be necessary to appropriately interface our existing scientific disciplines with the human and social sciences. Resources and positions required for longer-term implementation will be determined during the first year.

Appendix I – Two Page Biosketches

Brian D. Badgley

Crop & Soil Environmental Science
Virginia Tech
1880 Pratt Drive, Room 1121
Blacksburg, VA 24061
(540) 231-9629
badgley@vt.edu

(a) Professional Preparation

University of Georgia	Zoology	B.S., 1995
University of Maryland	Marine-Estuarine-Environmental Sciences	M.S., 2002
University of South Florida	Biology	Ph.D., 2009
University of Minnesota	Environmental Microbiology	Post-doc, 2009-12

(b) Appointments

2012-	Assistant Professor, Crop & Soil Environmental Science, Virginia Tech
2009-12	Post-Doctoral Associate, BioTechnology Institute, University of Minnesota
2002-04	Coastal Training Coordinator, Rookery Bay National Estuarine Research Reserve
2001-02	Sea Grant Fellow, NOAA, Estuarine Reserves Division
1996-97	Environmental Education Instructor, Jekyll Island 4-H Center, Jekyll Island, Georgia

(c) Products

(i) Related products (*student co-authors)

*Sun S, Li S, Avera BN, Strahm BD, **Badgley BD** (in press) Bacterial and fungal communities show distinct succession patterns during ecosystem restoration. *Appl Environ Microbiol.*

Wepking C, Avera B, **Badgley BD**, Barrett JE, *Franklin J, Knowlton KF, Ray PP, *Smitherman C, Strickland MS (2017) Exposure to dairy manure leads to greater antibiotic resistance and increased mass-specific respiration in soil microbial communities. *Proc Roy Soc B* 284*.*

Li X, *Sun S, **Badgley BD**, He Z (2016) Long-term performance and microbial community characterization of an osmotic anammox system for removing reverse-fluxed ammonium. *Bioresource Tech* 211:628-635.

Li X, *Sun S, **Badgley BD**, Sung S, Zhang H, He Z (2016) Nitrogen removal by granular nitritation - anammox in an upflow membrane-aerated biofilm reactor. *Water Res* 94:23-31.

Scholz F[#], **Badgley BD**[#], Sadowsky MJ, Kaplan DH (2014) Immune mediated shaping of microflora community composition depends on barrier site. *PLoS One* 9:e84019. ([#]co-first authors)

(ii) Other Significant Products

Harwood VJ, Staley C, **Badgley BD**, Borges K, Korajkic A. (2014) Microbial source tracking markers for detection of human sewage and fecal contamination in environmental waters: relationships to pathogens and human health outcomes. *FEMS Mirobiol Rev.* 38:1-40.

Sugawara M, Epstein B, **Badgley BD**, Unno T, Xu L, Reese J, Gyaneshwar P, Denny R, Mudge J, Bharti AK, Farmer AD, May GD, Woodward JE, Medigue C, Vallenet D, Lajus A, Rouy Z, Martinez-Vax B, Tiffin P, Young ND, Sadowsky MJ (2013) Comparative genomics of the core and accessory genomes of 48 *Sinorhizobium* strains comprising five genospecies. *Genome Biol* 14:R17.

Badgley BD, Thomas FIM, Harwood VJ (2011) Quantifying environmental reservoirs of fecal indicator bacteria associated with sediment and submerged aquatic vegetation. *Environ Microbiol* 13:932-942.

Badgley BD, Thomas FIM, Harwood VJ (2010) The effects of submerged aquatic vegetation on the persistence of environmental populations of *Enterococcus* spp. *Environ Microbiol* 12:1271-1281.

Badgley BD, Nayak BS, Harwood VJ (2010) The importance of sediment and submerged aquatic vegetation as potential habitats for persistent strains of enterococci in a subtropical watershed. *Water Res* 44:5857-5866.

(d) Synergistic Activities

- Co-organized and hosted a workshop entitled “Strategies for sequence-based analyses of microbial communities (and the caveats)” which was attended by over 35 students, post-docs, and faculty from eight different departments across the Virginia Tech campus (2013)

- President of the Virginia Branch of the American Society of Microbiology (2015-2017)

- Cofounded a microbial ecology networking group of students and faculty at Virginia Tech to facilitate collaboration, discussion, and project development on campus (2012-ongoing)

- Dedicated to providing undergraduate research opportunities, including direct mentoring of 6 NSF REU students, 3 VT Minority Summer Research Interns, and 7 paid undergraduate research assistants since 2013.

- Manuscript reviewer for *Appl Env Microbiol, Bioremediation, Environ Sci Tech*, *FEMS Microbiol Ecol*, *J Environ Mon*, *J Great Lakes Res*, *Sci Tot Environ*, *Water*, *Water Res* (ongoing)

Curriculum Vitae

W. Lee Daniels

Thomas B. Hutcheson, Jr. Professor of Soil Science

Department of Crop and Soil Environmental Sciences
Virginia Polytechnic Institute and State University
Blacksburg, Virginia 24061
540-231-7175; wdaniels@vt.edu

Education

B.S. Forestry	VPI & SU	1978
M.S. Agronomy - Soil Genesis	VPI & SU	1980
Ph.D. Agronomy - Soil Mineralogy & Geomorphology	VPI & SU	1985

Previous Positions

1989-1998 Associate Professor in Crop and Soil Env. Sci. (Va Tech)
1987-1989 Assistant Professor in Agronomy (Va Tech)
1982-1987 Instructor in Agronomy (Va Tech)
1981-1982 Research Associate in Agronomy (Va Tech)

Honors and Recognition

Elected as Fellow, Soil Science Society of America (2016).

Lifetime Achievement in Mine Land Reclamation (*William T. Plass Award*), American Society of Mining and Reclamation (2012).

Appointed Thomas B. Hutcheson, Jr. Professor, Department of Crop and Soil Environmental Sciences (2010).

Keynote Speaker, AMIREG 2009, Towards Sustainable Development: Assessing the Footprint of Resource Utilization and Hazardous Waste Management, Athens Greece.

