VIRGINIA TECH Department of

FOREST RESOURCES AND ENVIRONMENTAL CONSERVATION

Highlights of 2012

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Department of Forest Resources and Environmental Conservation
College of Natural Resources and Environment
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www.frec.vt.edu
frec@vt.edu

OVERVIEW OF THE DEPARTMENT

This report highlights accomplishments in learning, discovery, and engagement in the Department of Forest Resources and Environmental Conservation (FREC) during 2012. 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. Following are a few key accomplishments and challenges of 2012.

Learning: Undergraduate enrollment grew from 191 in Fall Semester 2011 to 196 in Fall Semester 2012. Virginia Tech made a decision to move away from the Academic Common Market. As such we will be losing approximately 20 undergraduate students from Maryland and other areas. We are actively working with Virginia State University to establish a two-year AA degree in forestry and natural resources to facilitate transfers to FREC. Our new undergraduate major, Environmental Informatics, has received final approvals, and we will be launching that program in Fall Semester 2013. A new undergraduate degree, Water: Resource, Policy, and Management, is currently in the approval process, and we hope to launch it next year.

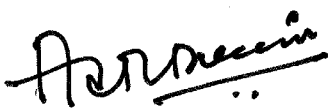
Discovery: You will note from the graph on page 18 that our research expenditures increased by 16% in 2012. You will also note from the list of refereed publications that our faculty members are actively engaged in advancing the boundaries of science. Graduate enrollment continues to be at record high levels (upper 70s). The FREC Graduate Research Symposium has expanded further and is now attracting participants from various departments across campus and from 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 2012. In particular, the Director of Virginia Cooperative Extension was impressed with the accomplishments of our Master Naturalist Program and agreed to support a full-time, permanent Program Coordinator position. As a result, we have hired Dr. Alycia Crall!

New Horizons: FREC is blessed with several new opportunities:

- A college-wide Center for Natural Resources Assessment and Decision Support has been established under the leadership of Dr. Steve Prisley.
- We are working closely with USFS officials to facilitate a USFS Center to Support Forest Products Use and the National FIA Program. We hope that this will provide many research and graduate student support opportunities for FREC.
- Two new tenure-track Assistant Professors (one in Policy and the other in Hydroinformatics) will be hired by July, 2013, to support the water program.

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

Huaguo Huang joined the department in March, 2012, as a Visiting Scholar working with Drs. Randy Wynne, Valerie Thomas, and Harold Burkhart. Dr. Huang is an Associate Professor at Beijing Forestry University, and his research focuses on forestry lidar remote sensing. He will be in Blacksburg for one year.

David Walker received his Master of Science in forestry from Virginia Tech and joined the Department of Forest Resources and Environmental Conservation in June, 2012, as a Research Associate. He is working with Dr. Phil Radtke on a Forest Service project to develop methods for estimating total tree biomass.

In July, 2012, **Gantulga Dashzeveg** was hired as a Postdoctoral Associate to lead sponsored research projects in the laboratories of Dr. Jason Holliday (FREC) and Dr. David Schmale (Department of Plant Pathology, Physiology, and Weed Science). She received her Ph.D. in Molecular Biology and Biochemistry from Virginia Tech and her M.S. in Biophysics from Lomonosov Moscow State University.

In order to promote undergraduate programs across the Commonwealth of Virginia and beyond, the department hired **Kyle Dingus** as FREC Futures Intern in August, 2012. Kyle received his B.S. in Forestry from Virginia Tech. 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.

NEW FACES IN FREC

Thakur Upadhyay joined FREC in December, 2012, as a Research Associate working with Dr. Janaki Alavalapati on conducting quantitative economics and policy analysis of a range of natural resources management issues—including bioenergy—at local, regional, national levels and beyond. He earned a Ph.D. in Resource/Forest Economics at the Norwegian University of Life Sciences, an M.Sc. in Development and Resource Economics at the Agricultural University of Norway, and an M.A. in Economics at Tribhuvan University, Nepal.

PROMOTIONS

Chad Bolding was promoted to Associate Professor and granted tenure on July 1, 2012. Dr. Bolding's research areas include forest operations, harvesting, wood supply chain efficiency, and biomass utilization. His teaching responsibilities include courses on forest harvesting, timber procurement, and harvesting systems evaluation.

