VIRGINIA TECH Department of

FOREST RESOURCES AND ENVIRONMENTAL CONSERVATION

Highlights of 2013

Cover and title page photographs by
J. R. Seiler

Highlights of 2013

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OVERVIEW OF THE DEPARTMENT

This report highlights accomplishments in learning, discovery, and engagement in the Department of Forest Resources and Environmental Conservation (FREC) during 2013. The department continues to be one of the leading programs of its type and is poised to achieve even higher levels of excellence in the future. According to the *Quacquarelli Symonds (QS) World University Rankings 2014*, the forestry program in the Virginia Tech College of Natural Resources and Environment placed in the top 100 in the *World University* rankings. Following are a few key accomplishments and challenges of 2013.

Learning: Undergraduate enrollment remained steady at 196 in Fall Semester 2013. Virginia Tech's decision to move away from the Academic Common Market was detrimental to FREC's undergraduate enrollment by more than 20 students lost from Maryland and other areas. We have formally launched our new Environmental Informatics undergraduate major, and the new undergraduate degree, Water: Resource, Policy, and Management, is in the final phase of the approval process.

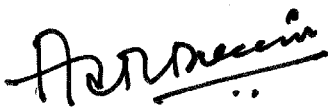
Discovery: You will note from the graph on page 21 that our research expenditures were stable in 2013. You will also note from the list of refereed publications that our faculty members are actively engaged in advancing the boundaries of science. Graduate enrollment continues to be at record high levels. We are very proud of our graduate students who organized the 5th FREC Graduate Research Symposium so successfully! It attracted participants from various departments across campus and from several other universities.

Engagement: Our extension programs are more vibrant than ever. We are proud of the accomplishments and awards that our extension faculty and specialists won during 2013. Of particular note, FREC was able to advance Dr. Scott Barrett from an extension specialist to tenure-track faculty!

New Horizons: FREC is blessed with several new opportunities:

- Two new tenure-track Assistant Professors (one in Policy and the other in Ecohydrological Modeling and Informatics) have been hired.
- We are in the final phase of the search process to fill the vacancy left by the retirement of Dr. Shep Zedaker.

I cannot list all the awards and accomplishments of our faculty and students here, but let me say that they always make the department proud. We deeply appreciate the solid support from our alumni, friends, and clientele groups throughout the forestry community, and we look forward to the challenges and opportunities ahead.



Janaki Alavalapati
Department Head

NEW FACES IN FREC

Dr. Kelly Cobourn, Assistant Professor, is a natural resource economist with research interests in the area of water resource policy and law, applied econometrics, bio-economic modeling, and invasive species management. Dr. Cobourn's teaching responsibilities include an undergraduate course in water policy, law, and economics and a graduate course in natural resource economics.

She received a Ph.D. in Agricultural and Resource Economics from the University of California, Davis; an M.S. in Resource Economics from the University of Maine; and a B.A. in Economics from the University of Virginia.

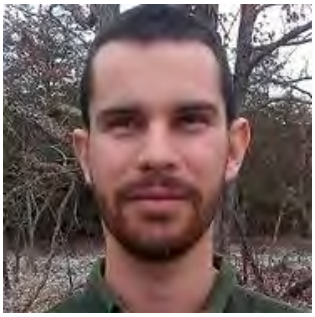
Dr. Alycia Crall is Coordinator of the Virginia Master Naturalist Program. She came to Virginia Tech from Rutgers University, where she was serving as a postdoctoral researcher on an NSF-funded grant to initiate citizen science projects with the Virginia Master Naturalist program. Dr. Crall earned her undergraduate degrees in Environmental Health Science and Ecology at the University of Georgia, her master's degree in Ecology at Colorado State University, and her Ph.D. in Environmental Studies at the University of Wisconsin-Madison. For her dissertation research, she helped develop and implement a national invasive species citizen program, working extensively with volunteers in Colorado and Wisconsin. She was also instrumental in the development of the website www.CitSci.org, which provides community groups with online resources to collect, analyze, and disseminate data from their citizen science projects.

Dr. Quinn Thomas, Assistant Professor, joined FREC from the National Center for Atmospheric Research in Boulder, Colorado, where he was a postdoctoral researcher in the Terrestrial Sciences Section of the Climate and Global Dynamics Division. His research focuses on carbon, nitrogen, and energy dynamics in forest ecosystems using statistical, ecosystem, and Earth system models. Dr. Thomas's extensive use of large datasets and models that require state-of-the-art computational resources is aligned with expertise required for the new Environmental Informatics major. He will teach courses in ecosystem-climate interactions and forest ecosystem modeling.

Dr. Thomas received his A.B. in Environmental Biology from Dartmouth College, his M.S. in Natural Resources from the University of New Hampshire, and his Ph.D. in Ecosystem Ecology from Cornell University.

Timothy Albaugh is a Research Associate and the Data Manager and Analyst for the Forest Productivity Cooperative. His research interests include management of site resource availability, plantation productivity, and loblolly pine ecophysiology.

Dr. Evan Brooks is a Postdoctoral Associate in the area of remote sensing. His current research foci include regional modeling of loblolly pine growth and yield, regional land surface change detection and monitoring, and developing multitemporal analysis tools for use by researchers. His interests include the above as well as working with big data, programming, and communicating climate change issues.



Dr. Kathleen Guillozet is a Postdoctoral Associate working with Assistant Professor Mike Sorice, adjunct faculty member Christopher Anderson, and other collaborators on a research project investigating human perceptions and socio-ecological thresholds for ecosystem restoration in Tierra del Fuego. Dr. Guillozet is based in Ushuaia, Argentina, and is contributing to the portion of the project that looks at carbon dynamics in riparian forests and at policy implications of ecosystem service valuation approaches. She is interested in socio-ecological research, forest-based livelihoods, riparian forest management, ecosystem services, and associated markets.

John Haworth is the new FREC Futures Recruiter. His responsibilities include visiting high schools and community colleges, establishing contacts and relationships with guidance counselors, attending forestry and natural resources events, and reaching out to alumni and stakeholders to recruit potential students.

A Virginia Tech graduate in Environmental Resource Management, John's experiences and interests involve media and content marketing based on themes of natural resources. His expertise in these areas has enabled him to design both printed and online marketing materials and enhance FREC's social media presence.

Dr. David Mellor is Coordinator of the Citizen Science Project. He is a behavioral ecologist whose research interests have included the mating behaviors of cichlids—a diverse group of fish from Africa and Central America—and investigating the manner in which people understand and learn about science. He has worked with citizen scientists on monitoring invasive plant species in New York and New Jersey, monitoring common loons in New Hampshire, and collecting data on cichlid fish behavior. He joined FREC to work with Dr. Alycia Crall on sustaining ecological communities through citizen scientists and online collaboration.

Dr. Thomas Ochuodho is a Postdoctoral Associate working as part of an interdisciplinary team, under the supervision of Professor Janaki Alavalapati, on conducting regional economic impact analysis of a range of natural resources management issues, including bioenergy, forestry, and other natural resources.

Dr. Matthew Sumnall, Postdoctoral Associate, is working with Drs. Tom Fox, Randy Wynne, and Val Thomas on lidar applications in forestry. His specific research deals with use of lidar to separate overstory trees from understory vegetation in loblolly pine plantations. The goal is to develop more accurate methods to determine leaf area of both the overstory pines and the understory vegetation. This work is supported by the Forest Productivity Cooperative.

Katie Trozzo is an Extension Project Associate working with Dr. John Munsell. Her interests include agroforestry adoption, outreach prioritization, and landowner network development and capacity building. Her current work aims to jumpstart agroforestry practices in the Chesapeake Bay region of Virginia by prioritizing subwatersheds to initiate landowner networks and extension programs that support the use of riparian buffer and silvopasture practices.

RETIREMENTS

On January 31, 2014, **Dr. Shep Zedaker** retired after serving Virginia Tech and the Department of Forest Resources and Environmental Conservation for more than 32 years. Shep and his wife, Deb, have purchased a home in Venice, Florida, and plan to spend their retirement years sailing and enjoying life.

PERSONNEL

TENURE-TRACK FACULTY	POSITION	TERMINAL DEGREE	SPECIAL INTERESTS
Alavalapati, Janaki R. R.	Professor and Department Head	Ph.D., University of Alberta	Exploring market solutions for natural resources, energy, and environmental problems and issues at local, regional, and international levels
Amacher, Gregory S.	Julian N. Cheatham Professor of Forestry	Ph.D., University of Michigan	Natural resource and environmental economics; public economics and policy design; econometrics; international forest development
Aust, W. Michael	Professor	Ph.D., North Carolina State University	Impacts of forestry operations on soil and hydrology; ecology and management of forested wetlands and riparian areas; development and implementation of forestry best management practices
Barrett Scott M.	Assistant Professor and Extension Specialist	Ph.D., Virginia Tech	Forest operations and biomass utilization; logger education and the impacts of education on logging safety, productivity, and the implementation of sustainable forestry practices.
Bolding, M. Chad	Associate Professor	Ph.D., Oregon State University	Forest operations; harvesting; wood supply chain efficiency; biomass utilization
Brunner, Amy M.	Associate Professor	Ph.D., Oregon State University	Genomics of tree development, ecophysiology, and adaptation; molecular genetics of tree maturation, flowering, and crown architecture; epigenetic mechanisms and small RNAs in trees; long-distance signaling in trees; tree biotechnology
Burkhart, Harold E.	University Distinguished Professor	Ph.D., University of Georgia	Development of growth and yield prediction techniques; application of statistical methods to forest measurement problems
Cobourn, Kelly M.	Assistant Professor	Ph.D., University of California-Davis	Natural resource economics, applied econometrics, bio-economic modeling, water resource policy, invasive species management
Copenheaver, Carolyn A.	Associate Professor	Ph.D., Pennsylvania State University	Dendrochronology; land-use history; vegetation distribution; stand dynamics
Day, Susan D. (Joint appointment with Department of Horticulture)	Assistant Professor	Ph.D., Virginia Tech	Urban forestry, including urban runoff mitigation, urban soils (rehabilitation and modeling effects on urban forest canopy), construction damage, buried root systems, urban rhizosphere
Fox, Thomas R.	Professor	Ph.D., University of Florida	Forest fertilization and tree nutrition; forest soils; silviculture of southern pine plantations and Appalachian hardwoods; silvicultural practices to restore productivity and health of forest ecosystems; sustainability of managed forests
Holliday, Jason A.	Assistant Professor	Ph.D., University of British Columbia	Understanding the genetic basis for complex adaptive traits in widely distributed tree species, as well as molecular studies of abiotic stress and conservation genetics.
Hull, R. Bruce	Professor	Ph.D., Virginia Tech	Public ecology and sustainability; human dimensions of natural resource management; negotiation of acceptable environmental quality; forest fragmentation and urbanization; recreation
McGee, John A.	Associate Professor and Geospatial Extension Specialist	Ph.D., University of Massachusetts-Amherst	Natural resource management; geospatial applications; technology transfer
McGuire, Kevin J.	Assistant Professor	Ph.D., Oregon State University	Watershed, hillslope, and forest hydrology; runoff generation processes; tracer and isotope applications in hydrology; land use and climate change effects on watershed processes and water quality; forest watershed management; interactions between hydrology and biogeochemistry

Munsell, John F.	Associate Professor and Extension Specialist	Ph.D., SUNY College of Environmental Science and Forestry	Forest management extension; private forest stewardship; collaborative conservation; integrated natural resources problem solving
Prisley, Stephen P.	Associate Professor	Ph.D., Virginia Tech	Quantitative and spatial analysis of natural resources for management planning, including spatial harvest scheduling, inventory projection, and forest carbon modeling
Radtke, Philip J.	Associate Professor	Ph.D., University of Minnesota	Assessment and modeling of forest resources; evaluating models used in forestry and ecology; acquisition, management, and analysis of data
Schoenholtz, Stephen H.	Professor and Director of the Virginia Water Resources Research Center	Ph.D., Virginia Tech	Forest management impacts on water and soil quality; restoration of degraded ecosystems; ecology and management of forested wetlands and riparian zones; biogeochemistry; criteria and indicators of sustainable forest management
Seiler, John R.	Alumni Distinguished Professor	Ph.D., Virginia Tech	Forest tree physiology; physiological applications in silviculture; multimedia, computer innovations for teaching forestry
Sorice, Michael G.	Assistant Professor	Ph.D., Texas A&M University	Natural resource recreation; human dimensions of natural resource management; conservation on private lands; research methods
Stern, Marc J.	Associate Professor	Ph.D., Yale University	Human dimensions of natural resource policy and management; environmental communications; protected areas management; international conservation; natural resource management effectiveness; attitudes vs. actions; public responses to natural resource management; evaluation of environmental education and other outreach programs; research methods
Strahm, Brian D.	Assistant Professor	Ph.D., University of Washington	Understanding relationships between soil properties and processes in order to better predict how external forces (e.g., forest management, land use, or global change) affect soil/ecosystem function (e.g., carbon sequestration, forest productivity)
Sullivan, Jay	Professor	Ph.D., University of California, Berkeley	Forest resource economics and management; regional economics; forest landowner behavior and incentives
Thomas, R. Quinn	Assistant Professor	Ph.D., Cornell University	Understanding the interactions between forests and global environmental change working across a wide range of spatial scales using ecosystem and Earth system models, remote sensing, large dataset analysis, and whole-ecosystem experiments
Thomas, Valerie A.	Assistant Professor	Ph.D., Queen's University	Remote sensing of forest canopy structure and function using lidar and hyperspectral technology; integration of these data with micrometeorological measurements to model canopy-scale photosynthesis; evaluation of the impact of local heterogeneity on estimates of carbon exchange
Wiseman, P. Eric	Associate Professor	Ph.D., Clemson University	Landscape tree establishment and maintenance; tree physiological responses to arboricultural treatments; urban soils; urban forest ecophysiology
Wynne, Randolph H.	Professor	Ph.D., University of Wisconsin-Madison	Application of remote sensing to forestry, natural resource management, environmental monitoring, carbon management, ecosystem services, and Earth systems modeling