USEPA National Biosolids Beneficial Use Research Award (2000).

Keynote Speaker, First South American International Conference on Rehabilitation of Degraded Lands, Parana, Brazil. (1994)

Reclamation Researcher of the Year, Amer. Society for Surface Mining and Reclamation. (1993)

President, American Society for Surface Mining and Reclamation (1990)

President, Virginia Association of Professional Soil Scientists (1988)

Outstanding Ph.D. Candidate Award, VPI & SU Sigma Xi Science Society (1985)

Outstanding Technical Paper Award, 1982 National Symposium on Surface Mining Hydrology, Sedimentology and Reclamation, Lexington, KY.

Areas of Specialization and Expertise

Restoration of disturbed lands including areas disturbed by mining, road building, waste disposal, urbanization, and erosion. Extensive experience in mine reclamation and wetlands restoration.

Geochemistry of near-surface weathering reactions and their influence on soil solution, leachate chemistry, and runoff water quality, including lab simulations and field verification.

The influence of land application of wastes on soil properties, geochemical weathering reactions, and water quality. Extensive experience with municipal and industrial sludges and ash materials.

Soil geomorphology and landscape analysis with particular emphasis on the relationships among surficial geology, hydrology, soil patterns, and long-term landscape evolution processes.

Membership in Professional Organizations

American Society of Mining and Reclamation
Society of Wetland Scientists
Society for Mining, Metallurgy and Exploration
Soil Science Society of America
Virginia Association of Professional Soil Scientists
Virginia Association of Wetland Professionals

Selected Recent Mine Reclamation Publications

Orndorff, Z.W., W.L. Daniels, C.E. Zipper, M. Eick, and M. Beck. 2015. A column evaluation of Appalachian coal mine spoils' temporal leaching behavior. Environmental Pollution 204:39-47.

Evans D., C. Zipper, P. Donovan, and W. Daniels. 2014. Long-term trends of specific conductance in waters discharged by coal-mine valley fills in Virginia, USA. J. Amer. Water Resources Assoc., http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1752-1688

Daniels, W.L., Z.W. Orndorff, M.J. Eick and C.E. Zipper. 2013. Predicting TDS release from Appalachian mine spoils. p. 275-285. *In*: J.R. Craynon (ed.), Environmental Considerations in Energy Production, April 14-18, 2013, Charleston, WV. Soc. Mining Met. & Explor., Englewood, CO. www.smenet.org.

Orndorff, Z.W., W. L. Daniels, M. Beck, and M. J. Eick. 2010. Leaching Potentials of Coal Spoil and Refuse: Acid-Base Interactions and Electrical Conductivity. p. 736-766 In: R.I. Barnhisel (Ed.), Proc. 2010 Meet., Amer. Soc. Mining and Rec., Pittsburgh, PA, June 5 - 11, 2010. ASMR, http://www.asmr.us.

Susan Downing Day, Ph.D.

Associate Professor, Department of Forest Resources & Environmental Conservation and Department of Horticulture, Virginia Tech, Blacksburg, VA 24061
sdd@vt.edu Tel: 540-231-7264 Fax: 540-231-3330

(a) Professional Preparation

Yale University, New Haven, CT	Philosophy	B.A. 1985
Cornell University, Ithaca, NY	Horticulture	M.S. 1993
Virginia Tech, Blacksburg, VA	Forestry	Ph.D. 1999

(b) Appointments

Associate Professor, 2014-present, Virginia Tech Depts. of Forest Res. & Environ. Conserv. and Horticulture
Assistant Professor, 2008-2014, Virginia Tech Depts. of Forest Res. & Environ. Conserv. and Horticulture
Research Assistant Professor 2004-2008, Virginia Tech, Department of Forestry
Visiting Assistant Professor 2000-2004, Virginia Tech, Department of Forestry
Cunningham Fellow 1995-1999, Virginia Tech
Extension Research Associate 1993-1995, Virginia Tech, Dept. of Horticulture
Liberty Hyde Bailey Fellow 1990-1993, Cornell University

(c) Publications

(i) Closely related publications (* indicates student under my supervision)

1. Layman*, R.M., S.D. Day, D. K. Mitchell*, Y. Chen*, J. R. Harris, and W. L. Daniels. 2016. Below ground matters: Urban soil rehabilitation increases tree canopy and speeds establishment. Urban Forestry & Urban Greening 16:25-35.
2. Day, S.D. and D.K. Mitchell*. 2015. A new perspective on opportunities for stormwater mitigation through soil management in ordinary urban landscapes. Watershed Science Bulletin, January 2015.
3. Kimball, L., Wiseman, P.E., Day, S.D., and J.F. Munsell. 2014. Use of urban tree canopy assessments by localities in the Chesapeake Bay Watershed. Cities and the Environment 7(2):9.
4. Chen*, Y., S.D. Day, A.F. Wick, K. McGuire. 2014. Influence of urban land development and subsequent soil rehabilitation on soil aggregates, carbon, and hydraulic conductivity. Science of the Total Environment 494: 329-336. DOI:10.1016/j.scitotenv.2014.06.099.
5. Chen*, Y., S.D. Day, R.K. Shrestha, B.D. Strahm, and P.E. Wiseman. 2014. Influence of urban land development and soil rehabilitation on soil-atmosphere greenhouse gas fluxes. Geoderma 226-227: 348-353. DOI: 10.1016/j.geoderma.2014.03.017
6. Chen*, Y., S.D. Day, A.F. Wick, B.D. Strahm, P.E. Wiseman, and W.L. Daniels. 2013. Changes in soil carbon pools and microbial biomass from urban land development and subsequent post-development soil rehabilitation. Soil Biology and Biochemistry 66:38-44. DOI: 10.1016/j.soilbio.2013.06.022
7. McGee, J.A., S.D. Day, R.H. Wynne, and B. White. 2012. Using geospatial tools to assess the urban tree canopy: Decision support for local governments. *Journal of Forestry* 110(5): 275-286. DOI: 10.5849/jof.11-052
8. Bartens*, J., S. D. Day, J. R. Harris, T. M. Wynn, and J. E. Dove. 2009 Transpiration and root development of urban trees in structural soil stormwater reservoirs. *Environmental Management* 44(4): 646-657. DOI: 10.1007/s00267-009-9366-9