John Munsell was promoted to Associate Professor and granted tenure on July 1, 2012. Dr. Munsell is an Extension Specialist with interests in private forestland stewardship, agroforestry and whole farm planning, bioenergy and family forest sustainability, collaborative conservation, and integrated natural resources problem solving.

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
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
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, 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
Zedaker, Shepard M.	Professor	Ph.D., Oregon State University	Regeneration silviculture; chemical silviculture; vegetation management; quantitative ecology and stand dynamics

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
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
Carlson, Colleen A.	Research Associate	M.Sc., University of Witwatersrand	Manipulation and optimization of growth and timber quality in plantation systems, with emphasis on nutritional influences
Gantulga, Dashzeveg	Postdoctoral Associate	Ph.D., Virginia Tech	Molecular biology and biochemistry

Laviner, M. Andrew	Research Associate	M.S., North Carolina State University	Resource management in plantation forestry; silviculture, ecophysiology, and forest management
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
Sabatia, Charles O.	Postdoctoral Associate	Ph.D., Virginia Tech	Modeling forest growth and yield under varying silviculture; stand genotypic composition and climate
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
Upadhyay, Thakur P.	Research Associate	Ph.D., Norwegian University of Life Sciences	Socio-economic policy analysis for natural resource management and climate change mitigation and adaption
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 ASSOCIATES	POSITION	TERMINAL DEGREE	SPECIAL INTERESTS
Barrett, Scott M.	Coordinator, Virginia SHARP Logger Program	M.S., Virginia Tech	Logger training and education
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

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
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

TECHNICAL STAFF

Deborah H. Bird
Samuel A. Frye
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

2012-13 DEPARTMENTAL COMMITTEES

Budget & Planning:
A. Brunner
S. Day (Chair)
C. Gillin
K. McGuire
S. Prisley
T. Sherman

Facilities:
A. Brunner
J. Holliday
P. Radtke (Chair)
T. Roberts
J. Seiler

Graduate Affairs:
P. Braff
C. Copenheaver
S. Schoenholtz
B. Strahm
R. Wynne (Chair)

Promotion & Tenure:
G. Amacher
C. Copenheaver
T. Fox
B. Hull
S. Prisley
M. Stern
J. Sullivan (Chair)

Undergraduate Affairs:
M. Aust
J. Seiler
M. Stern
V. Thomas
E. Wiseman (Chair)

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Michael Cerchiaro, Forest Investment Associates, Atlanta, GA
Keith Cline, USDA Forest Service, Washington, DC
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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, MeadWestvaco, Appomattox, VA
Ed Milhous (Chair), 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-Elect), 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:
  Carl Garrison
- 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

SCOTT BARRETT received the Virginia Loggers Association President's Award for outstanding service.

AMY BRUNNER received the 2012 Gamma Sigma Delta Faculty Research Award.

THOMAS FOX was elected as Fellow in the Soil Science Society of America and as Fellow in the Society of American Foresters. He also received the Southern Extension Forest Resources Specialists Gold Award.

JENNIFER GAGNON received two awards from the Association of Natural Resource Extension Professionals—the Program Leadership Award, Silver, and the Outstanding Newsletter Award, Gold—and she also received the Gold Award for Exceptional Extension Program from Southern Regional Extension Forestry.

JEFFREY KIRWAN, Professor Emeritus, received the Crown Award from the Virginia Department of Forestry. The award—the department's highest civilian honor—was established to recognize an individual or entity that has not only gone beyond the call of duty but has set an admirable standard of excellence. Kirwan is only the fourth recipient in the history of the award.

JEFFREY MARION received the Distinguished Service Medal presented by the Boy Scouts of America (BSA) for volunteer service to advance Leave No Trace education and training within the BSA.

MARC STERN received a Virginia Tech Certificate of Teaching Excellence and also was selected as Scholar of the Clemson University Institute for Parks, a prestigious honor for researchers who study parks and protected areas.

BRIAN STRAHM was awarded the Best Paper of Session at the Soil Science Society of America International Annual Meeting held in Cincinnati, Ohio, for his paper titled *Soil Biogeochemistry in Acid Rain-Affected Forest Ecosystems*.