RESEARCH PROFESSORS	POSITION	TERMINAL DEGREE	SPECIAL INTERESTS
Marion, Jeffrey L.	Adjunct Faculty*	Ph.D., University of Minnesota	Recreation resources management; recreation ecology; park and wilderness management; ecotourism management *Unit Leader/Scientist, Cooperative Park Studies Unit, USGS Patuxent Wildlife Research Center
Merry, Frank D.	Research Associate Professor	Ph.D., University of Florida	International forest policy and economics

RESEARCH FACULTY	POSITION	TERMINAL DEGREE	SPECIAL INTERESTS
Albaugh, Timothy J.	Research Associate	M.F., Duke University	Management of site resource availability, plantation productivity, loblolly pine ecophysiology
Amateis, Ralph L.	Senior Research Associate	M.S., University of Florida	Statistical techniques applied to forestry problems; growth and yield modeling
Blinn, Christine E.	Research Scientist	Ph.D., Virginia Tech	Remote sensing; geographic information systems; statistical applications for natural resource inventory and management
Brooks, Evan B.	Postdoctoral Associate	Ph.D., Virginia Tech	Expansion and application of Landsat-based models and inputs to the southeastern US.
Guillozet, Kathleen H.	Postdoctoral Associate	Ph.D., Oregon State University	Socio-ecological research, forest-based livelihoods, riparian forest management, ecosystem services, and associated markets
Laviner, M. Andrew	Research Associate	M.S., North Carolina State University	Resource management in plantation forestry; silviculture, ecophysiology, and forest management
Ochuodho, Thomas O.	Postdoctoral Associate	Ph.D., University of New Brunswick	Natural resource economics and policy analysis; economic analysis of bioenergy development; application of computable general equilibrium modeling in assessing economy-wide impacts of forest policy, management, trade, and climate change; applied econometrics
Peer, Kyle R.	Research Associate and Superintendent, Reynolds Homestead Forest Resources Research Center	M.S., University of Maine, Orono	Vegetative propagation; clonal forestry; nursery and greenhouse production; tree breeding
Sheng, Xiaoyan	Research Associate	M.S., University of Saskatchewan	Functional genomics in forestry; biotechnology and molecular breeding of biomass forest trees
Shrestha, Raj K.	Research Scientist	Ph.D., University of the Philippines	Greenhouse gas fluxes and ammonia volatility following nitrogen fertilization in managed forests of the southeastern and northwestern United States
Sumnall, Matthew J.	Postdoctoral Associate	Ph.D., Bournemouth University	Use of lidar to separate overstory trees from understory vegetation in loblolly pine plantations
Walker, David M.	Research Associate	M.S., Virginia Tech	Woody biomass estimation and modeling, forest inventory methods, dendrochronology, forest entomology and pathology
Zhou, Lecong	Senior Research Associate	Ph.D., China Agricultural University	Genomics and bioinformatics of plant biotic and abiotic stresses

EXTENSION FACULTY	POSITION	TERMINAL DEGREE	SPECIAL INTERESTS
Crall, Alycia W.	Coordinator, Virginia Master Naturalist Program	Ph.D., University of Wisconsin	Citizen science, informal science education, environmental education, invasive species, interdisciplinary approaches to conservation, program evaluation, biological data integration
Gagnon, Jennifer L.	Coordinator, Virginia Forest Landowner Education Program	M.S., University of Florida	Landowner education; shortleaf and longleaf pine silviculture; uneven-aged management
Kidd, John B.	Coordinator, PINEMAP Intern Program	M.S., University of Arkansas; M.Ed., Auburn University	Education and extension for secondary students and the general public

Mellor, David T.	Coordinator, Citizen Science Project	Ph.D., Rutgers University	Citizen science, informal science education, environmental education, invasive species, behavioral ecology, sexual selection, student retention
Trozzo, Katie E.	Project Associate	M.S., Virginia Tech	Agroforestry adoption; outreach prioritization based on biophysical and social variables; multifunctional agroforestry riparian buffers; silvopasture; forest farming; non-timber forest product cultivation, harvesting, processing, and marketing; community-based participatory action research; landowner network development; and capacity building

ADJUNCT FACULTY

Anderson, Christopher B.	Professor	Institute of Polar Sciences, Natural Resources and Environment, National University of Tierra del Fuego, Argentina
Busby, Gwenlyn M.	Research Associate	School of Engineering and Applied Science, University of Virginia, Charlottesville, VA
Eisenbies, Mark H.	Research Hydrologist	USDA Forest Service, Southern Research Station, Mississippi State University, Mississippi State, MS
Horcher, Andy T.	Natural Resource Operations Manager	USDA Forest Service, Savannah River Site, Aiken, SC
Lakel, William A.	Water Quality Program Supervisor	Virginia Department of Forestry, Charlottesville, VA
Lawson, Steven R.	Senior Project Consultant	Resource Systems Group, Inc., White River Junction, VT
Maier, Christopher A.	Research Biological Scientist	USDA Forest Service, Southern Research Station, Research Triangle Park, NC
Mei, Chuansheng	Scientist II	Institute for Advanced Learning and Research, Danville, VA
Schilling, Erik B.	Senior Research Scientist	National Council for Air and Stream Improvement, Inc., Newberry, FL
Soucek, David J.	Associate Research Program Leader	Illinois Natural History Survey, Prairie Research Institute, University of Illinois
Sucre, Eric B.	Sustainability Scientist	Weyerhaeuser NR Company, Vanceboro, NC

EMERITUS FACULTY

Robert E. Adams
Gregory N. Brown
Gregory J. Buhyoff
James A. Burger
Otis F. Hall
Harry L. Haney, Jr.
John F. Hosner
J. Michael Kelly
Jeffrey L. Kirwan
W. David Klemperer
William A. McElfresh
Robert L. McElwee
Richard G. Oderwald
Marion R. Reynolds, Jr.
Joseph W. Roggenbuck
Robert M. Shaffer
David Wm. Smith
Harold W. Wisdom
Shepard M. Zedaker

TECHNICAL STAFF

Deborah H. Bird
David O. Mitchem
John A. Peterson
E. Talcott Roberts, Jr.
B. Clay Sawyers

OFFICE SUPPORT STAFF

Tiffany N. Brown
Kathryn C. Hollandsworth
Stacey A. Kuhar
Tracey S. Sherman
Suzanne C. Snow
Brooke M. Warrington

2013-14 DEPARTMENTAL COMMITTEES

Budget & Planning:
C. Bolding
K. Coleman
K. McGuire (Chair)
P. Radtke
T. Sherman
E. Wiseman

Facilities:
M. Aust (Chair)
J. Holliday
J. McGee
T. Roberts
M. Sorice

Graduate Affairs:
P. Braff
A. Brunner
S. Day (Chair)
B. Strahm
R. Wynne

Promotion & Tenure:
G. Amacher (Chair)
M. Aust
H. Burkhart
B. Hull
S. Schoenholtz
M. Stern
J. Sullivan

Undergraduate Affairs:
M. Aust
C. Copenheaver
J. Seiler
J. Sullivan
V. Thomas (Chair)

2014 FREC ADVISORY BOARD

Michael Cerchiaro, Forest Investment Associates, Atlanta, GA
Keith Cline, USDA Forest Service, Washington, DC
Brad Fuller, Huber Engineered Woods LLC, Crystal Hill, VA
Mike Hincher, The Forestland Group, LLC, Abington, VA
Franklin Jackson, Virginia State University, Petersburg, VA
Alan Jones, Bartlett Tree Experts, Charlottesville, VA
Brent Keefer, Hancock Timber Resource Group, Charlotte, NC
James Kuykendall, Glatfelter Pulp Wood Company, Spotsylvania, VA
Easton Loving (Chair-Elect), MeadWestvaco, Appomattox, VA
Ed Milhous, TreesPlease, Haymarket, VA
Ken Morgan, Morgan Lumber Company, Inc., Red Oak, VA
Chuks Ogbonnaya, Mountain Empire Community College, Big Stone Gap, VA
Danette Poole, Virginia Department of Conservation and Recreation, Richmond, VA
Paul Revell (Chair), Virginia Department of Forestry, Charlottesville, VA
Greg Scheerer, MeadWestvaco, Appomattox, VA
Edward Sontag, Enviva LLP, Richmond, VA
Darrel Williams, Global Science & Technology, Inc., Greenbelt, MD

Ex-Officio Members

- State Forester of Virginia, Virginia Department of Forestry
  Vacant
- Executive Vice President, Virginia Forestry Association:
  Paul Howe
- Forest Supervisor, USDA Forest Service-George Washington & Jefferson National Forests:
  Tom Speaks
- Station Director, USDA Forest Service–Southern Research Station:
  Robert Doudrick

SELECTED HONORS AND AWARDS

CHAD BOLDING received the 2012-13 Outstanding Faculty Award, Department of Forest Resources and Environmental Conservation.

AMY BRUNNER was named Scholar of the Week by the Office of the Vice President for Research. The goals of the Scholar of the Week are to recognize individuals while also telling people about research and scholarly activities at the university.

HAROLD BURKHART was named the Virginia Outstanding Scientist 2013 by the Governor's Office and Science Museum of Virginia. He also received the Forest Champion Award from the Forest Landowners Association, which was presented at the FLA National Convention in Coeur D'Alene, Idaho.

SUSAN DAY was named Scholar of the Week by the Virginia Tech Office of the Vice President for Research.

THOMAS FOX received the Society of American Foresters' Barrington Moore Award in Biological Science, which recognizes outstanding achievement in biological research leading to the advancement of forestry.

JENNIFER GAGNON received the Virginia Division Society of American Foresters Merit Award and the Virginia Tech Alumni Award for Excellence in Extension.

JOHN McGEE received the AmericaView Education Award presented by AmericaView, Inc., in honor of geospatial educational efforts and workforce development programs in Virginia and in support of AmericaView's Education Committee.

MARC STERN was named Fellow, Center for Leadership in Global Sustainability.

With co-author and M.S. student Bethany Avera, *BRIAN STRAHM* was awarded Best Paper of Session (General Forest, Range, and Wildland Soils), Soil Science Society of America 2013 International Annual Meeting.

VALERIE THOMAS received a 2013 Certificate of Teaching Excellence for the College of Natural Resources and Environment.

ERIC WISEMAN was named Teacher of the Week by the Virginia Tech Center for Instructional Development and Educational Research (CIDER). He was also co-instructor for the University Exemplary Program Award: Invest the Sustainable Future Program, which was awarded by the Office of the Provost and facilitated by CIDER.

FREC GRADUATE RESEARCH SYMPOSIUM

The fifth annual FREC Graduate Research Symposium was held on April 2, 2013. Graduate students came from across the Virginia Tech campus and from other universities to participate. Every year the symposium has grown, and in 2013 concurrent oral presentations were held to make the most of the day-long affair. The event featured 11 Ph.D. oral presentations, 8 M.S. oral presentations, and 20 poster presentations. Many of the FREC faculty were involved as moderators and judges.

The symposium was honored to host Carol Werner, Executive Director of the Environmental and Energy Study Institute in Washington, DC, as the keynote speaker. Dr. Paul Winistorfer, Dean of the College of Natural Resources and Environment; Dr. Dean Stauffer, Associate Dean for Academic Programs; and Dr. Janaki Alavalapati, FREC Department Head, also gave brief presentations.