(ii) Other significant publications

1. Trammell, T.L.E., S.D. Day, R.V. Pouyat, C. Rosier, B. Scharenbroch, and I. Yesilonis. Drivers of Urban Soil Carbon Dynamics. 2017.In Advances in Soil Science: Urban Soils. R. Lal and B.A. Stewart (Eds.) Taylor and Francis (in press)
2. Scharenbroch, B., S. D. Day, T.L.E. Trammell, and R.V. Pouyat. Urban Soil Carbon Storage 2017.In

Advances in Soil Science: Urban Soils. R. Lal and B.A. Stewart (Eds.) Taylor and Francis (in press)

3. Day, S.D. and J. R. Harris. Improving Soil Quality for Urban Forests (pp 309-322). 2017. In The Routledge Handbook of Urban Forestry. F. Ferrini, C.Konijnendijk van den Bosch, and A. Fini (Eds.). Routledge, London. 540 pp.

(d) Synergistic Activities

- I served on the Sustainable Sites Initiative (SITES™), Soils Technical Committee and Technical Core Committee (2007-2013). Now administered by the U.S. Green Building Council, SITES represents the cutting edge in sustainable site design and continues to be an effective means of disseminating research and new technology to practitioners and policymakers. sustainablesites.org
- Immediate Past Chair of the Urban and Anthropogenic Soils Division of the Soil Science Society of America (SSSA). I organized and sponsored numerous symposia and special sessions on human-dominated soils including a session on Manufactured, Blended, and Engineered Soils in 2016.
- I am leading the development of the Ecological Cities pathways minor, an innovative approach to creating meaningful cross-disciplinary collaboration among professions that manage urban land systems. I developed a university Pathways class, Plants and Greenspaces in Urban Communities, at Virginia Tech that reaches undergraduates across campus, including nonSTEM majors and minorities, and engages them in science-based urban sustainability problem-solving activities.
- I am the co-leader of the urban forestry program at Virginia Tech, urbanforestry.frec.vt.edu, that maintains strong links city personnel in order to improve technology transfer policy makers and practitioners and continue to serve on review and advisory panels such as a Scientific Technical Advisory Committee (STAC) Panel for the Chesapeake Bay Program to advise on urban forests and stormwater policy issues.

(e) Collaborators & Other Affiliations

Collaborators and Co-editors

Amateis, Ralph—Virginia Tech; Bassuk, N. L.—Cornell University; Clements, Terry—Virginia Tech; Dahle, Gregory—West Virginia University; Daniels, W. Lee—Virginia Tech; Frey, Gregory—Virginia State; Grissino-Mayer, Henry—University of Tennessee; Gugercin, S. B.—Virginia Tech; Harris, J. Roger—Virginia Tech; Livesley, Stephen—University of Melbourne; McGee, John A.—Virginia Tech; Munsell, John—Virginia Tech; Owen, James—Virginia Tech; Pouyat, Richard—USDA Forest Service, Washington DC; Scharenbroch, Bryant—Morton Arboretum, Lisle IL; Seiler, John—Virginia Tech; Shrestha, Raj K.—Virginia Tech; Strahm, Brian—Virginia Tech; Stewart, Ryan D.—Virginia Tech; Sullivan, Joseph—University of Maryland; Thompson, Theresa—Virginia Tech; Verweij, Vincent—Arlington County, Virginia; Watson, Gary—Morton Arboretum, Lisle IL; White, Barbara—Virginia Department of Forestry; Wick, Abbey—North Dakota State University; Wiseman, P. Eric—Virginia Tech; Wynne, Randolph—Virginia Tech; Yesilonis, Ian—USDA Forest Service, Baltimore MD.

Graduate Advisors and Postdoctoral Sponsors

John R. Seiler, Forest Resources & Environmental Conservation, Virginia Tech, Blacksburg VA
David Wm. Smith, (Emeritus) Forest Resources & Environmental Conservation, Virginia Tech, Blacksburg VA
Nina L. Bassuk, Horticulture, Cornell University, Ithaca NY

Thesis Advisor (completed)

Total Number of Graduate Students completed as Chair or Co-Chair: 10

Matthew J. Eick

Academic Rank: Professor

Appointment Date: 1997

Appointment: 10% Research, 90 % Teaching

Education

1995 Ph.D. Environmental Soil Chemistry, University of Delaware
1989 M.S. Soil Chemistry, University of Delaware
1987 B.S. Agronomy, Virginia Tech

Professional Experience

2012- Professor, Virginia Tech
2002-2012 Associate, Virginia Tech
1997-2002 Assistant Professor, Virginia Tech
1995-1997 Assistant Professor, Louisiana State University

Awards and Recognition

2015 Pathways Scholar
2013 Award for Excellence in Career Advising
2012 College of Agriculture and Life Sciences Certificate of Teaching Excellence
2012 Gamma Sigma Delta Teaching Award of Merit
2010 USEPA Scientific and Technological Achievement Award
2007 Highly Cited Paper, American Chemical Society Publications
2002 G. Burke Johnston Award in recognition of excellence in teaching

Teaching and Advising

ALS 3854 Environment, Health, and Latin American Culture Study abroad
CSES 5634 Soil Chemistry
CSES 5115 Soils for Professionals
ENSC/CSES/CHEM 4734 Environmental Soil Chemistry
CSES/ENSC/GEOL 3124 Soils Laboratory
CSES 3134 Soil in the Landscape
ENSC 1015-16 Foundations of Environmental Science
125 Undergraduate ENSC advisees
ENSC Program Director

International Activities (since 2006)

2012-2013 Study Abroad, Nepal
2013-2014 Study Abroad, Senegal
2014-2017 Study Abroad, Ecuador

List of Refereed Publications (Since 2011)

Favorito, J.E., M.J. Eick, P.R. Grossl. 2017. Selenium Geochemistry in Reclaimed Phosphate Mine Soils and its Relationship with Plant Bioavailability. Accepted.