JAY SULLIVAN was the recipient of a 2011-12 Outstanding Faculty Award presented by the CNRE Curriculum Clubs. The college curriculum clubs annually honor a faculty member from each department in recognition of dynamic teaching ability, excellent professional attitude to teaching, and outstanding student relationships.

ERIC WISEMAN was the 2012 recipient of the International Society of Arboriculture's Early Career Scientist Award. The award recognizes scientists in the field of urban forestry and arboriculture who demonstrate exceptional promise and high career potential for producing internationally recognized research.

FREC GRADUATE RESEARCH SYMPOSIUM

The fourth annual FREC Graduate Research Symposium was held on March 27, 2012. It showcased graduate research from a number of Virginia Tech departments and, for the first time, from several other universities. The event featured 5 Ph.D. oral presentations, 6 M.S. oral presentations, and 19 poster presentations. Many of the FREC faculty were involved as moderators and judges.

The symposium was honored to host Dr. Michael Campana, immediate past president of the American Water Resources Association and Professor of Geosciences at Oregon State University, as the keynote speaker. Dr. Karen DePauw, Vice President and Dean for Graduate Education, and Dr. Paul Winistorfer, Dean of the College of Natural Resources and Environment, also gave brief presentations.

2012 Symposium Winners

Photo
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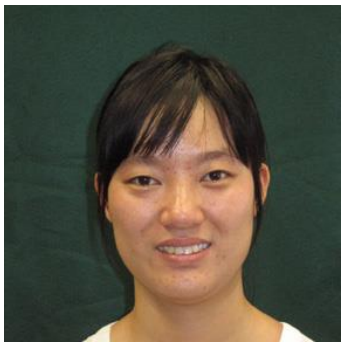
Stesha Dunker
University of Virginia
Ph.D. Oral Presentation

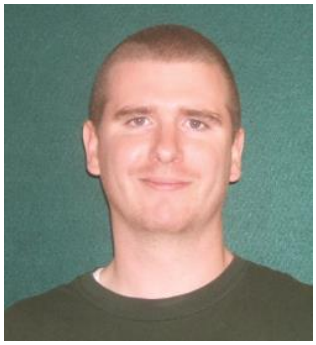
Katie Trozzo
M.S. Oral Presentation



Yujuan Chen
1st Place – Poster

Nina Craig
2nd Place – Poster

Beth Boehme
3rd Place – Poster (tie)



David Walker
3rd Place – Poster (tie)

The success of this year's symposium was due to the commitment and hard work of the symposium planning committee:

Beth Stein (Co-Chair)
Amy Werner (Co-Chair)
Patricia Brousseau
Yujuan Chen
Nina Craig
Cody Gillin
Huiquan Jiang
Maura Leveroos
Kevan Minick
Ying Xu

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.

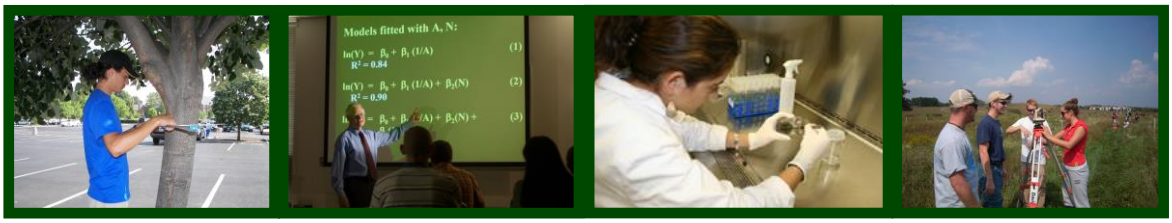
Obviously, teaching is an extremely important part of the mission of the Department of Forest Resources and Environmental Conservation, and students—defined in the broadest sense—are a principal constituent. All members of the faculty participate in the teaching program, which includes formal undergraduate 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 2012 was 5.36 out of a possible 6.0.