2013 Symposium Winners

No photo available

Michelle Jusino
Biological Sciences
Ph.D. Oral Presentation

Paliza Shrestha
FREC
M.S. Oral Presentation

Cody Gillin
FREC
1st-2nd Place Tie – Poster

Maura Leveroos
FREC
1st-2nd Place Tie – Poster

Bethany Avera
FREC
3rd Place – Poster

The success of the symposium was due to the commitment and hard work of the symposium planning committee:

Maura Leveroos (Co-Chair)
Amy Werner (Co-Chair)
Bethany Avera
Beth Boehme
Cody Gillin
A.J. Lang
Kevan Minick

TEACHING

The College of Natural Resources and Environment (CNRE) is firmly committed to excellence in teaching. Our stated educational goals are: (1) to educate high-quality professionals who can function effectively in entry-level positions and assume positions of ever-increasing responsibility throughout their careers; (2) to provide graduate programs that combine (a) a high-quality faculty, (b) a student body selected from the best undergraduate degree recipients in this country and abroad, and (c) courses offering the most advanced knowledge in order to produce outstanding researchers, educators, and practitioners; (3) to provide students not enrolled in the college's majors with an understanding of renewable natural resources so they can assume leadership roles and foster a rational conservation ethic within the general public; (4) to effectively disseminate knowledge and to provide a new program of public service to the college's constituencies, which will enhance the benefits, goods, and services obtained from natural resources of the state and surrounding region.

Obviously, teaching is an extremely important part of the mission of the Department of Forest Resources and Environmental Conservation, and students—defined in the broadest sense—are a principal constituent. All members of the faculty participate in the teaching program, which includes formal undergraduate and graduate on-campus instruction and a variety of extension courses, including continuing education for professionals. Evaluations of these educational efforts continue to be outstanding. The overall evaluation for all formal courses taught by full-time FREC teaching faculty in Fall Semester 2013 was 5.42 out of a possible 6.0.

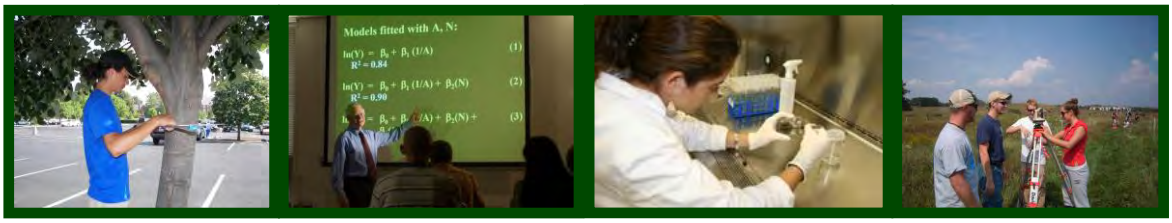
The Department of Forest Resources and Environmental Conservation now has four majors and eight options:

FORESTRY MAJOR
Forest Resource Management Option
Forest Operations and Business Option
Urban Forestry Option

NATURAL RESOURCES CONSERVATION MAJOR
Conservation and Recreation Management Option
Environmental Education Option
Natural Resources Science Education Option

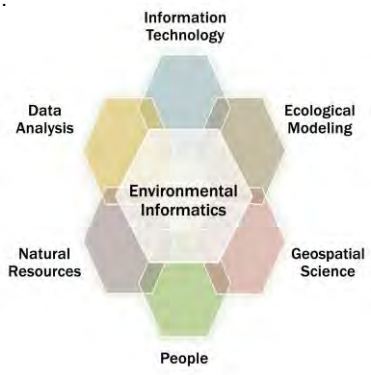
ENVIRONMENTAL RESOURCES MANAGEMENT MAJOR
Environmental Resources Management Option
Watershed Management Option

ENVIRONMENTAL INFORMATICS MAJOR
*** New in 2013 ***



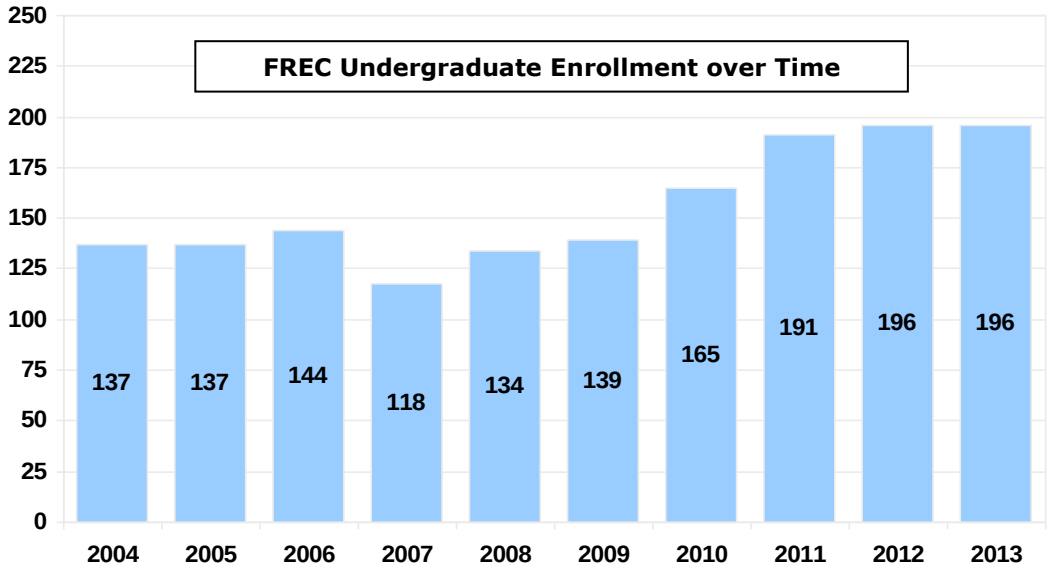
Environmental Informatics Major

A new FREC major, Environmental Informatics, made its debut in Fall Semester 2013. Environmental Informatics applies information science to the management of natural resources. It is designed to help students develop critical analytical and decision skills for the 21st century job market:

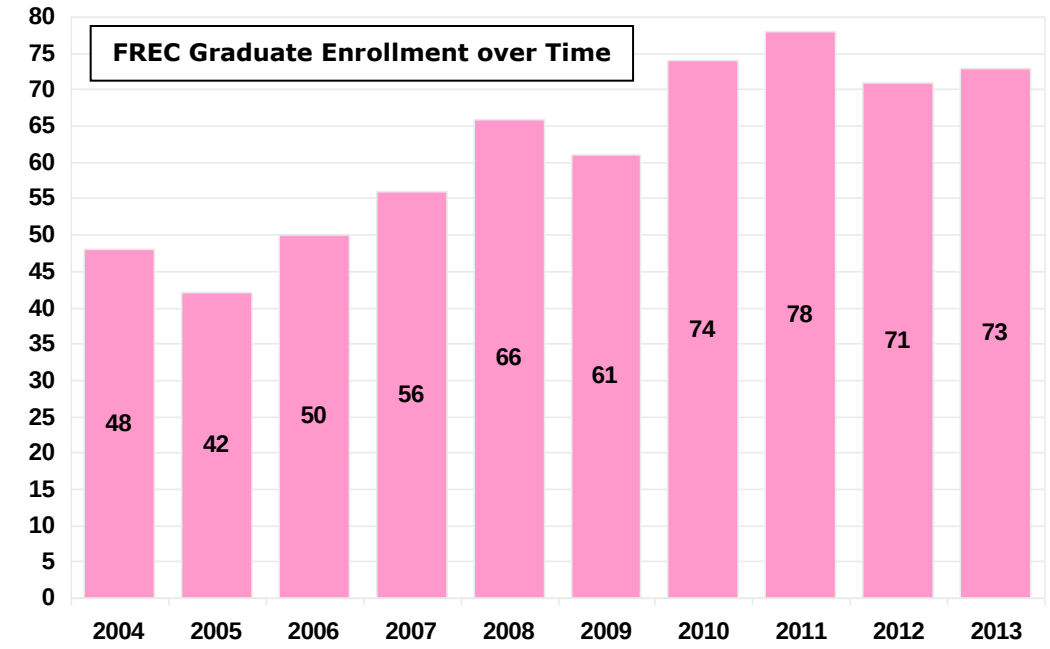


- Environmental problem solving
- Effective oral and written communications
- Mathematical and statistical modeling
- Remote sensing
- Geographic information systems (GIS)
- Ecosystem management
- Web and database management
- Spatial data analysis
- Sustainability analytics

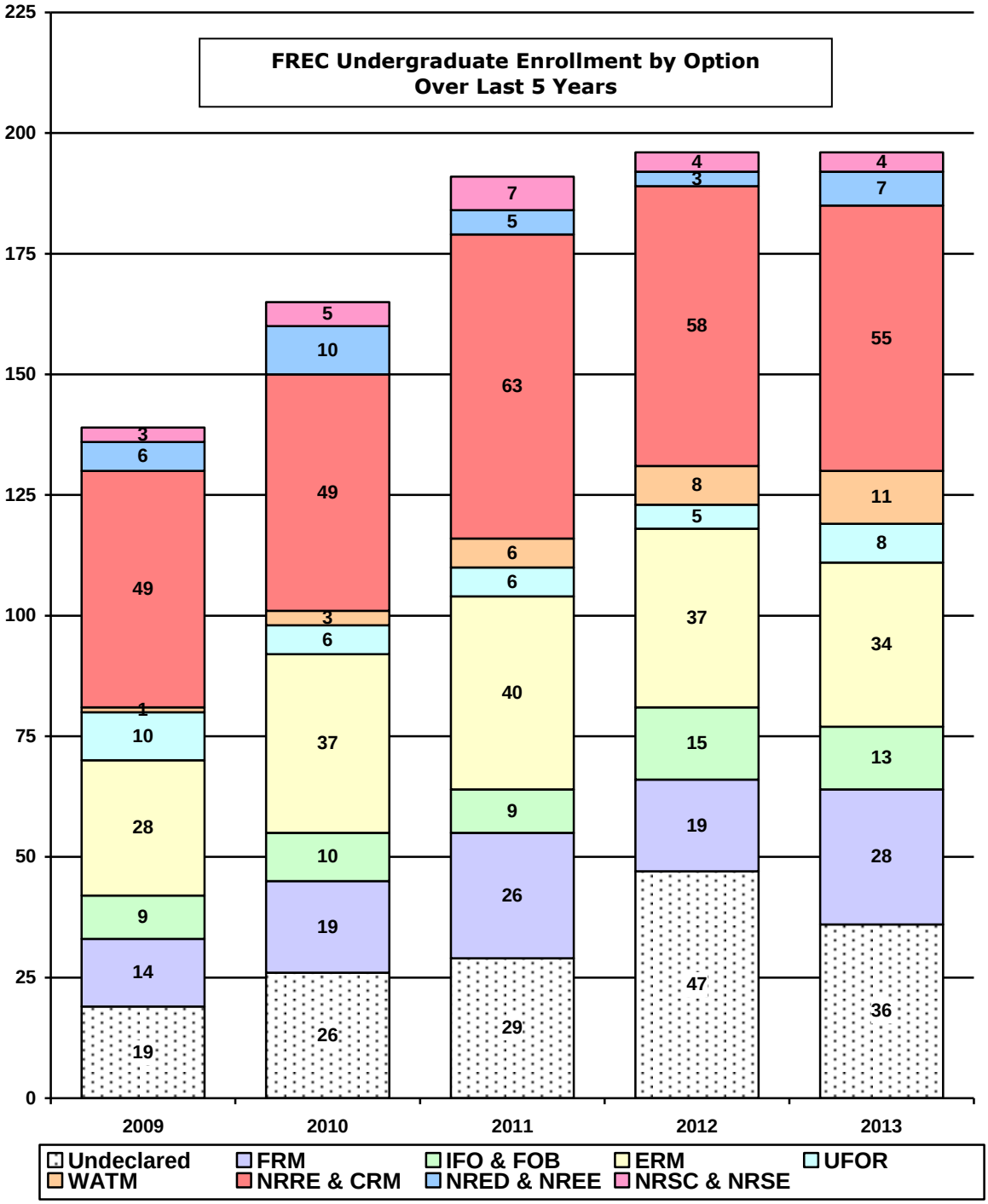
Environmental Informatics brings together science, technology, modeling, and analysis—enabling increased understanding and sustainable management of the natural world. Graduates of the Environmental Informatics Major will be part of a new wave of data scientists trained to handle vast amounts of data for different specialties.



The department's educational programs continue to thrive. There were 740 undergraduates in the College of Natural Resources and Environment in Fall Semester 2013; of these, 196 students—or approximately 26%—were in options associated with the Department of Forest Resources and Environmental Conservation.



There were 73 graduate students (42 Ph.D. and 31 master's) in our department Fall Semester 2013. We continue to have more qualified applicants to our graduate program every year than we have faculty, funds, and space to accommodate.