Orndorff, Z.W., W.L. Daniels, C.E. Zipper and M.E. Eick. 2015. A Column Evaluation of Appalachian Coal Mine Spoils' Temporal Leaching Behavior. Env. Pollution. 204:39-47

Easton, Zachary, Mark Rogers, James Davis, James Wade, Emily Bock and, Matt Eick. 2015. Mitigation of sulfate reduction and nitrous oxide emission in denitrifying bioreactors with amorphous iron oxide and biochar. Ecological Engineering. http://dx.DOI.org/10/1016/j.ecoleng20115.05.008.

Rosenquist, S.E., W.C. Hession, M.J. Eick, D.H. Vaughan. 2011. Field application of a renewable constructed wetland substrate for phosphorous removal. JAWRA. 47(4):800-812.

Rodenquist, S.E., C.L. Levy, S.T. Sell, W.C. Hession, M.J. Eick, D.H. Vaughan. 2011.Facilitated ironreduction as a possible means of rejuvenating phosphorous removal performance of filtration substrates. Transactions of the ASABE. 54(2): 715-722.

Luxton, T.P., M.J. Eick, and K.G. Scheckel. 2011. Characterization and Dissolution Properties of Ruthenium Oxides. Journal of Colloid and Interface Science. 359:30-39

Professional Service (2006 to present)

2011	USDA. NIFA SBIR. Panel Manager of NIFI SBIR review panel. 2011. Selected panel members from across the country based on their area of expertise, assigned and reviewed 65 proposals, organized panel meeting and ranked proposals for funding.
2010	USDA. NIFA SBIR. Member of NIFA SBIR review panel.
2008	Chair American Society of Agronomy Resident Education Awards Committee
1997-	The Virginia representative to the American Society of Agronomy's Council of Soil Science Examiners (CSSE)

Professional Memberships

American Chemical Society
Soil Science Society of America
Geochemical Society of America

Erik H. Ervin, Ph.D.

Department of Crop and Soil Environmental Sciences
Virginia Polytechnic Institute and State University
Blacksburg, VA 24061-0404
(540) 231-9775 (540) 231-3431 (fax) eervin@vt.edu

EDUCATION

- Ph.D. Horticulture. Colorado State University. 1998.
- M.S. Horticulture. Colorado State University. 1995.
- M.A. Philosophy. University of Colorado-Boulder. 1992.
- B.S. Horticulture. Iowa State University. 1989.

PROFESSIONAL POSITIONS

Department Head (interim), Department of Crop and Soil Environmental Sciences (CSES), November 1, 2016 to present.
Assistant Dean of Academic Programs, College of Agriculture and Life Sciences (CALS), Virginia Tech, 2013 to present, 50% appointment.
Professor, Turfgrass Culture and Physiology, CSES, Virginia Tech, 2013 to present.
Professor, CSES, Virginia Tech, Appointment: 40% Teaching, 60% Research, 2011 to 2013.
Associate Professor, CSES, Virginia Tech, 2005 to 2011.
Assistant Professor, CSES, Virginia Tech, 2001 to 2005.
Assistant Professor and State Extension Turfgrass Specialist. Division of Plant Sciences (Horticulture), University of Missouri-Columbia. 1998-2000.

AWARDS

Fellow of American Society of Agronomy, 2016
Virginia Turfgrass Council Award for Outreach Excellence, 2004
Watson Fellowship from Golf Course Superintendents Association of America, 1998

AREAS OF SPECIALIZATION

- Undergraduate, graduate, and adult education in turfgrass agronomics.
- Undergraduate advising and curriculum management.
- Adaptation and cultural management requirements for warm- and cool-season turfgrass species used on golf courses, lawns, parks, athletic fields, and roadsides.
- The physiology and ecology of turfgrass responses to environmental stress and the use of synthetic and natural plant growth regulators for improved stress response.

TEACHING and ACADEMIC PROGRAMS

CSES 2564, Turfgrass Management, 3 credits, with lab; taught each Fall

CSES 3564, Golf and Sports Turf Management, 3 credits, with lab; taught each Fall
CSES 5064, Turfgrass Science Seminar, 2 credits; taught every other Spring

Ex Officio, CALS Curriculum Committee, 2013 to present

Academic Lead: Pathways Minor in Global Food Security and Health, 2016 to present

Principal Investigator: USDA Higher Education Challenge Grant Program to Develop a Virginia Tech Sustainability Scholars Program

PRESENTATIONS AND OUTREACH

Scientific meetings

Author or coauthor of over 90 scientific papers at professional society meetings (e.g., Crop Science Society of America, Plant Growth Regulator Association of America, International Turfgrass Society Conference) since 1993; Abstract list not included.

Turfgrass industry presentations at state, national and international conferences
Invited to speak on numerous turfgrass subjects at over 100 conferences, meetings, and workshops in 35 US states, Australia, Canada, United Kingdom, Chile, Columbia, and China since 1998, for a total of 285 presentations (list not included).

SCHOLARLY PUBLICATIONS

Publication Type	Lead author	Senior to student or post-doc	Junior to colleague	Total
Books written or edited	1	0	2	3
Book chapters	1	1	3	5
Papers in refereed journals	12	38	6	56
Paper in refereed proceedings	4	10	5	19
Peer-reviewed Extension publications	5	0	8	13
Totals	23	49	24	96

Career: 1803 total citations, h-index = 24 as of May 12, 2017 (Google Scholar)

Select recent refereed publications; *denotes a graduate student

Ervin, E. H., N. Reams*, X. Zhang, A. Boyd*, and S. Askew. 2017. An integrated nutritional and chemical approach to *Poa annua* suppression in creeping bentgrass greens. Crop Science, 57(2):567-572.

Zhang, X., E. H. Ervin, W. Wu, N. Sharma*, and A. Hamill*. 2016. Auxin and trinexapac-ethyl impact on root viability and hormone metabolism in creeping bentgrass under water deficit. Crop Science: doi:10.2135/cropsci2016.05.0434

McCall, D. S., E. H. Ervin, C. D. Shelton*, N. Reams*, and S. D. Askew. 2016. Influence of ferrous sulfate and its elemental components on dollar spot suppression. Crop Science, 57(2):581-586.