The Department of Forest Resources and Environmental Conservation now has three 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



FREC FUTURES INTERN

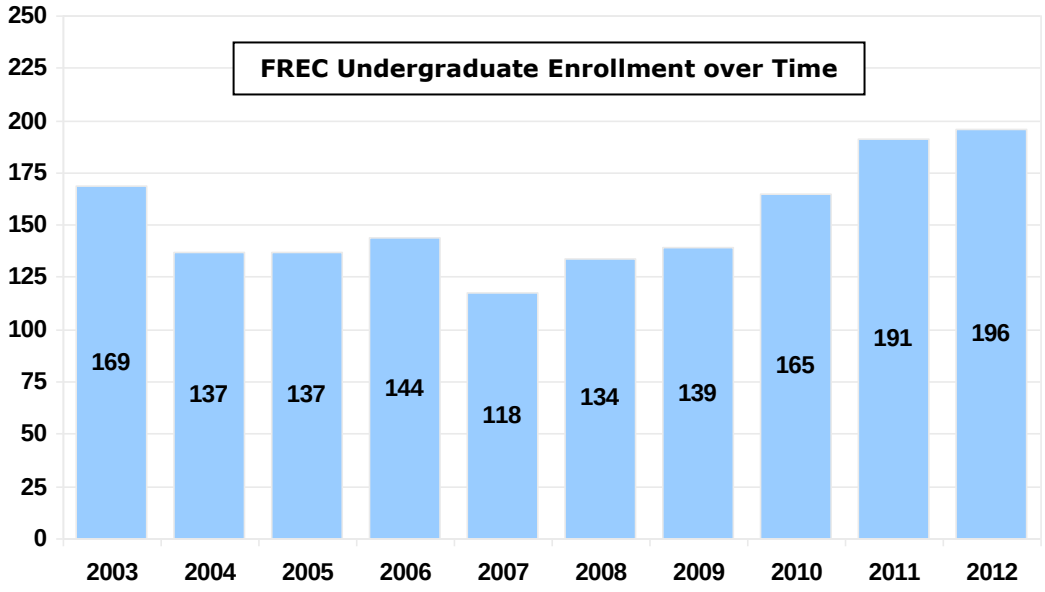
Following its March, 2012, meeting, the FREC Advisory Board made a formal recommendation that the College of Natural Resources and Environment consider deploying additional resources to support undergraduate recruiting efforts, including consideration of a marketing consultant. The Department of Forest Resources and Environmental Conservation decided to invest departmental resources in recruiting and hired Mr. Kyle Dingus in August, 2012, as the first FREC Futures Intern with the goal of promoting FREC undergraduate programs across the Commonwealth of Virginia and beyond.

Kyle was exceptionally well qualified to fill this new position, having graduated in May, 2012, with a B.S. in Forest Resource Management from Virginia Tech. He received FREC's Alumni Award for Outstanding Senior 2011-12, the David William Smith Leadership Award 2011-12, participated in the CNRE Leadership Institute 2011-12, and served as Chair of the Virginia Tech Chapter of the Society of American Foresters and President of Xi Sigma Pi Honorary Society.

Kyle has spent countless hours traveling across Virginia to spread awareness about FREC's programs. He has already visited more than 100 high schools and 13 community colleges, given 29 lectures about forestry and natural resources to approximately 443 high school students, established contacts and relationships with guidance counselors and teachers, attended community events, participated in Envirothon trainings for high school students, attended the Virginia Association of Science Teachers conference in Williamsburg, and collaborated with our two FREC Student Ambassadors to construct a career booklet for prospective students. In the future Kyle hopes to find ways to reach out to alumni and stakeholders and encourage them to serve as resources and mentors for current and potential students.

For additional information, contact:

Mr. Kyle Dingus (540) 231-1423 kdd8989@vt.edu



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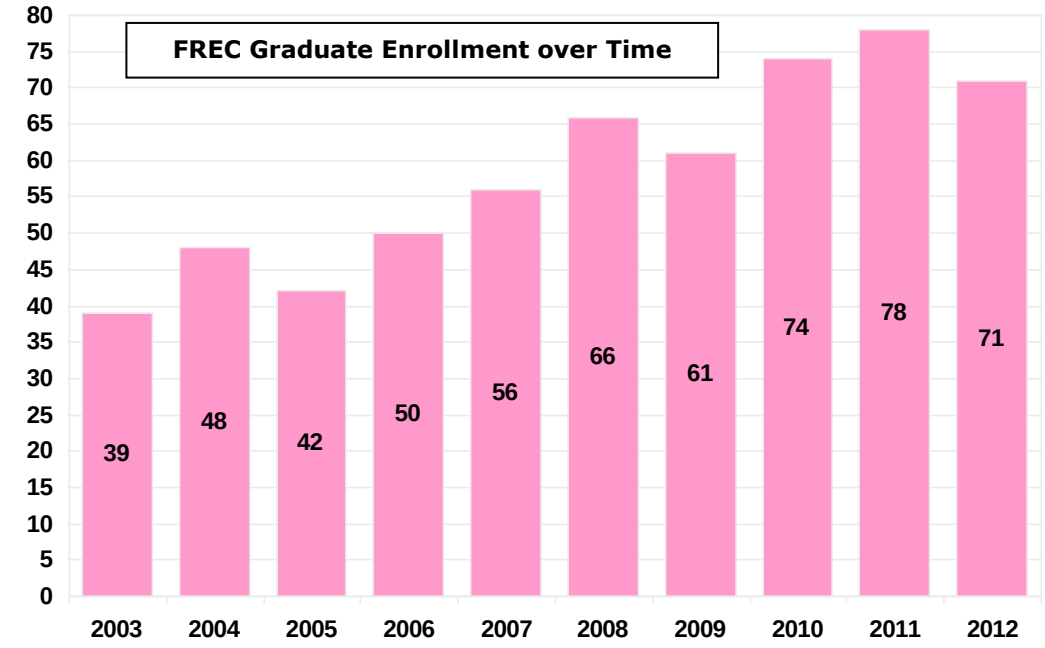
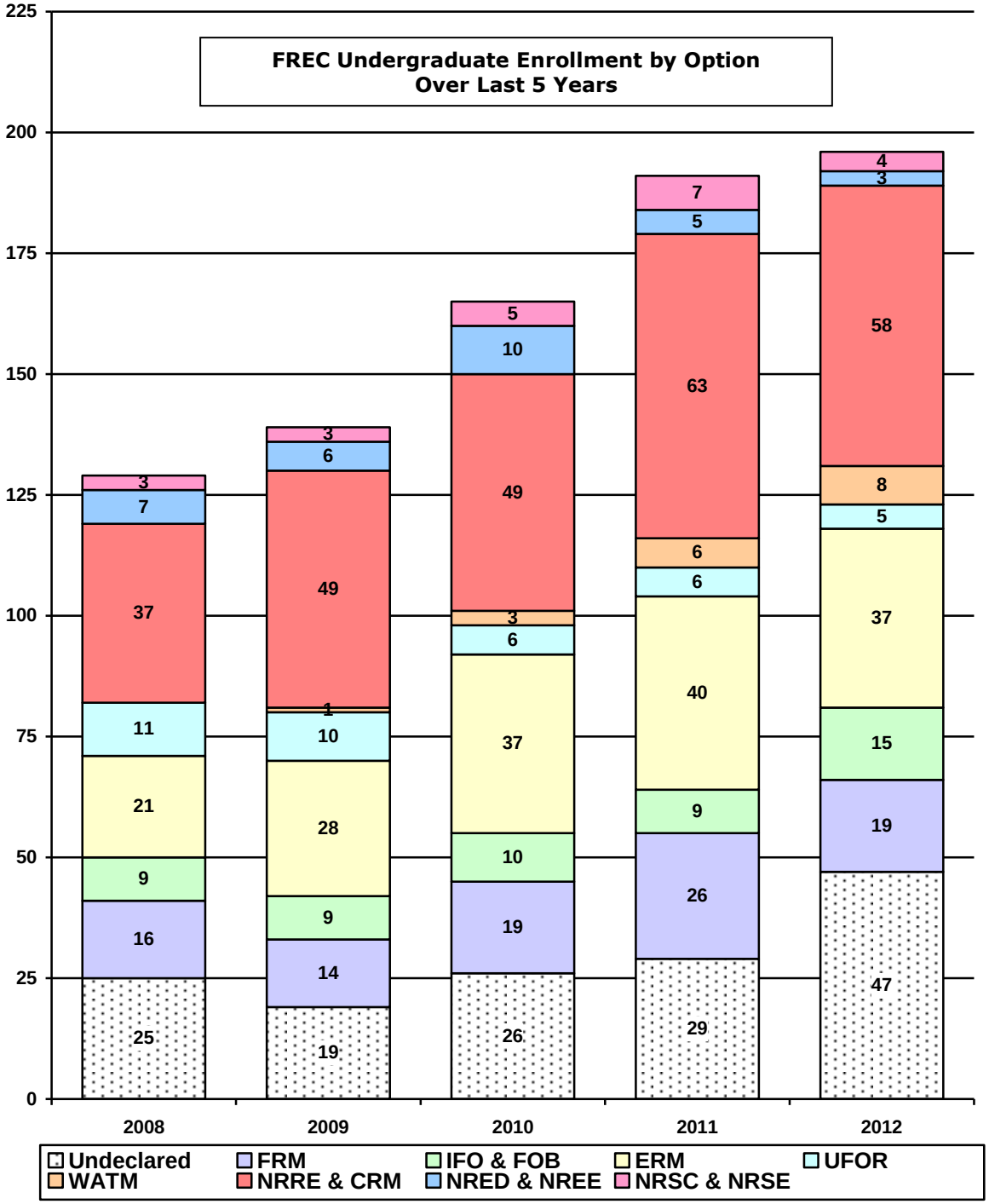
approximately 28%—were in options associated with the Department of Forest Resources and Environmental Conservation.