FREC Undergraduate Enrollment by Option
Over Last 5 Years
225
200
175
150
125
100
75
50
25
0
2009
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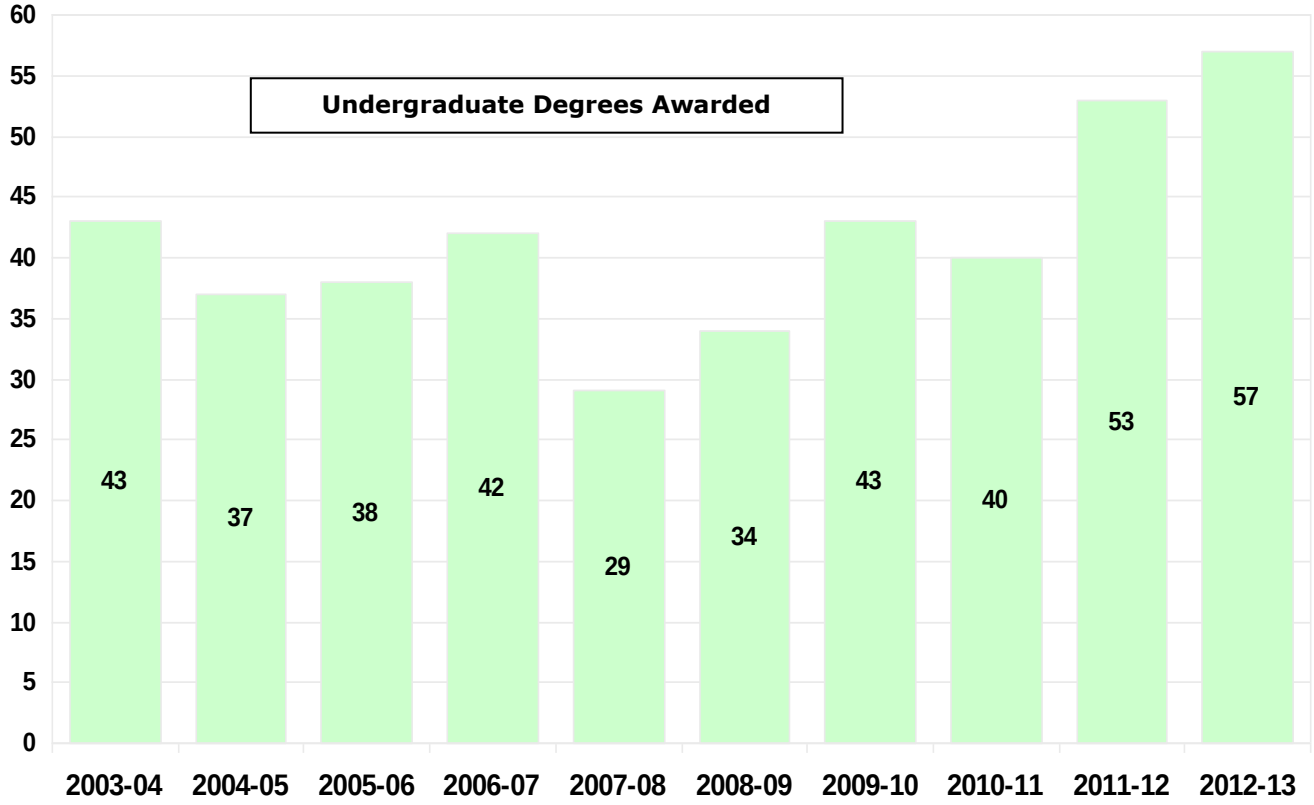
Undergraduate Degrees Awarded
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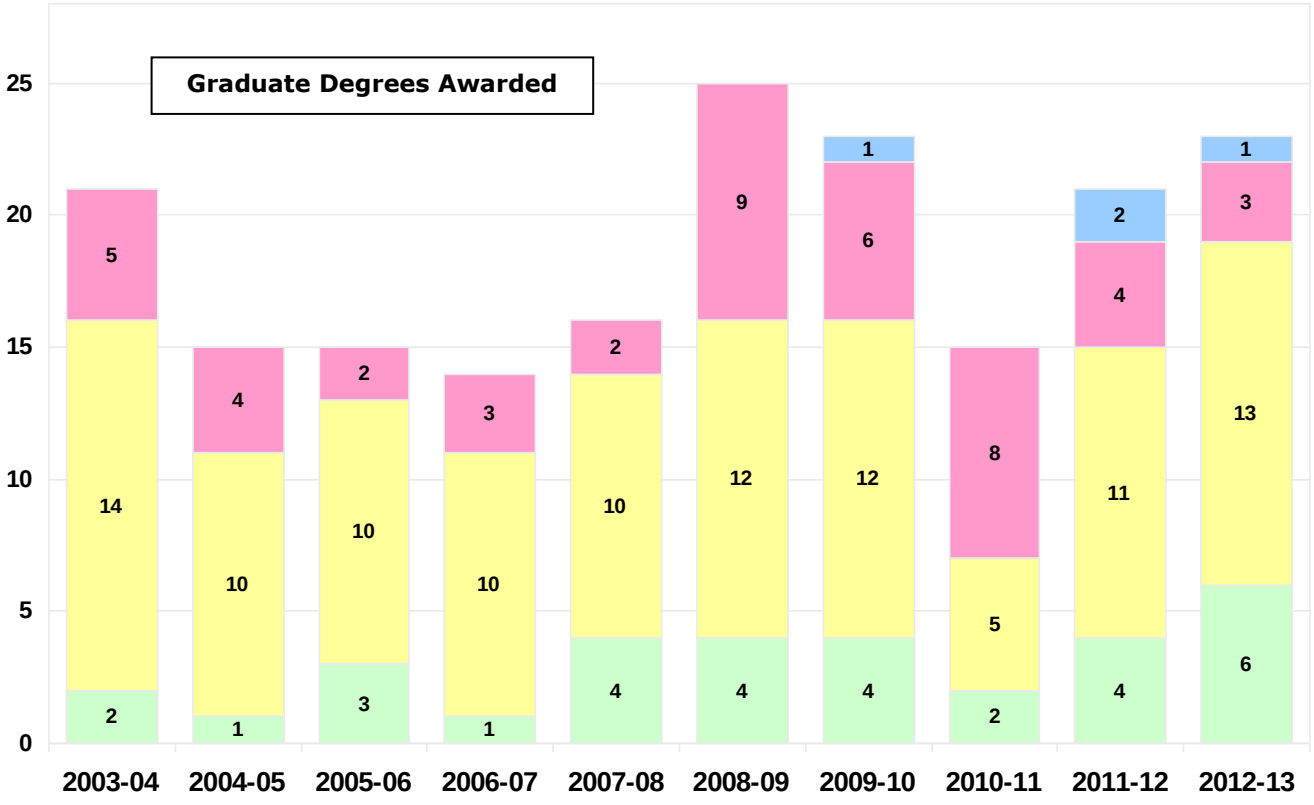
Graduate Degrees Awarded
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2004-05: 1, 10, 4
2005-06: 3, 10, 2
2006-07: 1, 10, 3
2007-08: 4, 10, 2
2008-09: 4, 12, 9
2009-10: 4, 12, 6, 1
2010-11: 2, 5, 8
2011-12: 4, 11, 4, 2
2012-13: 6, 13, 3, 1
M.F.
M.S.
Ph.D.
Ph.D. (GEA)

Graduate Degrees Awarded During Calendar Year 2013

Master of Forestry (4)	Graduate Chair(s)	Title of Paper
Chakurda, Taylor N.	J. Munsell	Whole-farm agroforestry planning for the proposed Springsbury Institute
Lang, Albert J.	M. Aust C. Bolding	Streamside management zones compromised by stream crossings, legacy gullies, and over-harvest in the Piedmont
Montecinos, Percy G.	T. Fox	Impact of fertilization and weed control on growth of loblolly, shortleaf, white and Virginia pine
Saville, Trevor E.	P. Radtke	Whole tree biomass estimators for white oak

Master of Science (14)	Graduate Chair(s)	Title of Thesis
Boehme, Elizabeth A.	S. Schoenholtz C. Zipper	Temporal dynamics of benthic macroinvertebrate communities and their response to elevated specific conductance in headwater streams of the Appalachian coalfields
Brousseau, Patricia A.	B. Strahm	Nitrate sorption in the soils of the Coweeta Hydrologic Laboratory
Gillin, Cody P.	K. McGuire	Digital terrain analysis to predict soil spatial patterns at the Hubbard Brook Experimental Forest
Leveroos, Maura K.	J. Sullivan	Economic viability of woody bioenergy cropping for surface mine reclamation
Lorentz, Laura J.	B. Strahm V. Thomas	Hyperspectral reflectance and stable isotopic nitrogen: Tools to assess forest ecosystem nitrogen cycling
McDonald, Kelly M.	J. Seiler	Eastern hemlock needle physiology as impacted by hemlock wooly adelgid and treatment with imidacloprid
McLean, Kevin D.	M. Stern	Interpreter attributes and their impact on visitor outcomes in National Park Service interpretive programs
Moore, Elizabeth A.	J. Munsell	Agroforestry preferences, identity, and potential collaboration among CAR refugees and host community Cameroonians in Adamaoua, Cameroon
Nichols, Lara K.	T. Fox B. Strahm	Relationships among soil properties and soil CO_2 efflux in a loblolly pine-switchgrass intercropped system
Ramsdell, C. Paxton	M. Sorice	Paying for nature: Incentives and the future of private land stewardship
Shockey, Melissa D.	P. Radtke	Incorporating climate sensitivity for southern pine species into the forest vegetation simulator

Shrestha, Paliza	J. Seiler B. Strahm	Greenhouse gas fluxes and root productivity in a switchgrass and loblolly pine intercropping system for bioenergy production
Suren, Haktan	J. Holliday	Architecture and evolution of xylem-related gene coexpression networks in poplars
Werner, Amy	T. Fox	Nitrogen release, tree uptake, and ecosystem retention in a mid-rotation loblolly pine plantation following fertilization with ^{15}N-enriched enhanced efficiency fertilizers.

Doctor of Philosophy (7)	**Graduate Chair(s)**	**Title of Dissertation**
Barrett, Scott M.	M. Aust C. Bolding	Operational characteristics, erosion potential, and implementation of forestry best management practices on biomass harvesting operations
Brooks, Evan B.	R. Wynne V. Thomas	Fourier series applications in multitemporal remote sensing analysis using Landsat data
Chen, Yujuan	S. Day	The influence of urban soil rehabilitation on soil carbon dynamics, greenhouse gas emission, and stormwater mitigation
Gyawali, Nabin	H. Burkhart	Modeling general response to silvicultural treatments in loblolly pine stands
Jia, Xiaoyan	A. Brunner E. Beers	Functional analysis of novel protein-protein interactions involving ROP GTPases in *Arabidopsis thaliana* and *Populus trichocarpa*
Kayastha, Nilam (GEA)	V. Thomas J. Galbraith	Application of light detection and ranging (lidar) and multi-temporal Landsat for mapping and monitoring wetlands
Kuusela, Olli-Pekka	G. Amacher	Three essays in natural resource and environmental economics

RESEARCH

The Department of Forest Resources and Environmental Conservation at Virginia Tech undertakes research in a number of focus areas. These include:

- biometrics and geomatics
- ecosystem science and management
- forest economics and policy
- forest genetics and biotechnology
- forest operations and business
- human dimensions of natural resources
- urban forestry
- water resources.

Funding from contracts and grants generated by the faculty totaled $3.73 million in fiscal year 2013. Twenty-three students completed graduate degrees in the Department of Forest Resources and Environmental Conservation during the 2012-13 academic year; 6 M.F., 13 M.S., and 4 Ph.D.s were awarded. Twenty-three new graduate students entered our graduate program during 2012-13.

Highlights of research activities during 2013 are contained on the following pages.

Research Expenditures

Biometrics and Geomatics

Research and outreach in forest biometrics and geomatics at Virginia Tech is focused on applying cutting-edge science and information technologies to address critical questions related to the measurement, modeling, management, and monitoring of natural resources. We aim to expand the frontiers of forest resources management through powerful new applications that merge remote sensing, computer and statistical modeling, and field studies, often synthesizing results and delivering them to policymakers and the public via geographic information systems (GIS) and internet technology.

Research in the biometrics and geomatics area falls into three broad categories: growth modeling and simulation, forest inventory and sampling, and remote sensing and geographic information systems.

Growth Modeling and Simulation

Growth and yield modeling consists of a continuous cycle of data collection, analysis, and interpretation. The Forest Modeling Research Cooperative (FMRC) is an outgrowth of the Loblolly Pine Growth and Yield Research Cooperative that was founded at Virginia Tech in 1979 for the purpose of developing growth and yield models for intensively managed loblolly pine plantations. Although loblolly pine remains a primary research thrust, we are addressing an expanded array of growth and yield modeling projects that span diverse species and production objectives and that include genetic improvement, management treatments, and environmental influences on forest productivity.

Forest Inventory and Sampling

Work is ongoing on developing improved methods for forest inventories, including methods to improve forest carbon estimates for the U.S. New biomass estimation procedures for national-scale forest inventories are being developed in collaboration with U.S. Forest Service researchers and scientists from five other universities. Use of forest inventory data for state and regional assessments is also a focus of biometrics/geomatics faculty engaged with the college's Center for Natural Resources Assessment and Decision Support (CeNRADS).

Remote Sensing and Geographic Information Systems

Net ecosystem productivity is being modeled for a wide range of management intensities using both *in situ* and remotely sensed data. Efforts are continuing to develop remote sensing applications needed to improve the statistical efficiency and spatial specificity of carbon monitoring and management in Virginia's timberland and urban forests. Geospatial analysis involves the combination of multiple sources of spatial data, each with differing source scale, timeliness, and reliability.