Wang*, K., X. Zhang, and E. H. Ervin. 2016. Small heat shock proteins, a key player in grass plant thermotolerance. Heat Shock Proteins and Plants, Asea et al., (eds.). Chapter 3, pp. 41-64. Springer International Publishing, Switzerland.

Wang*, K., X. Zhang, J. M. Goatley, and E. H. Ervin. 2014. Heat shock proteins in relation to heat stress tolerance of creeping bentgrass at different N levels. PLOS One, 9(7):e102914.

Zhang, X., E. H. Ervin, G. K. Evanylo, J. Li, and K. Harich. 2013. Corn and soybean hormone and antioxidant metabolism responses to biosolids under two cropping systems. Crop Sci. 53:2079-2089.

Steinke, K. and E. H. Ervin. 2013. Turfgrass Ecology, Chapter 10: 347-382. *In* Turfgrass: Biology, Use, and Management. J. C. Stier, B. P. Horgan, and S. A. Bonos (editors). ASA-CSSA-SSSA Monograph No. 56. Madison, Wisconsin.

EXTRAMURAL GRANTS (1998-2017)

	Office of Sponsored Programs	Field Testing (industry-various)
Principal Investigator, VT	$1,913,449	$1,363,731
Co-P.I., VT	$2,105,288	$85,000
University of Missouri	$0	$191,200
Totals	$4,018,737	$1,639,931
Career Total	**$5,658,668**	

Meredith K. Steele

Assistant Professor, Department of Crop and Soil Environmental Sciences

328a Smyth Building, Virginia Polytechnic Institute and State University, Blacksburg, VA 20406

a. **Professional Preparation**

University of Maryland, College Park	Environmental Science and Policy	B.S. 2004
University of Maryland, College Park	Natural Resource Economics	B.S. 2004
University of Maryland, College Park	Soil Science	M.S. 2007
Texas A&M University, College Station	Urban Biogeochemistry	Ph.D. 2011
Duke University, Durham	Postdoctoral Associate	2012 - 2014

b. **Appointments**

2014 to Present. *Assistant Professor of Landscape Ecosystems*

Dept. of Crop and Soil Environmental Sciences,

Virginia Polytechnic Institute and State University.

c. **Research Products**

Five Relevant Products

1. **Steele MK,** Heffernan JB, N. Bettez, J. Cavender-Bares, P.M. Groffman, M. Grove, S. Hall, S. E. Hobbie, K. Larson, J. L. Morse, C. Neill, K.C. Nelson, J. O'Neil-Dunne, L. Ogden, D.E. Pataki, C. Polsky, R. Roy Chowdhury. (2014) Convergent hydrography in US cities. Ecosystems. 17:685-697.
2. **Steele MK,** Heffernan JB (2014) Morphological characteristics of urban water bodies: mechanisms of change and implications for ecosystem function. Ecological Applications. 24(5):1070-1084.
3. Groffman PM, J Cavender-Bares, N Bettez, **MK Steele, et al.** (2014) Ecological homogenization of urban America. Frontiers in Ecology and the Environment. 12:74-81.
4. **Steele MK**, Aitkenhead-Peterson JA (2011) Long-term sodium and chloride surface water exports from the Dallas/Fort Worth Region. Science of the Total Environment, 409(16):3021-3032.
5. **Steele MK**, Aitkenhead-Peterson JA (2012a) Urban soils of Texas: Relating irrigation sodicity to water-extractable carbon and nutrients. Soil Science Society of America, 76:973-982.

Five Other Products

1. **Steele MK**, Aitkenhead-Peterson JA (2012b) Salt impacts on organic carbon and nitrogen leaching from senesced vegetation. Biogeochemistry, 112(1):245-259. doi: 10.1007/s10533-012-9722-3

2. Polsky C., J.M. Grove, C. Knudson, P.M. Groffman, N. Bettez, J. Cavender-Bares, S.J. Hall, J.B. Heffernan, S.E. Hobbie, K.L. Larson, J.L. Morse, C. Neill, K.C. Nelson, L.A. Ogden, J. O'Neil-Dunne, D.E. Pataki, R. Roy Chowdhury, **MK Steele** (2014) Assessing the homogenization of urban land management with an application to US residential lawn care. PNAS doi:10.1073/pnas.1323995111
3. **Steele MK**, McDowell WH, Aitkenhead-Peterson JA (2010) Chemistry of urban, sub-urban, and rural surface waters. In: JA Aitkenhead-Peterson and A Volder (Eds) Urban Ecosystem Ecology. Agronomy Monograph 55. ASA, CSA, SSSA Madison WI, USA.
4. Aitkenhead-Peterson JA, **Steele MK**, Nahar, N, Santhy K (2009) Dissolved organic carbon and nitrogen in urban and rural watersheds of south-central Texas: land use and land management influences. Biogeochemistry 96:119-129.
5. Steele MK, Coale FJ, Hill RL (2012) Winter annual cover crop impacts on no-till soil physical properties and organic matter. Soil Science Society of America, doi:10.2136/sssaj2012.0008, 76(6):2164-2173.

d. **Recent Synergistic Activities**

Mentoring and Undergraduate Research

- Mentor for 3 NSF REU Student. Complex Human and Water Dynamics - An Interdisciplinary Research Experience at the Virginia Tech StREAM Lab, Award Number: 1156688
- Provided undergraduate research opportunities for four paid undergraduate research assistants since 2014.
- Teaching mentor for Graduate Teaching Scholars awardee.
- CALS School of Plant Science Planning Committee, Virginia Tech
- CSES Graduate Education Committee, Virginia Tech

Professional Memberships and Other Service:

- Member: American Geophysical Union, Ecological Society of America, Soil Science Society of America, American Society of Limnology and Oceanography
- Served as adhoc Reviewer: NSF, Ecosystems, Ecosphere; Biogeochemistry; Water, Air, and Soil Pollution, Science of the Total Environment
- Convener of Special Sessions at American Geophysical Union Annual Meetings:
    - 2009: B13 Biogeochemistry of Soil and Surface Water in Rural, Sub-urban, and Urban Ecosystems I and II.
    - 2010: B34 Biogeochemistry of Urban and Suburban Ecosystems