There were 71 graduate students (41 Ph.D. and 30 master's) in our department Fall Semester 2012. 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
2008
2009
2010
2011
2012
25
16
9
21
11
37
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FRM
IFO & FOB
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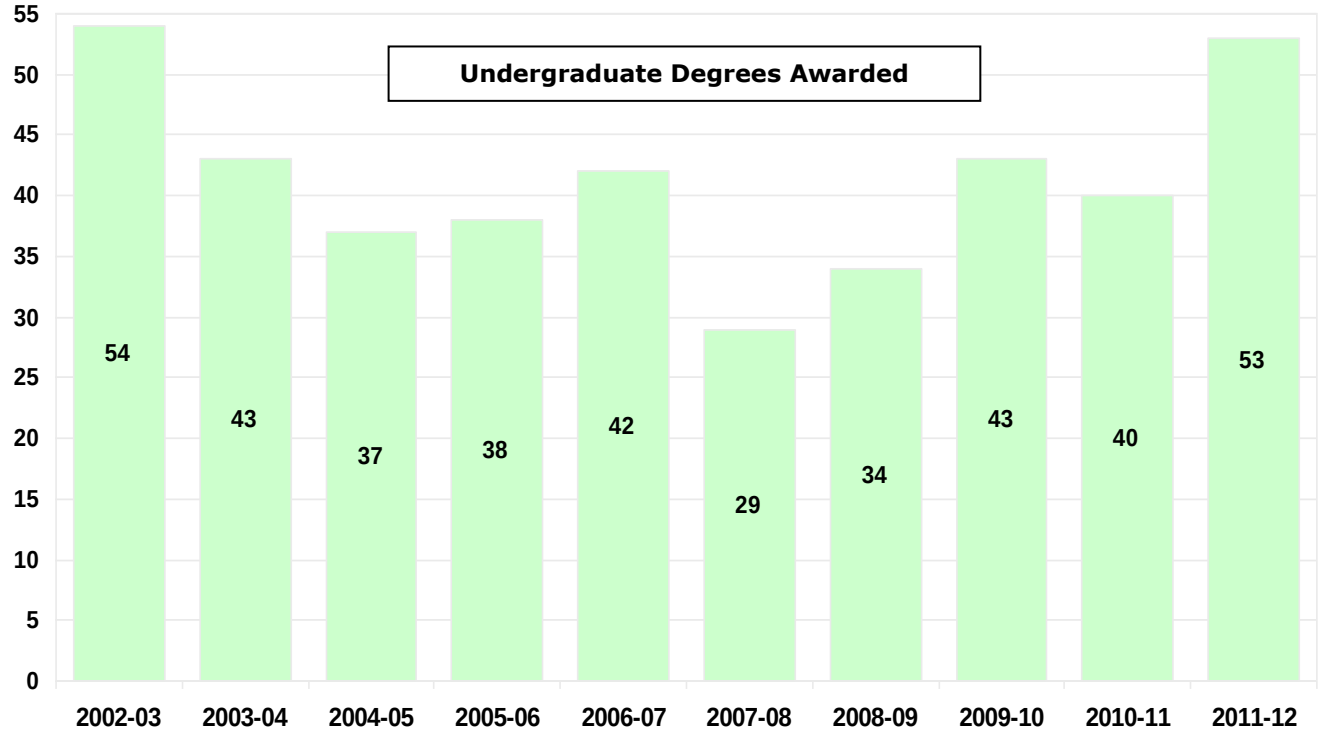
WATM
NRRE & CRM
NRED & NREE
NRSC & NRSE