Ecosystem and Earth System Modeling

Forest carbon, nitrogen, and energy balances are being modeled at the stand- to global-scale using ecosystem models, remote sensing, and Earth system models. The interactions between forests and the changing environment (climate, nitrogen pollution, and land-use) are being simulated using high-performance computing. In particular, net ecosystem productivity is being modeled for a wide range of management intensities and climate scenarios.

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Economics and Policy

The faculty of the forest and natural resources economics section of the Department of Forest Resources and Environmental Conservation is engaged in a comprehensive research and teaching program that revolves around understanding use and exploitation of natural resources, both domestically and internationally, and designing policies to achieve a sustainable and socially-best use of forest and land resources. Concurrent with these objectives is to model and understand the behavior of forest landowners and users with multiple objectives and of agencies involved in public policy.

Some specific projects include:

- the economics of forest risks (fire, invasive species)
- the optimal design of ecosystem restoration, the development of woody-based alternative energy sources, and the design and implementation of natural resource policies to achieve various goals in the United States, Africa, Latin America, and Asia
- modeling developing country forest exploitation at community and regional levels
- understanding the implications of corruption and illegal logging along with design of better enforcement systems
- modeling the spatial nature of forest landowner and policy maker cooperation.

We visit these problems using a variety of quantitative methods drawn from economic theory, econometrics, and operations research. Our graduate students are trained in these quantitative methods while having freedom to tailor their programs to suit their specific interests.

Department faculty members in our section either currently serve or have served on editorial boards of a number of important scholarly journals in the field, including *Forest Science*, *Forest Policy and Economics, Journal of Forestry*, *Journal of Environmental Economics and Management*, *Natural Resource Modeling*, and *Journal of Forest Economics*, and serve on several advisory committees.

We have secured funding for projects from sponsors including the U.S. Departments of Agriculture and Energy, the National Science Foundation, the USDA Forest Service, and other international and national donors. Faculty teach graduate and undergraduate courses in forest economics, natural resource and environmental economics, forest management, and natural resource policy. Previous graduate students now hold positions in academia, private research think tanks, forest industry, the financial sector, international organizations, and government agencies.

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Dr. Frank Merry		fmerry@vt.edu
Dr. Jay Sullivan	(540) 231-4356	jsulliv@vt.edu

Forest Ecology

Forest ecology at Virginia Tech focuses on community ecology, dendroecology, historical ecology, and disturbance ecology. The research projects are directed towards examining human impacts on the environment, quantifying natural variation in ecosystems, and identifying detectable growth responses to climate. Some current research projects include:

- reconstructing stand dynamics in old-growth forests from tree-ring widths
- comparing the climatic response of sugar maples that have been repeatedly tapped for maple syrup production with untapped sugar maples
- monitoring invasive shrub species on Natural Area Preserves
- quantifying the ecological impact of recreation on forest communities
- identifying the response of eastern hemlock to infestation by hemlock woolly adelgid
- integrating wood anatomy and dendrochronology to identify historical frost patterns, insect outbreaks, and periods of drought.

Funding sources to support these research projects include Bureau of Land Management, Environmental Protection Agency, National Fish and Wildlife Foundation, United States Department of Agriculture, and Sustainable Engineered Materials Institute.

Results of our research are regularly presented at national and international conferences, including the International Tree-Ring Conference; Ecological Society of American Annual Meeting; Tree Rings Archeology, Climatology, and Ecology; and North American Forest Ecology Workshop.

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Forest Operations and Business

The Virginia Tech forest operations team works in four major research areas related to forest management activities:

- Evaluating operations with regard to safety, productivity, planning, and logistics
- Creating tools to improve the efficiency and profitability of forest operations
- Analyzing forest business issues such as supply chain management/biomass utilization
- Evaluating the environmental impacts of forest operations.

Comparison of Five Erosion Control Techniques for Bladed Skid Trails in Virginia

This study evaluated five bladed skid trail closure BMPs for erosion control in the Piedmont of Virginia. BMP closures evaluated were: (1) water-bar only (Water-bar); (2) water-bar and grass seed (Grass); (3) water-bar, grass seed, and straw mulch (Mulch); (4) water-bar and piled hardwood slash (H-Slash); and (5) water-bar and piled pine slash (P-Slash). The study was arranged as a randomized complete block design where six newly constructed trails provided six blocks. Five treatments were applied to five segments within each block. Erosion from the 30 treatment plots was captured in sediment traps and weighed monthly for 13 months, providing 78 erosion weights per treatment. Results indicate that Water-bar was the most erosive closure method (137.7 tonnes ha^{-1} yr^{-1}), followed by Grass (31.5 tonnes ha^{-1} yr^{-1}), H-Slash (8.9 tonnes ha^{-1} yr^{-1}), P-Slash (5.9 tonnes ha^{-1} yr^{-1}), and Mulch (3.0 tonnes ha^{-1} yr^{-1}). Overall, BMPs that provide soil coverage levels similar to either slash or mulch closure should provide good erosion control, and final selection should be based on costs, availability of material, or landowner objectives.

Treatment	Erosion (tonnes ha^{-1} yr^{-1})	
Water-bar	137.7	a
Grass	31.5	b
H-Slash	8.9	bc
P-Slash	5.9	cd
Mulch	3.0	d

Effectiveness of Best Management Practices for Sediment Reduction at Operational Forest Stream Crossings

Three skid trail stream crossing BMP treatments were installed and replicated three times to quantify BMP efficacy for reducing sedimentation. BMP treatments were: (1) slash, (2) mulch and grass seed, and (3) mulch, grass seed, and silt fence. Water samples were collected daily both upstream and downstream from operational skidder stream crossings for one year following timber harvesting and BMP treatment installation. Samples were evaluated for total suspended solids (TSS). Results indicate that both slash and mulch treatments effectively reduced TSS following harvesting. Slash could be the preferred method of stream crossing closure due to lower cost, especially if application is incorporated into logging operations. However, if slash was being utilized for biomass and was not available, seed and mulch is a viable option for stream crossing closure. The mulch, seed, and silt fence treatment was the most expensive treatment and led to increased TSS, probably due to silt fence installation disturbances near the streams. Thus, silt fences should not be installed directly adjacent to stream banks if other alternatives exist.

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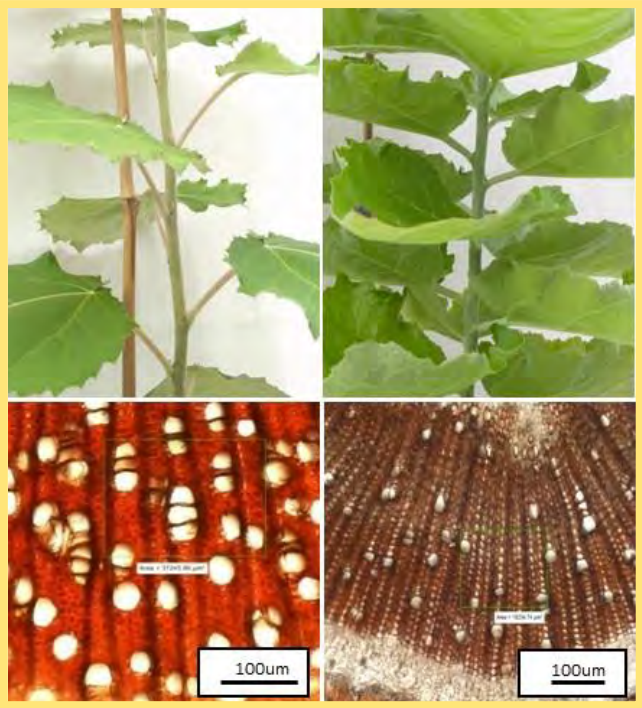
Genomics and Biotechnology

The genomics and biotechnology program focuses on identifying and characterizing genes and their regulatory interactions that control economically and ecologically important traits in forest trees. An ultimate goal is to translate fundamental tree biology research into tools and methods that can accelerate tree improvement for various end uses, including traditional wood products, bioenergy, and biomaterials. Our state-of-the-art laboratories are located in Latham Hall, and we also participate in the interdepartmental Molecular Plant Sciences Graduate Program (http://www.molplantsci.org.vt.edu/) based in Latham Hall. Our program is supported by grants from the National Science Foundation, U.S. Department of Energy, USDA National Institute of Food and Agriculture (NIFA), and the Virginia Agricultural Council.

Populus (Poplar) Functional Genomics and Field Testing

The structure, arrangement, and relative proportions of the specialized xylem cell types that constitute wood and the composition of their secondary cell walls determine the physical and chemical properties of wood and, hence, its suitability for specific commercial applications. Research in Amy Brunner's lab studies the regulation of wood formation in poplar using a variety of techniques. Funded by the DOE/USDA Plant Feedstock Genomics for Bioenergy Program, a collaborative project with Eric Beers in the Horticulture Department, Richard Helm in Biochemistry, and Allan Dickerman in the Virginia Bioinformatics Institute is continuing to map a large number of protein-protein interactions that occur during wood formation (http://xylome.vbi.vt.edu/). Drs. Brunner and Beers and doctoral student Stephen Rigoulot are also collaborating with colleagues at Oregon State University to map protein-protein interactions regulating responses to drought and other abiotic stresses. In addition to the mapping, doctoral students Xiaoyan Sheng, Earl Petzold, and post-doctoral fellow Bidisha Chanda are studying how these proteins affect growth and wood development in order to ultimately guide design of new strategies for molecular breeding of woody biomass crops. Ms. Sheng has identified a gene that regulates shoot elongation and radial growth, in part by affecting the biosynthesis of the phytohormone gibberellin. Drs. Brunner, Beers, and Helm are also collaborating on a new USDA-NIFA-funded project that seeks to discover new approaches to increasing tree growth and carbon partitioning to wood.



In collaboration with Harold Burkhart, GreenWood Resources, Inc., and the Virginia Department of Forestry, the top 12 performing clones from hybrid poplar screening trials are being validated in yield-verification trials planted in May-June of 2012 at the Appomattox-Buckingham State Forest and the Reynolds Homestead Forest Resources Research Center in Patrick County. The ultimate goal is to develop hybrid poplar as a bioenergy crop for Virginia that could also be grown for pulp, paper, and wood products.

Genomics of Climatic Adaptation

The capacity of the world's forests to provide ecosystem and economic services requires that adaptive traits of local populations track optimums enforced by their respective climatic conditions. With anthropogenic climate change substantially altering adaptive landscapes, natural tree populations will be forced to adapt, migrate, or be extirpated. Selection of families and clones for

the production of timber, pulp, and bioenergy feedstocks will face similar challenges. A technological revolution is currently underway that is rapidly making the genomics tools once reserved for model species available for use in trees. The research of Jason Holliday focuses on understanding the causes and consequences of natural genetic variation in complex adaptive traits in trees and in applying this knowledge to improve forest health and productivity. A better understanding of adaptive genetic variation facilitates genome-enabled breeding for the sustainable production of wood biomass, enables predictions of carbon sequestration in future forests under climate change, and enhances the adaptive potential of local populations through conservation of ecologically relevant genetic variation.

The population genomics group led by Dr. Holliday focuses primarily on the genera *Populus* (cottonwoods and aspens), *Picea* (spruce), and *Pinus* (pine), which contain the most economically and ecologically important tree species in the United States and for which extensive genomic tools have been developed. Our primary interest is in the genomic dissection of complex traits using association mapping and landscape genomics, which employ large natural populations and contemporary high-throughput sequencing to find the relevant genes. A significant current focus is the genus *Populus*, for which the National Science Foundation funded a study aimed at elucidating the genomic architecture of climatic adaptation. A recently developed sequence capture technology is being used to retrieve exons and regulatory sequences for all expressed genes in *P. trichocarpa* (black cottonwood), which have been sequenced in a replicated mapping population developed for this project. In addition to encompassing the wide latitudinal range of poplar, this population includes collections along altitudinal transects, which will allow us to better understand adaptation at coarse versus fine spatial scales. Associations are being sought with key adaptive traits (e.g., growth, bud phenology, cold hardiness, drought tolerance, etc.), as well as with climate variables that represent the principle environmental constraints related to these traits. Having planted our mapping population in two contrasting environments (Virginia and southwest British Columbia), we will be able to identify genotype-by-environment interactions, and using data provided by collaborators, comparative studies of adaptation will be undertaken in both *P. tremuloides* (trembling aspen) and *P. deltoides* (eastern cottonwood).

In addition to our work on poplars, we are involved in collaborations that have resulted in funded projects focused on spruce and pine. Loblolly pine is the preeminent softwood timber species in the United States, and the Holliday lab is part of the successful USDA NIFA Climate Change CAP (Coordinated Agricultural Project) proposal aimed at developing management strategies to mitigate and adapt loblolly pine forestry practices to climate change. Dr. Holliday is also collaborating on a Genome Canada funded project that uses genomics to facilitate predictions of climate change outcomes for two economically and ecologically important western tree species, lodgepole pine (*Pinus contorta*) and interior spruce (*Picea glauca x Engelmanii*). Extensive sequencing has been carried out in both natural populations and seed orchards (used for reforestation) to map adaptive loci and better understand the adaptive genomic portfolio of current deployment populations. In addition the results of this study will be used to develop new seed transfer policies aimed at maximizing productivity and adaptability of reforested lands.