Ryan D. Stewart, Ph.D., E.I.T.
Assistant Professor
Crop and Soil Environmental Sciences
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a. Professional Preparation

California Polytechnic State U.	Mechanical Engineering	B.S. 2002
Oregon State University	Water Resources Engineering	M.S. 2010
Oregon State University	Water Resources Engineering	Ph.D. 2013
Oregon State University	Post Doctoral Scholar	2013

b. Appointments

Since 2014 Assistant Professor, Virginia Tech

c. Products

Five relevant publications

1. **Stewart, R. D.**, M. R. Abou Najm, D. E. Rupp, and J. S. Selker. 2016. Modeling multi-domain hydraulic properties of shrink-swell soils. *Water Resources Research*. 52: doi:10.1002/2016WR019336.
2. **Stewart, R. D.**, M. R. Abou Najm, D. E. Rupp, and J. S. Selker. 2016. A Unified Model for Soil Shrinkage, Subsidence, and Cracking. *Vadose Zone Journal.* 15(3): 1-15. doi: 10.2136/vzj2015.11.0146.
3. **Stewart, R. D.**, D. Moreno, C. T. Gregory and J. S. Selker. 2016. Evaluation of infiltration discharge as a strategy to meet effluent temperature limits. *Journal of Sustainable Water in the Built Environment*. doi: 10.1061/JSWBAY.0000818.
4. **Stewart, R. D.**, D. Moreno, and J. S. Selker. 2014. Quantification and scaling of infiltration from a constructed infiltration wetland. *Journal of Hydrologic Engineering.* 04015007. doi:10.1061/(ASCE) HE.1943-5584.0001164.
5. **Stewart, R. D.**, M. R. Abou Najm, D. E. Rupp, John W. Lane, Hamil C. Uribe, Jose Luis Arumí, and J. S. Selker. 2014. Hillslope runoff thresholds in shrink-swell clay soils. *Hydrological Processes*. doi:10.1002/hyp.10165.

Five other publications of significance

1. **Stewart, R. D.**, Z. Liu, D. E. Rupp, C. W. Higgins and J. S. Selker. 2015. A new instrument to measure plot-scale runoff. *Geoscientific Instrumentation, Methods and Data Systems.* 4: 57-64. doi:10.5194/gi-4-57-2015.
2. **Stewart, R. D.**, D. E. Rupp, M. R. Abou Najm, and J. S. Selker. 2013. Modeling effect of initial soil moisture on sorptivity and infiltration. *Water Resources Research*. doi:10.1002/wrcr.20508.
3. **Stewart, R. D.**, M. R. Abou Najm, D. E. Rupp, and J. S. Selker. 2012. An image-based method for determining bulk density and the soil shrinkage curve. *Soil Science Society of America Journal*. 76(4):1 217-1221. doi: 10.2136/sssaj2011.0276n.
4. **Stewart, R. D**., M. R. Abou Najm, D. E. Rupp, and J. S. Selker. 2012. Measurement tool for dynamics of soil cracks. *Vadose Zone Journal*. 11(2). doi:10.2136/vzj2011.0048.

5. **Stewart, R. D.**, R. W. Hut, D. E. Rupp, H. Gupta, and J. S. Selker. 2012. A resonating rainfall and evaporation recorder. *Water Resources Research*. 48(8): W08601. doi: 10.1029/2011WR011529.

d. Synergistic Activities

1. Convener/Co-Convener: "Applying Soil Physics to Soil Health," Soil Science Society of America Annual Meeting (2017); "Soil Physics and Hydrology Division Student Competition," Soil Science Society of America Annual Meeting (2017); "Understanding Hydrogeophysical States and Fluxes: Connecting Point Scale Information with Remote Sensing," American Geophysical Union Fall Meeting (2015).
2. Reviewer: Panel Member, National Science Foundation, Engineering Directorate, CBET Division (2016; 2017); Panel Member, National Science Foundation, Geosciences Directorate, Graduate Research Fellowship Program (2015); Journal Reviewer (34 total in 19 different journals).
3. Committee Member: S483 Don and Betty Kirkham Soil Physics Award, Soil Science Society of America Soil Physics and Hydrology Division (2016-present); Virginia Tech, College of Agriculture and Life Sciences, Graduate Education Committee for the proposed School of Plant and Environmental Sciences (2015-2016); Virginia Tech, Crop & Soil Environmental Sciences Dept., Graduate Seminar Committee (2014-present)
4. Member: Multi-State Project W3188: Environmental Soil Physics (2014-present)

Kang Xia
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Virginia Tech
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a. Professional Preparation

Beijing Agricultural University	Soil Chemistry	B.S.	1989
Louisiana State University	Soil Chemistry	M.S.	1993
University of Wisconsin-Madison	Soil Chemistry	Ph.D.	1997
University of Wisconsin-Madison	Environmental Chemistry (Postdoctoral Associate)		1997-1998

b. Appointments

2016 to present	Professor, Dept. Crop & Soil Environ. Sci., Virginia Tech
2011 to 2016	Associate Professor, Dept. Crop & Soil Environ. Sci., Virginia Tech
2006 to 2011	Director for Research Division and Industrial and Agricultural Services Division, Mississippi State Chemical Laboratory
2010 to 2011	Associate Professor, Dept. of Chemistry, Mississippi State University
2006 to 2010	Assistant Professor, Dept. of Chemistry, Mississippi State University
2002 to 2005	Assistant Professor, University of Georgia
1998 to 2001	Assistant Professor, Kansas State University
1997 to 1998	Postdoctoral Researcher, University of Wisconsin-Madison

c. Publications

[out of 52 peer-reviewed journal publications and book chapters]

5 most related:

1. Chen, C. Q., and **K. Xia**. 2017. Fate of Land Applied Emerging Organic Contaminants in Waste Materials. Current Pollution Reports. Curr. Pollution Rep. 3:38-54.
2. Ray, P*, C.Q. Chen, K. F. Knowlton, A. Pruden, and **K. Xia**. 2017. Fate and effect of antibiotics in beef and dairy manure during static and turned composting. J. Environ. Qual. 46:45-54.
3. Kulesza, S. B., R. O. Maguire, **K. Xia**, J. Cushman, K. F. Knowlton, and P. Ray. 2016. Impact of manure injection on pirlimycin transport in surface runoff. J. Environ. Qual. 45:511–518.
4. Chao Q., D. Troya, C. Shang, S. Hildreth, R. Helm, and **K. Xia**. 2015. Surface Catalyzed Oxidative Oligomerization of 17β-estradiol by $Fe3^{+}$-Saturated Montmorillonite. Environ. Sci. Technol. 49:956–964.
5. Ray, P., K.F. Knowlton, C. Shang, and **K. Xia**. 2014. Method development and validation: solid phase extraction (SPE)-ultra performance liquid chromatography-tandem mass

spectrometry (UPLC-MS/MS) quantification of pirlimycin in bovine feces and urine. J AOAC International. 97:1730-1736.

5 other significant publications:

6. Ray, P., K.F. Knowlton, C. Shang, and **K. Xia**. 2014. Development and validation of a UPLC-MS/MS method to monitor cephapirin excretion in dairy cows following intramammary infusion. PLOS ONE. 9:1-12.
7. Gunatilake, S. R., J. W Kwon, T. E. Mlsna, and **K. Xia**. 2014. A novel approach to determine estrogenic hormones in swine lagoon wastewater using QuEChERS method combined with solid phase extraction, and LC/MS/MS analysis. Anal. Methods. 6:9267 – 9275.
8. Fahrenfeld, N., K. Knowlton, L. A. Krometis, W. C. Hession, **K. Xia**, E. Lipscomb, K. Libuit, B. L. Green, A. Pruden. 2014. Effect of Manure Application on Abundance of Antibiotic Resistance Genes and their Attenuation Rates in Soil: Field-Scale Mass Balance Approach. Environ. Sci. Technol. 48:2643–2650.
9. Keith A. Maruya, D. E. Vidal-Dorsch, S. M. Bay, J. W. Kwon, ***K. Xia***, and K. L. Armbrust. 2012. Organic contaminants of emerging concern in sediments and flatfish collected near outfalls discharging treated wastewater effluent to the Southern California Bight. Environ. Toxicol. Chem. 31:2683–2688.
10. ***Xia, K.***, G. Hagood, C. Childers, J. Atkins, B. Rogers, L. Ware, K. Armbrust, J. Jewell, D. Diaz, N. Gatian, and H. Folmer. 2012. Polycyclic Aromatic Hydrocarbons (PAHs) in Mississippi Seafood from Areas Affected by the Deepwater Horizon Oil Spill. Environ. Sci. Technol. 46 (10):5310–5318.

d. <u>Synergistic Activities</u>

Major advisor for graduate students in environmental chemistry; Panel member of the USDA Soil Process Program; Reviewer of approximately 20 papers and proposals every year; Associate Editor for Journal of Environmental Quality. Conduct interdisciplinary research to investigate mineral surface reactivity and soil organic C and N dynamics using synchrotron-based spectroscopic techniques, to study the environmental fate of emerging contaminants in animal waste and biosolids-affected soil and water environment, and to develop chromatographic analytical methods for detecting trace level organic contaminants.

Carl E. Zipper

Professor, Crop and Soil Environmental Sciences;
and Director, Powell River Project.
Virginia Tech, Blacksburg VA 24061.
Phone: (540) 231-9782.
E-mail: czip@vt.edu

Summary

30+ years' professional experience dealing with issues that concern environment and energy, working at the interface of science and government policy.

Professional knowledge/experience of wide-ranging environment and energy topics, including:

- Water quality, air quality, ecosystems and at-risk species, climate change.
- Restoration of lands and waters affected by coal mining and other disturbances.
- Appalachian regional environmental issues, *e.g.* deforestation, water, invasive plants.
- Policy applications of federal statutes, including: Clean Water Act, Surface Mining Control and Reclamation Act, Endangered Species Act, Clean Air Act.

Recognized expertise in the above subject areas: national and regional awards; author / co-author of >100 peer-reviewed publications; invited advisory service, etc.

Education

1970	B.A.	Lehigh University. Bethlehem, PA. Social Science.
1981	B.S.	Virginia Tech. Agronomy. Concentration: Environmental science.
1986	Ph.D.	Virginia Tech. Agronomy. Concentration: Soil science.
1987	M.S.	Virginia Tech. Agricultural Economics. Concentration: Environmental policy.

Employment History, Professional Appointments

1996 -	present	Member of the tenure-track faculty, Virginia Tech (currently Professor)
1997 -	present	Director, Powell River Project, Virginia Tech.
1989 -	2003	Associate Director, Center for Coal and Energy Research, Virginia Tech.
1986 -	1996	Research Associate and Research Scientist, Virginia Tech.
1981 -	1986	Graduate student, Virginia Tech.

Responsibilities and Experience

Dr. C.E. Zipper conducts research, teaching, and outreach addressing environmental issues of societal concern with emphases on energy-environment interactions and the interface of science with policy. His primary focus is Appalachian environmental issues, including those related to coal. He teaches classes that focus on air quality, water quality, and global issues including climate change. His is also knowledgeable of Clean Water Act applications, energy infrastructure (coal, gas, power), and other environmental topics. He leads Powell River Project, a mine reclamation research and education program that has generated >$8 million to support >40 M.S. and Ph.D. degrees and >100 peer-reviewed publications under his direction. With Virginia Center for Coal and Energy Research, he conducted research on economic and policy issues concerning coal, electric power, and renewable energy, including studies for the Virginia General Assembly. He serves Virginia Department of Environmental Quality, US Office of Surface Mining, and the Clinch-Powell Clean Rivers Initiative in science advisory capacities; and has international experience including advisory service to the International Energy Agency.