Undergraduate Degrees Awarded
55
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45
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54
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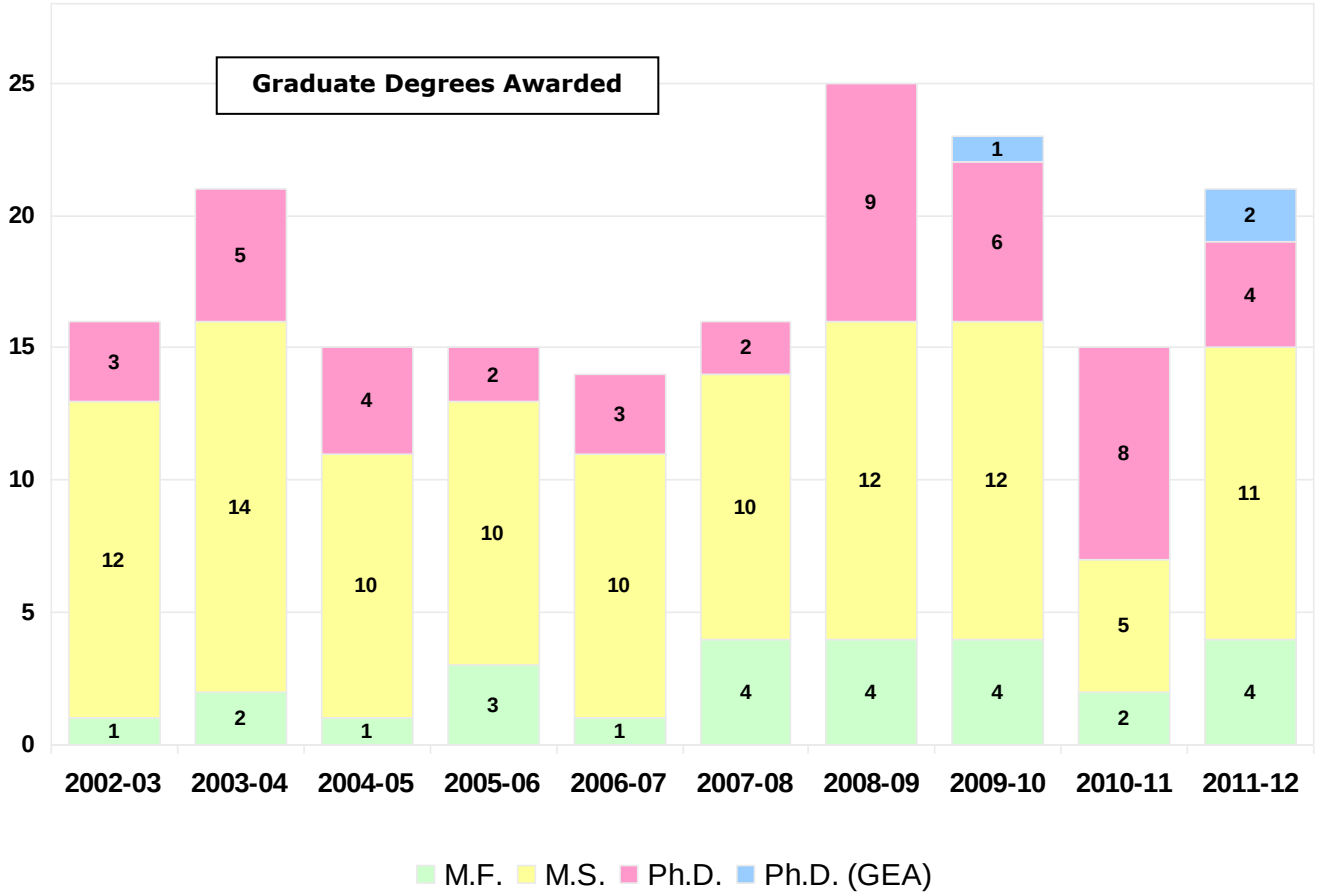
2006-07
2007-08
2008-09
2009-10
2010-11
2011-12