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Human Dimensions of Natural Resources

Natural resource problems are created and solved by people. Our program emphasizes human organization and behavior as they relate to natural resources. We address a wide range of contexts, including land change, land management agency practices and policies, urbanization, conservation movements, environmental education, outdoor recreation visitor behavior and experience, collaborative community-based conservation, and sustainable development. We work both domestically and internationally on issues regarding the interactions between people, their environments, and the multiple competing interests associated with natural resource use.

The Human Dimensions faculty members employ a variety of qualitative and quantitative methods, often using mixed-methods approaches. We work at different scales of social organization—from individuals to institutions. We collaborate with experts from sociology, ecology, economics, political science, anthropology, communications, social psychology, urban planning, and public administration disciplines.

Current research is addressing:

How can web-based technologies support agroforestry education and outreach?
Forest farming is an agroforestry practice that intentionally cultivates edible, floral, medicinal, and craft products that grow underneath a forest canopy. Forest farming is an alternative to wild gathering that can tap into existing markets while also enhancing product consistency and resource sustainability. John Munsell is leading a national group of academics, agency personnel, and forest farmers that is developing web-based methods to support on-the-ground application. The project also includes a joint venture with the USDA Forest Service Southern Research Station to create procedures for a non-timber product output system that will provide market information to forest farmers via public reports and maps.

How can agroforestry be used to support refugee settlements?
Elizabeth Moore is a master's student working under the direction of John Munsell. She is studying preferences and procedures for agroforestry projects in support of refugees from the Central African Republic (CAR) that have crossed into Cameroon's East and Adamaoua provinces. The Diaspora, referred to as the hidden Darfur, is comprised predominantly of Mbororo, a tribe of nomadic cattle herders that has fled its villages due to violence, insecurity, and frequent kidnappings. Elizabeth's work uses illustrations and focus group data, along with land availability, to develop a decision-support framework for agroforestry projects.

Cross-sector partnership and collaboration
Sustainability leadership requires collaborations among businesses, government programs, and civil-society organizations. Faculty and students work with existing and forming partnerships around the world. For example, faculty and students traveled with the Center for Leadership in Global Sustainability to work on collaboration between Cargill, The Nature Conservancy, Brazilian landowners, and Brazilian government agencies to reduce conversion of tropical rainforest to soy fields, promote climate change mitigation, assist farmer profitability and stability, and minimize displacement of indigenous cultures.

How do we empower local communities to engage in conservation?

Faculty and graduate students in our section assist local communities wrestle challenges of sustainable development. One example is our Landcare research and outreach efforts, such as can be found in Catawba Valley, which lies between Blacksburg and Roanoke and is the headwaters to several national watersheds including the Chesapeake Bay. We facilitated community meetings and community actions promoting the triple bottom line of economic development, community vitality, and environmental sustainability. Another example is working with serious objections by Tea Party and other new activists groups concerned with local land use planning efforts promoting smart growth, climate adaption, green infrastructure, and land use taxation.

How can biodiversity conservation on private lands be enhanced?

Over 60% of the land in the United States is privately held, and over 80% of threatened and endangered species use or rely on private lands for habitat. The rise of market-based mechanisms to encourage private landowners to contribute to conservation has led Michael Sorice and his colleagues to explore the social factors associated with participation in conservation programs. What tradeoffs are landowners willing to consider when deciding to help imperiled species? Dr. Sorice's work on songbirds in Texas and gopher tortoises in the southeastern United States finds that it isn't all about the money—other factors related to program design and administration play a big role.

What social drivers perpetuate undesirable ecosystem change?

Afforestation can be considered "bad" when grasslands that have existed for millennia are transformed into woodlands, threatening the rural livelihoods of ranchers in the Southern Great Plains of the United States. In South America another invasive is rampantly transforming riparian forests. The North American beaver (*Castor canadensis*) was introduced into the southern islands of Argentina and Chile in the 1950s to start a fur trade. Michael Sorice works with ecologists to address invasive species issues focusing on the management decisions landowners make that facilitate or impede their spread.

What makes for better outcomes in natural resource management planning processes?
Marc Stern's research has uncovered key lessons about leadership and the internal dynamics of interdisciplinary teams, approaches to public involvement, risk assessment, and compliance with the National Environmental Policy Act by the U.S. National Forest Service over the past seven years. Dr. Stern has collaborated with colleagues to publish 13 peer-reviewed journal articles on this work, and key findings are now being incorporated in agency-wide training. Dr. Stern is now studying collaborative process on large landscape scale restoration initiatives in the United States.

What makes one conservation grant more successful than another?
Marc Stern has partnered with colleagues from Clemson University and Stanford University on a five-year study to examine the key drivers of success in conservation granting programs. The research involves examining the characteristics and outcomes of 400 conservation grants provided through the TogetherGreen Conservation Initiative of National Audubon Society and Toyota. The study aims to uncover key lessons about training, community engagement strategies, partnerships, and adaptive management for achieving conservation success.

What drives visitor outcomes in interpretive experience in National Parks?
Marc Stern and a colleague at Clemson University sent a team of graduate students to nearly 400 ranger programs across 24 units of the National Park Service, tracking in detail multiple attributes of the ranger, the context, the visitors, and the program's delivery. Through visitor surveys immediately following these programs, the study identified the characteristics that lead to enhancing visitor experiences and inspiring stewardship. The study is the first of its kind and its results are informing both training and monitoring across all 398 units of the U.S. National Park Service.

How can protected natural area managers avoid or minimize recreation impacts?
Jeff Marion, a U.S. Geological Survey scientist and an Adjunct Faculty member in our program, conducts recreation ecology research to assess, monitor, and manage recreation impacts. This work includes field assessments of trail, campsite, and recreation site conditions, evaluations of the efficacy of management actions such as Leave No Trace education, and research to improve carrying capacity planning and decision-making. Recent research in Alaska's Arctic National Wildlife Refuge and Denali National Park developed a suite of efficient methods employing GIS and GPS technologies in monitoring visitor-created trails in remote settings.

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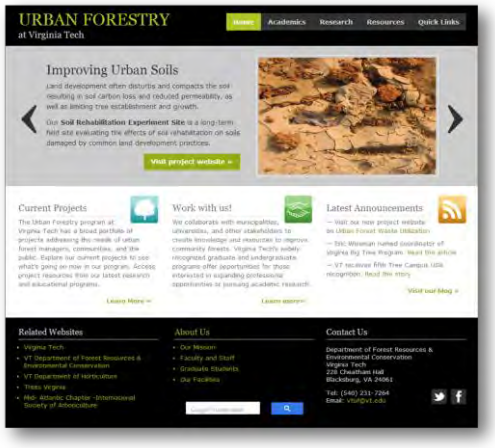
Urban Forestry



Virginia is a rapidly urbanizing state, which creates challenges and opportunities for managing forest resources. Faculty in the Department of Forest Resources and Environmental Conservation conduct research and outreach in a variety of urbanized landscapes, from densely populated cities to rural woodlots at the urban fringe. Our mission is to produce information and technology about urban forests that citizens, professionals, and policy makers can use to create sustainable cities and improve quality of life. We work to address urban forestry technical challenges at the state, regional, and national levels through research collaborations within the university and beyond. Our research sponsors include private industry, foundations, and state and federal government. In the Commonwealth we envision urban forests that are planned and managed based on sound principles and science to create safe, sustainable communities. Our program website offers information on our academic and research programs as well as tools and resources for urban forest professionals.

Assessing the Structure, Function, and Value of Virginia's Urban Forests

Urban forests have tangible value to communities—this notion has been well documented throughout the United States and is increasingly appreciated by the citizens of Virginia. However, an urban forest's value can only be fully realized when it is properly planned, established, and maintained. To be successful in these aspects of stewardship, a community must first understand the extent, location, and composition of its urban forest. Urban forestry faculty and the Virginia Geospatial Extension Program have collaborated with the Virginia Department of Forestry and numerous municipalities and agencies throughout the state to assess urban forests using geospatial and field inventory techniques to improve our understanding of this critical resource. With this knowledge Virginia communities are drafting effective urban forest policy and management plans. In addition to assisting Virginia communities, FREC researchers are also advancing the technology of urban forest assessment to help improve urban forest assessment nationally. FREC research has developed new sampling protocols and developed strategies for improving use of urban tree canopy data by municipalities.

Bringing the Forest to the City through Innovative Site Design

Urban forests and greenways have always been important parts of any city or suburb, but the accelerated pace of urbanization is increasing pressure on our environmental resources. This green infrastructure plays a crucial role in protecting our environment, including water supplies and the water quality in our rivers and coastal regions. Urban forests, like rural forest land, play a pivotal role in mitigating stormwater impacts on surface and groundwater, but developing approaches that exploit the ability of trees to handle stormwater is difficult in highly

built city cores or in urban sprawl where asphalt can be the dominant cover feature. Urban forestry faculty are exploring creative ways to enhance the ability of urban sites to support large trees while simultaneously providing specific ecosystem services—such as stormwater mitigation—for society. A new technology has been developed that places stormwater reservoirs beneath pavement in a special soil mix that supports tree roots and pavement and water storage simultaneously. This stormwater best management practice can be employed in dense urban cores or sprawling suburban parking lots. Canopy is declining in many cities and towns, but with innovative approaches to creating sustainable urban landscapes, we can bring the green back to the city. Projects have been supported by the USDA Forest Service's Urban and Community Forestry Grants Program and the TreeFund.

Urban Soil Rehabilitation with Soil Profile Rebuilding and Improved Surface Treatments

Urban land use change results in significant loss of ecosystem services from soils. Significant soil carbon is lost during urbanization, and the ability of soils to manage stormwater and support vegetation is severely impaired. Urbanization typically damages soils during the construction process when land is subjected to heavy equipment use and grading. These activities produce compacted soils with low organic matter, even in the lower soil horizons. In addition, soil surface treatments (mulch or turf) have traditionally been evaluated for their aesthetics and ability to suppress weeds. However, these treatments play a pivotal role in soil protection and quality as well as the ability of the surface to infiltrate stormwater. Virginia Tech research is evaluating surface treatments for these qualities to improve the performance of urban green infrastructure. The Virginia Tech Urban Forestry Program has a series of experiments to quantify these effects and develop soil best management practices for urban sites.

Urban Forestry—the Growth of the Profession

Urban forestry is still a new profession, but recent years have seen significant changes. Municipalities are demanding more expertise in management of forest resources, the Society of American Foresters initiated an accreditation program for urban forestry (Virginia Tech's program was the first to meet the new standard), and urban forestry certification credentials are on the horizon. However, municipalities continue to have difficulty recruiting qualified urban foresters, professional societies that serve urban foresters are diverse and not always coordinated, and educational programs are poorly understood by the public and employers. Virginia Tech has taken the lead in a regional project (supported by the National Urban and Community Forestry Advisory Council) with the University of Maryland, West Virginia University, and Virginia State University to analyze the links between these professional structures and the development of the urban forestry profession and offer solutions to move the profession forward.

Urban Wood Waste Utilization

Several new research initiatives are underway to investigate the potential for wood waste utilization in urban forests. By fully understanding the lifecycle of urban trees, there is potential to improve urban forest sustainability. FREC faculty and students are investigating strategies for identifying the best use for urban trees after their useful lifespan in the urban forest is at an end. Partners include Davey Resource Group, Casey Trees, and the Virginia Department of Forestry.

Exurban Forest Landcare

Virginia and the southeastern United States, like many other regions of the country and world, are experiencing rapid rates of parcelization and fragmentation of private forestland. In particular, exurban and rural residential forms of development have the potential to improve or degrade the forest ecosystems that are an essential part of our nation's green infrastructure. FREC faculty have been working with numerous public and private partners at the local, state, national, and international levels to develop research, education, and community engagement projects that address these land use and land cover changes. For example, the Headwaters Forest Landcare Partnership, facilitated by Virginia Tech, has brought together local businesses, civic organizations, state agencies, and other stakeholders to develop local markets for sustainable forest products in the Blue Ridge region of Virginia, North Carolina, and neighboring states. Support for these exurban and wildland-urban interface activities has been provided by organizations such as the U.S. Department of Agriculture, U.S. Environmental Protection Agency, Conservation Fund, National Network of Forest Practitioners, Blue Ridge Forest Cooperative, Landcare International, Rainforest Alliance, National Association of Regional Councils, and National Association of Conservation Districts.