Recognitions and Accomplishments

(See http://cses.vt.edu/people/teaching-research-extension-faculty/czipper.html for additional detail)

Selected Awards:

Virginia Tech: Scholar of the Week, 10-14 April 2017.
American Society of Mine Reclamation: William Plass Award for career achievement (2016)
Tennessee River Aquatic Biodiversity Network: Management / Science Award (2016)
Virginia Tech: Alumni Award for Excellence in University Outreach (2012)

Recent Publications, Selected: (**s designate graduate students advised or co-advised by CEZ)*

Greer B, T Burbey, CE Zipper, E Hester. Electrical resistivity imaging of hydrologic flow through surface coal mine valley fills with comparison to other landforms. Hydrol. Proc. (in press).

Clark EV*, CE Zipper *et al.*, 2017. Modeling patterns of total dissolved solids release from central Appalachia USA mine spoils. J. Environ. Qual. 46:55–63.

Oliphant AJ,* RH Wynne, CE Zipper *et al.* 2017. Autumn olive (*Elaeagnus umbellata*) presence and proliferation on former surface coal mines in eastern USA. Biol. Invasions 19:179-195

Skousen JG, CE Zipper *et al.* 2017. Review of passive systems for acid mine drainage treatment. Mine Water Environ. 36:133-153.

Boehme EA*, CE Zipper *et al*., 2016. Temporal dynamics of benthic macroinvertebrate communities and their response to elevated specific conductance in Appalachian coalfield headwater streams. Ecol. Indic. 64:171–180.

Clark EV*, CE Zipper. 2016. Vegetation influences near-surface hydrological characteristics on a surface coal mine in eastern USA. Catena 139: 241–249.

Krenz RJ*, SH Schoenholtz, CE Zipper. 2016. Riparian subsidies and hierarchical effects of ecosystem structure on leaf breakdown in Appalachian coalfield constructed streams. Ecol. Eng. 97:389-399.

Zipper CE *et al.* 2016. Spatial and temporal relationships among watershed mining, water quality, and freshwater mussel status in an eastern USA river. Sci. Tot. Environ. 541: 603-615.

Evans DM, CE Zipper, *et al.* 2015. Hydrologic effects of surface coal mining in Appalachia. J. Am. Water Res. Assoc. (JAWRA) 51: 1436–1452.

Li J, CE Zipper *et al.* 2015. Reconstructing disturbance history for an intensively mined region by time-series analysis of Landsat imagery. Environ. Mon. Assess. 187: 557.

Timpano A*, S Schoenholtz, D Soucek, C Zipper. 2015. Salinity as a limiting factor for biological condition in mining-influenced central Appalachian headwater streams. JAWRA 51: 240-250.

Evans DM, CE Zipper, *et al.* 2014. Long-term trends of specific conductance in waters discharged by coal-mine valley fills in central Appalachia, USA. JAWRA 50: 1449-1460.

Price JE, CE Zipper *et al.* 2014. Water and sediment quality in the Clinch River, Virginia and Tennessee, USA, over nearly five decades. JAWRA 50: 837–858.

Zipper CE *et al.* 2014. Freshwater mussel population status and habitat quality in the Clinch River, Virginia and Tennessee, USA. JAWRA 50: 807–819.

Zipper CE *et al.* 2013. Rebuilding soils on mined land for native forests in Appalachia, USA. Soil Sci. Soc. Am. J. 77: 337-349.

Sen S*, CE Zipper *et al.* 2012. Identifying revegetated mines as disturbance/recovery trajectories using an interannual Landsat chronosequence. Photo. Eng. Rem. Sens.78: 233-235.

Zipper CE et al. 2011. Forest restoration potentials of coal mined lands in the eastern United States. J. Environ. Qual. 40:1567-1577.

Zipper CE, JG Skousen. 2010. Influent water quality affects performance of passive treatment systems for acid mine drainage. Mine Water Environ. 29:135-143.

Appendix III – Example Position Descriptions

1: Atmosphere-Landscape Interactions. We seek to hire a scientist with expertise in characterizing the physics, chemistry, and biological processes associated with material and energy fluxes at the atmosphere-landscape interface. The scientist should be capable of measuring, monitoring, and modeling near-surface atmospheric processes and/or fluxes along the soil-plant-atmosphere continuum. The ideal candidate would be capable of modeling these interactions in complex systems and terrain, from the plant scale to the regional scale, and would be able to provide the local, regional and global implications of such work in relation to broader societal issues. This is envisioned as a research-teaching position. The individual hired into this position could teach new undergraduate courses in Air Quality and Pollution Science for the ENSC program. Major federal funding that could be garnered by an individual with this expertise includes: USEPA funds a broad range of research concerning air quality issues, as a means of aiding its enforcement of the Clean Air Act (http://www.epa.gov/air/criteria.html); NSF Atmospheric Chemistry; USDA-AFRI Climate Change; USEPA STAR.

2: Urban Restoration Ecology. We seek to hire a scientist that focuses on the role of plant and soil ecology in conservation, restoration, and enhancement of ecosystem services in built and disturbed environments. The scientist should have interdisciplinary research and teaching expertise that will contribute to the characterization and restoration of environmental sustainability and be able to address the impacts of climate change on the plant ecology of urban to peri-urban to rural environments. Areas of research could include, but are not limited to, ecophysiological responses of the urban flora to climate change, identification and enhancement of ecosystem services, ecological restoration and management of built and disturbed environments, floral dynamics with climate change, and interactions of the planted and spontaneous peri-urban flora. A PhD in ecology, ecophysiology, restoration, community ecology, or related disciplines is expected. Interactions and collaborations with the Virginia Tech National Capital Region campus and the Baltimore Ecosystem Study LTER are encouraged. The candidate is expected to establish an internationally recognized program in plant-soil restoration ecology, and train undergraduate and graduate students in the field. Funding for such a program is expected to come from several areas including NSF Environmental Biology, NSF Population and Community Biology, NSF Coupled Natural-Human Systems, NSF Long Term Ecological Research, Chesapeake Bay funding agencies and organizations, and USDA-NIFA.