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http://gep.frec.vt.edu/

Forest Modeling Research Cooperative

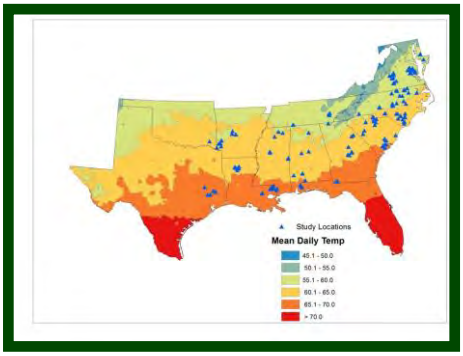
The Forest Modeling Research Cooperative (FMRC) is an outgrowth of the Loblolly Pine Growth and Yield Research Cooperative that was founded at Virginia Tech in 1979 for the purpose of developing growth and yield models for intensively managed loblolly pine plantations. Although loblolly pine remains a primary research thrust, the FMRC is addressing an expanded array of growth and yield modeling projects both in the United States and South America.

Growth Modeling and Simulation

A wide range of research projects is being conducted to develop improved growth and yield models for intensively managed forests. These studies include:

- Quantification of site quality
- Tree and stand increment equations
- Mortality modeling
- Tree volume and taper modeling
- Quantification of stem quality
- Quantification of wood quality characteristics
- Incorporation of cultural practices (e.g., planting genetically improved and varietal stock, applying fertilizers, controlling competing vegetation, thinning) into growth and yield models
- Modeling environmental influences on forest growth.

Integration of models into prediction and projection systems and incorporation of these systems into decision support tools (including web-based applications) comprises a significant part of the work of the FMRC.



In addition to loblolly pine, the FMRC has developed models for Appalachian hardwoods and pure stands of yellow-poplar. Current work includes development of models for South American pine plantations. Work is also ongoing for developing models for short-rotation "bioenergy" plantations.

Collaboration

The FMRC has a long history of collaboration and maintains strong working relationships with other research cooperatives, the Forest Service, and—through the National Science Foundation's Center for Advanced Forestry Systems—industry-supported research programs at other universities. In addition, FMRC is an integral part of the regional PINEMAP effort that is focused on climatic influences on forest productivity. Staff of the Forest Modeling Research Cooperative consists of a Director (Harold Burkhart), an Associate Director (Ralph Amateis), cooperating faculty in forest biometrics and geomatics at Virginia Tech, and graduate research assistants and postdoctoral research associates.

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Forest Productivity Cooperative

The Forest Productivity Cooperative (FPC) is an international research and technology transfer program working to create innovative solutions to enhance forest productivity and value through the sustainable management of site resources. The FPC conducts research in plantation silviculture, forest nutrition and fertilization, ecophysiology, soils, plant community ecology, growth and yield modeling, remote sensing, spatial analysis, and GIS applications. This is done in cooperation with forest industry in the United States and Latin America and scientists at Virginia Tech, North Carolina State University, The University of Concepcion in Chile and the Institute for Forest Research in Brazil. Thomas Fox serves as the Co-Director of the FPC at Virginia Tech.

The goal of the FPC is to increase the productivity, profitability, and sustainability of plantation management in the United States and Latin America. We work with both pine and eucalyptus plantations throughout these regions. The approach of the FPC includes a mix of applied research, fundamental research, graduate and undergraduate education, technology transfer, continuing education, and consulting. This mix provides a productive environment for addressing questions and immediately incorporating research results into silvicultural practices for cost-effective and environmentally sustainable plantation management.

The FPC is one of the world's largest cooperative silviculture research and education programs. Partners include the host universities, forest industry, timber management investment organizations, forestry consultants, governmental agencies, private landowners, and others interested in intensive plantation management. There are currently 65 members of the FPC who operate in the southern United States from Texas to Virginia and in Latin America in Argentina, Brazil, Chile, Colombia, Ecuador, Guatemala, Mexico, Uruguay, and Venezuela and collectively own or manage over 40 million acres of pine and eucalyptus plantations.

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National Science Foundation
Center for Advanced Forestry Systems

The Center for Advanced Forestry Systems (CAFS) is sponsored by the National Science Foundation (NSF) as part of the Industry/University Cooperative Research Centers (I/UCRC) Program within the Engineering Directorate. CAFS links existing cooperative forestry research programs at Virginia Tech, North Carolina State University, Oregon State University, University of Georgia, University of Florida, University of Washington, University of Maine, Purdue University, and the University of Idaho. At Virginia Tech this includes the Forest Productivity Coop led by Tom Fox and the Forest Modeling Research Cooperative led by Harold Burkhart. The NSF Center for Advanced Forestry Systems is designed to foster collaborative research between universities and forest industry that will increase the productivity, profitability, and sustainability of plantation forest management. The overall goal is to facilitate the development and application of forest science and technology needed by forest industry to remain globally competitive.

CAFS-sponsored research underway at Virginia Tech includes:

- Developing precision silvicultural regimes for clonal plantations of loblolly pine in the United States and South America
- Evaluating the potential productivity of loblolly pine in the southeastern United States and in Latin America across climatic-geologic-edaphic gradients
- Improving our understanding of the ecophysiology of loblolly pine and the responses in nutrient uptake, leaf area, light interception, photosynthesis, and respiration to silvicultural treatments in loblolly pine plantations
- Using stable isotopes of nitrogen to trace the fate of applied nitrogen fertilizers in forest plantations to evaluate fertilizer uptake efficiency
- Developing growth and yield predictions for diverse genotypes and silvicultural practices
- Developing improved understanding of stand response of loblolly pine to silvicultural treatments such as thinning and fertilization
- Determining the influence of soils and climate variables on tree and stand growth and mortality
- Integrating growth and yield models into decision-support systems.

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OUTREACH AND ENGAGEMENT

The outreach and engagement programs in the Department of Forest Resources and Environmental Conservation seek to strengthen and enhance the management of forest resources through educational programming and information transfer to all publics of our society. Programming is diversified to serve many audiences having varied objectives and interests.

Outreach programs are conducted in a variety of fields and using a host of methods. In the College of Natural Resources and Environment, outreach programs are organized into the following five categories:

- Cooperative and industrial Extension programs
- Continuing education programs
- Youth and teacher education programs
- Economic development programs
- International development programs

In the Department of Forest Resources and Environmental Conservation, faculty, staff, and students are actively involved in programs within all of these categories. Cooperative and industrial Extension programs are offered to a variety of audiences, such as forest landowners and loggers. Primary subject areas include forest management and economics, silvicultural applications, and timber harvesting. Educational programs are offered throughout the state in cooperation with the Virginia Department of Forestry, the Virginia Forestry Association, the State Implementation Committee of the Sustainable Forestry Initiative, and many other groups. One or more of the department's Extension specialists and associates generally coordinates Extension programs.

Continuing education (CE) programs are offered to professional audiences such as foresters, wildlife managers, certified public accountants, etc. These fee-based programs are conducted in cooperation with Virginia Tech's Office of Outreach Program Development and include several different types, such as open enrollment programs, contract programs, conference services, and research dissemination programs. The Department of Forest Resources and Environmental Conservation has an active CE program, involving both Extension and non-Extension faculty as coordinators and instructors. Programs are regularly offered in the areas of forest management and economics, silviculture, forest biometrics, and timber harvesting.

The Department of Forest Resources and Environmental Conservation is actively involved in educational programs to benefit youth and the teachers and adult leaders who work with school-aged children. Departmental faculty, staff, and students are actively involved through 4-H summer camp programs, 4-H in-school projects and judging programs, and middle school teacher and student projects.

In addition to educational programs and projects, faculty in the department are actively engaged in publishing educational bulletins, developing educational curriculum materials, producing newsletters and magazine columns, preparing videotapes, and developing and maintaining educational web sites.

The Department of Forest Resources and Environmental Conservation is committed to supporting economic development activities throughout the Commonwealth. Faculty and staff regularly consult and provide technical assistance to companies and other state agencies in support of broad-based economic development efforts. In addition, many of the continuing education and Cooperative Extension programs support the economic development mission.

International programs are an important component of the Department of Forest Resources and Environmental Conservation's outreach portfolio. Active involvement in international projects broadens the knowledge base of faculty, staff, and students and helps to connect the department with the rest of the world.

Virginia Forest Landowner Education Program

The Virginia Forest Landowner Education Program (VFLEP) develops and delivers educational programs about sustainable forest management to over 10,000 Virginia forest owners annually. This program is coordinated through Virginia Tech's Department of Forest Resources and Environmental Conservation.

Specific goals of VFLEP include:

- conserving Virginia's forest land base
- reducing exotic insects, plants, and diseases
- promoting the production of quality wood and non-timber forest products
- generating public understanding and support for the management of Virginia's vast forest resources
- creating dialogue and cooperation within Virginia's natural resources community and among private forest landowners.

Reducing Barriers to Forest Certification

Global market demands continue to drive product certification; however, because of their independent nature, southern forest owners have shown a low interest in forest certification, with certified forested acres averaging 17% of total forest land. Using funds from a USDA Forest Service Redesign Grant, a consortium of southern states initiated a project entitled "Reducing Barriers to Forest Certification." This project allowed states to (1) identify reasons why southern forest owners were not certifying their forests and (2) develop educational materials and conduct workshops to educate non-industrial private landowners, corporate landowners, state and federal agency personnel, natural resource consulting professionals, and non-governmental organizations on the various aspects and requirements for verifiable certification. The Virginia Department of Forestry (VDOF) and Virginia Tech Forestry Extension teamed up to fulfill Virginia's part of the project.

To identify the barriers to forest certification in Virginia, a survey was conducted of forest landowners, loggers, and wood product manufacturers throughout the Commonwealth. Survey results were compiled and used to direct the development of educational materials. Most survey respondents had a relatively neutral opinion of forest certification, and the overall indication was that they needed more information to make an informed decision.

To help reduce this educational barrier, we offered a series of four Train the Trainer workshops to 78 participants, with the intent of educating VDOF foresters so they would be able to discuss forest certification options with landowners more confidently. We also offered seven dinner meetings for private forest landowners. To supplement the information provided at the workshops, we developed three publications, each geared towards a different audience:

- *Forest Certification: A Guide and Overview* – Tri-fold brochure (for general audiences)
- *To Certify or Not? A Question for Virginia Forest Owners* – Virginia Cooperative Extension Publication ANR-50P (for private landowners)
- *The Role of Logging Business Owners in Forest Certification* – Virginia Cooperative Extension Publication ANR-51NP (for loggers)

Follow-up surveys are in the works. These surveys will be used to determine the extent to which VDOF foresters have increased their comfort level on forest certification and the number of forest owners seeking more information on certifying their forests. The final phase of this project will involve bringing together interested landowners, certification program professionals, and forest industry to facilitate the certification of additional forest acreage in Virginia.

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Virginia Geospatial Extension Program

VirginiaGeospatial ExtensionPROGRAM
gep.frec.vt.edu

Geospatial tools include the application of geographic information systems (GIS), global positioning systems (GPS), and remote sensing. The Virginia Geospatial Extension Specialist (VGES) acts as a knowledge broker, or the two-way conduit, between geospatial research, applications development, and practice. The VGES has a national reach and leverages the expertise of Virginia Cooperative Extension agents and specialists.

The program provides:

- hands-on geospatial technical training through workforce development initiatives,
- strategic planning for local governments,
- expertise to facilitate the integration of computer-aided tools with the planning and management needs of stakeholders.

In addition to working closely with extension agents and specialists, the program works closely with local, state, and federal government employees; Virginia's vibrant geospatial private sector; precollege educators; and faculty through Virginia's institutions of higher education.

Examples of programming efforts include:

- *Geospatial Workshops* – for local government employees, state agency employees, the private sector, and others. These are offered free or at very low cost basis to facilitate the diffusion of geospatial knowledge.

- *Geospatial Technician Education* (GeoTEd) – provides training and resources necessary to develop and implement a GIS program to support industry needs. This effort has been expanded to support the mid-Atlantic region and has resulted in 20 new geospatial course offerings across Virginia's Community Colleges.
- *The Urban Tree Canopy Project* – provides a baseline inventory of tree canopy and online map viewer applications (http://utcmapper.frec.vt.edu) for local jurisdictions and other stakeholders. Version 2 of the mapper was published in fall 2013.
- *VirginiaView* – provides educators and other stakeholders across Virginia with access to remote sensing imagery and resources to support their educational and workforce development efforts (http://www.virginiaview.net). Video tutorials developed in November, 2013, have already been downloaded over 6,000 times via the Geospatial YouTube Channel (http://www.youtube.com/user/VaGeoExtension).
- *Map@syst* – an eXtension community of practice designed to develop a Wiki-based clearinghouse for geospatial information.

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Virginia Master Naturalist Program

The Virginia Master Naturalist program is a volunteer training and service program providing education, outreach, and service to benefit natural resources and natural areas in Virginia. Volunteer training includes a minimum of 40 hours of classroom and field time in natural history and natural resource management. To become a Certified Virginia Master Naturalist, each volunteer must complete 40 hours of service in education, citizen science, or land stewardship. The program is sponsored jointly by Virginia Cooperative Extension, Virginia Department of Conservation and Recreation, Virginia Department of Environmental Quality, Virginia Department of Forestry, Virginia Department of Game and Inland Fisheries, and the Virginia Museum of Natural History, with additional support from the Virginia Tech College of Natural Resources and Environment and the Department of Forest Resources and Environmental Conservation. In addition, the 29 program chapters across the state work with more than 300 local partners, including schools, nature centers, nonprofits, and local governments. Currently the program has 1,378 active volunteers. Since the program's inception in 2006, these volunteers have contributed 417,946 hours of service—with a value of $9.5 million—to the Commonwealth of Virginia.

In 2013 Virginia Master Naturalist volunteers completed more than 24,000 hours of service on projects to educate the public about natural resources. They made more than 107,000 youth and adult contacts through these educational efforts. For example, several Master Naturalist chapters organized and led "Junior Naturalist" 4-H clubs that exposed youth to natural resources and local natural areas. Similarly, several other chapters organize or assist with afterschool nature programs for youth in their communities. Some of these programs specifically target underserved audiences such as inner-city youth and Spanish-speaking populations.

Virginia Master Naturalists completed more than 23,000 hours of service on stewardship projects, such as habitat restoration and trail maintenance, in 2013. Their efforts positively impacted more than 1,200 acres of land and more than 1,000 miles of trails and streams in Virginia.

Also in 2013 Virginia Master Naturalists completed more than 29,000 hours of citizen science, collecting data on wildlife populations, urban forests, and aquatic habitats in their communities. A new grant from the National Science Foundation is providing support for online training and coordinating for regional citizen science projects that directly meet the needs of Virginia's natural resource managers. New projects include mapping the extent of invasive grasses in a threatened, fire-managed ecosystem and testing the effectiveness of treatment methods and measuring the effect of stream buffers around buffered agricultural land under conservation easement.

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Virginia SHARP Logger Program

Virginia's **SHARP** Logger Program (**SHARP** = **S**ustainable **H**arvesting **A**nd **R**esource **P**rofessional) provides training to loggers, foresters, and others throughout Virginia. This training focuses on the principles of sustainable forestry, environmental protection, and workplace safety. The SHARP Logger Program was implemented in 1996 as part of the nationwide Sustainable Forestry Initiative (SFI). Since 2002 the Virginia Tech Department of Forest Resources and Environmental Conservation has been responsible for the administration and coordination of the SHARP Logger Program as a Virginia Tech Forestry Extension Program. The SHARP Logger Program is a cooperative effort between the Department of Forest Resources and Environmental Conservation, the Virginia SFI Implementation Committee, Virginia Cooperative Extension District Forestry and Natural Resources Extension Agents, and many others in Virginia's forest industry.

In order to become a SHARP Logger, participants must complete a three-part core program consisting of classes on sustainable forestry, logging safety, and pre-harvest planning and BMPs. After completing the core program, SHARP Loggers must earn 12 hours of Continuing Education (CE) credits every three years to maintain their SHARP Logger status. Over 3,500 individuals have completed the core program requirements to become SHARP loggers.

In 2013 the core SHARP Logger Program was offered at four locations throughout the Commonwealth, and 110 "new" SHARP loggers completed the core program. Twenty-five continuing education classes were offered across Virginia for SHARP Logger CE credits, and 819 individuals attended at least one program to earn SHARP Logger CE credits. These SHARP Loggers received a combined total of over 7,200 hours of training in 2013. As of January 1, 2014, there were a total of 1,290 active SHARP Loggers. The goal of the SHARP Logger Continuing Education program is to offer a diverse mixture of classes with face-to-face training provided by experts in their fields. The program also offers five online courses available on the SHARP Logger website.

Examples of CE classes offered in 2013 include:

- Chipper maintenance and productivity workshop
- Logging business management workshop
- BMP & water quality workshops
- GPS for loggers
- Basic timber cruising workshops
- Logging safety awareness workshop & OSHA refresher
- Wildlife management workshop

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Virginia's Link to Education about Forestry

Virginia's Forest Landowner Education, SHARP Logger, Master Naturalist, and 4-H Programs—along with the Virginia Department of Forestry's (VDOF) Conservation Education Program and four Virginia Cooperative Extension (VCE) district-level forestry/natural resource agents—constitute a remarkable array of educational resources. Constituents from the rural southwest to the populated north benefit from their efforts. While many regularly take advantage, the truth of the matter is that reaching new audiences is difficult. LEAF is making positive strides via a VCE/VDOF partnership that engages private and public entities to develop strategies that attract new audiences. To date efforts include establishing heritage-based outdoor classrooms and online education. LEAF has received support from the Virginia Sustainable Forestry Initiative (SFI) Implementation Committee, Ballyshannon Fund, Fred W. Scott, Jr., NRCS EQIP program, Powell River Project, College of Agriculture and Life Sciences, VDOF, VCE, Shenandoah RC&D Council, the Virginia Division and Skyline Chapter of the Society of American Foresters, Old Rag and Central Rappahannock Master Naturalists, and the Montpelier Foundation.

Heritage-Based Outdoor Classrooms

The state's rich history offers important prospects for creating outdoor LEAF classrooms that provide venues for coordinated demonstration, engaging interpretation, and self-guided education. Projects are underway at James Madison's Montpelier, Appomattox-Buckingham State Forest, Cyrus McCormick Farm/Shenandoah Valley Agriculture Research and Extension Center, Conway-Robinson State Forest, Powell River Project, Reynolds Homestead, and Arlington County.

James Madison's Montpelier

There are over 1,500 acres of forests at Montpelier. Two hundred acres house a relatively undisturbed old-growth deciduous forest. The Landmark Forest, as it is called, includes a trail system with educational signs and has long served as a backdrop for environmental education. To expand its program a forest management classroom has been developed in 28 acres of second-growth forest abutting the Landmark Forest.

Cyrus McCormick Farm/Shenandoah Valley Agriculture Research and Extension Center

Beef production and forage regimes are being combined with forest management at the Cyrus McCormick Farm, a National Heritage Site, to exhibit economic and environmental quality opportunities on working farms. Most recently a restorative shelterwood cut was implemented. Long-term objectives include researching and demonstrating the importance of sustainable forest management. Aims are also to develop an interpretive kiosk for farm visitors.

Online Education

Online learning is an increasingly viable mechanism if physical attendance at forestry education is constrained. It offers promise for reaching audiences that rely on or prefer computer-based education. LEAF is developing comprehensive online opportunities for foresters, loggers, private forest owners, and teachers. Content includes stand-alone learning modules and will house downloadable programs that correspond to LEAF's outdoor classrooms.

Summary

As LEAF moves forward, existing partnerships will be strengthened, new collaborations formed, and impacts expanded. Classrooms will span the Commonwealth, and online learning will provide affordable and accessible opportunities.

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INTERNATIONAL ACTIVITIES

JANAKI ALAVALAPATI served as an external examiner for a Ph.D. dissertation at the University of New Brunswick, Canada, and he made presentations at the University of Guyana, Georgetown, Guyana, and the Indian Institute of Chemical Technology, Hyderabad, India.

TIMOTHY ALBAUGH was a Visiting Research Scientist at Universidad de Concepción in Chile and was also a co-instructor for a graduate course held in Concepción. He presented a talk at the VII Summer Colloquium on Plant Ecophysiology in Puerto Montt, Chile, and attended the Forest Productivity Cooperative Contact Meeting in Curitiba, Brazil.

GREGORY AMACHER hosted a Ph.D. student from The French National Institute for Agricultural Research and the University of Paris to work on problems of transitions between deforestation and plantation establishment in developing tropical countries. He continues work with a colleague at the University of Helsinki on problems related to forest policy choices and on projects in the Amazon—funded by NASA and the Inter-American Development Bank—concerning institutional arrangements and community welfare and natural resource use. Dr. Amacher and *FRANK MERRY* are currently creating a Center for International Forest Policy and Economics that will encompass work ongoing in Africa and South America.

EVAN BROOKS attended the MultiTemp 2013 Conference in Banff, Alberta, Canada, and presented on his research with the FIA program and met with many of the chief scientists in remote sensing. He also began a joint research project with a colleague from the University of Montreal to study land use change in Java, Indonesia.

AMY BRUNNER presented a keynote lecture at the 5th International Plant Dormancy Symposium in Auckland, New Zealand.

HAROLD BURKHART served as an external examiner for a doctoral thesis at the University of Eastern Finland.

CAROLYN COPENHEAVER continues to collaborate with forest ecologists from the University of Mohaghegh Ardabili and the University of Tehran to study the diversity, structure, and composition of old-growth beech forests of northern Iran. Their most recent research focused on understanding the ecology and conservation needs of Persian ironwood, a tree endemic to the Hyrcanian Forest that borders the Caspian Sea.

SUSAN DAY co-led a Study Abroad course during the 2013 Wintermester. She traveled with 16 students to Barcelona and Valencia, Spain, to experience agriculture and natural resources management in Spain and learn the Spanish language.

THOMAS FOX serves as Co-Director of the Forest Productivity Cooperative (FPC), which is an international partnership working to increase the productivity and sustainability of plantation forestry. The FPC has 65 private industry members who collectively own and manage more than 35 million acres of pine and eucalyptus plantations in the U.S. and Latin America. In partnership with its members, the FPC has established and maintains an extensive network of research sites that also serves as a demonstration network throughout the region. The FPC has research and technology transfer programs in Mexico, Guatemala, Colombia, Venezuela, Ecuador, Brazil, Uruguay, Argentina, and Chile. The FPC works closely with forest industry in those countries to improve plantation silvicultural practices. It also collaborates with scientists at various universities in Latin America, including the Universidad de Concepcion, Universidad Austral de Chile, and Pontificia Universidad Catolica de Chile and University of Sao Paulo in Brazil.

Dr. Fox was invited to China to give a keynote at the International Symposium on Forest Soils: Linking Ecosystem Processes and Management to Forest Biodiversity and Functions. While in China Dr. Fox visited the Chinese Academy of Science and the Institute of Applied Ecology to discuss soil fertility and tree nutrition issues. He also visited a field research station maintained by the Institute of Applied Ecology in Inner Mongolia to discuss afforestation work in that region of China.

JEFFREY MARION traveled to Canada to consult with protected area managers and planners, speaking and consulting on various aspects of sustainable visitation management. He also traveled to China to consult with Chinese scientists on sustainable recreation planning and management.

KEVIN McGUIRE hosted the U.S.-Japan Joint Seminar on Catchment Hydrology and Forest Biogeochemistry in Honolulu, Hawaii. The seminar brought together 18 U.S. and 24 Japanese scientists and was designed to stimulate and engage the next generation of scientists, who will become leaders in catchment science research and support future interaction between the two countries.

JOHN MUNSELL continues to work in Cameroon on research and extension activities. His research focuses on management system adaptation and permanence among agroforestry farmers in three regions of the country. Extension activities involve supporting Cameroonian and American NGO partners with on-the-ground technical and scientific support related to sustainable farming, rural livelihoods, and wildlife habitat protection. Dr. Munsell's former graduate student, Elizabeth Moore, won a student presentation award at the 13th North American Agroforestry Conference in Prince Edward Island, Canada, for her research in the Adamaoua Region of Cameroon.

STEVE PRISLEY served as an external examiner for a doctoral dissertation at Makarere University, Uganda. He also co-hosted a USAID workshop in Blacksburg on Forest Forecasting and Futures Modeling for forestry professionals from India and presented at a Pinchot Institute International Workshop on The Transatlantic Trade in Wood for Energy in Savannah, Georgia.

MICHAEL SORICE and his colleagues are currently working in Tierra del Fuego, Argentina, to understand perspectives of private landowners toward an invasive species, the North American beaver. Dr. Sorice is also working in Thailand to understand conflicts between artisanal fisheries and marine mammals.

MARC STERN has begun work in Bali, Indonesia, in partnership with the Center for Leadership in Global Sustainability to examine sustainability issues on the rapidly developing island. Dr. Stern also served as a consultant for the Bahamas National Trust to conduct research on local reactions to the expansion of the Andros West Side National Park in the Bahamas, and he remains a member of the IUCN's Commission on Education and Communication and the World Commission on Protected Areas.

Virginia Tech and Virginia State University are working in South Sudan on a USAID-sponsored program entitled "Rebuilding Higher Education in Agriculture." Within our department *JOHN SEILER* and *BRIAN STRAHM* are currently serving as graduate advisors to Ruba Bilal, an instructor at the University of Juba, as he pursues a Ph.D. at Virginia Tech.

Beginning in 2009 and culminating in 2013, *BRIAN STRAHM* was on the planning committee for the 12th North American Forest Soils Conference, which met during the summer of 2013 in Whitefish, Montana.

QUINN THOMAS traveled to Melbourne, Australia, for an invited talk at the CSIRO for Atmospheric and Marine Sciences. He spoke on his research that investigates the role of N limitation of forest carbon in global models that simulate climate dynamics. Dr. Thomas also initiated a collaboration with a colleague at the University of Edinburgh in Scotland. They are developing a new model that describes how carbon and nitrogen cycles interact to limit the productivity of forest ecosystems.

RANDY WYNNE gave invited talks at Beijing Forestry University and at Silvilaser, which was held in Beijing, China, in 2013.

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