Graduate Degrees Awarded
25
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4
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3
3
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2002-03
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2007-08
2008-09
2009-10
2010-11
2011-12
M.F.
M.S.
Ph.D.
Ph.D. (GEA)

Graduate Degrees Awarded During 2012

Master of Forestry (7)	Graduate Chair(s)	Title of Paper
Allen, R. Sean	Brian Strahm	Evaluating the long-term effects of herbaceous ground cover on the reforestation of mined lands with native hardwoods
Christie, Adam M.	Mike Aust Shep Zedaker	Potential fireline erosion rates as influenced by rehabilitation in the mountains of southwest Virginia
Comish, Kenneth A.	Shep Zedaker	Long-term effects of silvicultural treatments used to control rhododendron in southwestern Virginia
Feldhaus, Jeffrey	Carolyn Copenheaver	Mapping of the non-native Japanese spiraea (*Spiraea japonica* L.F.) at Buffalo Mountain Natural Area Preserve
Passauer, David P.	Mike Aust	Productivity of loblolly pine plantations sixteen years after wet and dry weather harvesting and site preparation on wet flats
Reijo, Courtney J.	Kevin McGuire	Influence of riparian topography in predicting nitrogen loads in the Chesapeake Bay watershed: An application of SPARROW modeling
Roberts, E. Talcott	Chad Bolding	A ten-year analysis of timber harvesting injuries in the southeastern United States

Master of Science (14)	Graduate Chair(s)	Title of Thesis
Bawa, Rajesh K.	Jason Holliday	Signatures of natural selection and local adaptation in *Populus trichocarpa* and *Populus deltoides* along latitudinal clines
Campbell, Chad D.	John Seiler Eric Wiseman	Soil carbon dynamics in lawns converted from Appalachian mixed oak stands
Craig, Nina G.	Brian Strahm	Properties and potentials of coal mine soils in southwest Virginia 29 years after establishment
Fowler, Shannon M.	John Munsell John Seiler	Forestry education attitudes and teaching practices among high school science teachers in the southern Piedmont
Geiger, Richelle M.	Gwen Busby	Prescribed fire in a Florida landscape with mixed ownership: Spatial interactions
Martin, Caysie A.	Marc Stern	Risk management in United States Forest Service National Environmental Policy Act planning processes
Patterson, Mason F.	Eric Wiseman	Standardization of street sampling units to improve street tree population estimates derived by I-Tree streets inventory software
Stanley, William L.	John Seiler Shep Zedaker	Methods for rapid screening in woody plant herbicide development
Stein, Beth R.	Valerie Thomas	The relationship between wildlife biodiversity and landscape characteristics in Virginia

Trozzo, Katie E.	John Munsell	Potential adoption of native fruit and nut tree riparian buffers on private lands in western Virginia
Walker, David M.	Carolyn Copenheaver	Radial growth response of eastern hemlock to infestation of hemlock woolly adelgid
Wear, Laura R.	Mike Aust Chad Bolding	Skid trail stream crossing closure techniques for protecting water quality
Wilburn, John D.	John Munsell	Potential silvicultural effects on bald eagle nesting substrate and economic yields at a Navy installation in the Chesapeake Bay: An approach using the forest vegetation simulator and Mahalanobis distance
Xu, Ying	Gwen Busby	Optimal wildlife reserve site selection with spatially correlated risk

Doctor of Philosophy (3)	Graduate Chair(s)	Title of Dissertation
Gökkaya, Kemal	Valerie Thomas	Prediction of foliar biochemistry in a boreal forest canopy using imaging spectroscopy and LiDAR data
Hoover, Katherine N.	Marc Stern	Public involvement in the U.S. Forest Service
Walker, Jessica J. (GEA)	Randy Wynne	Analysis of dryland forest phenology using fused Landsat and MODIS satellite imagery

RESEARCH

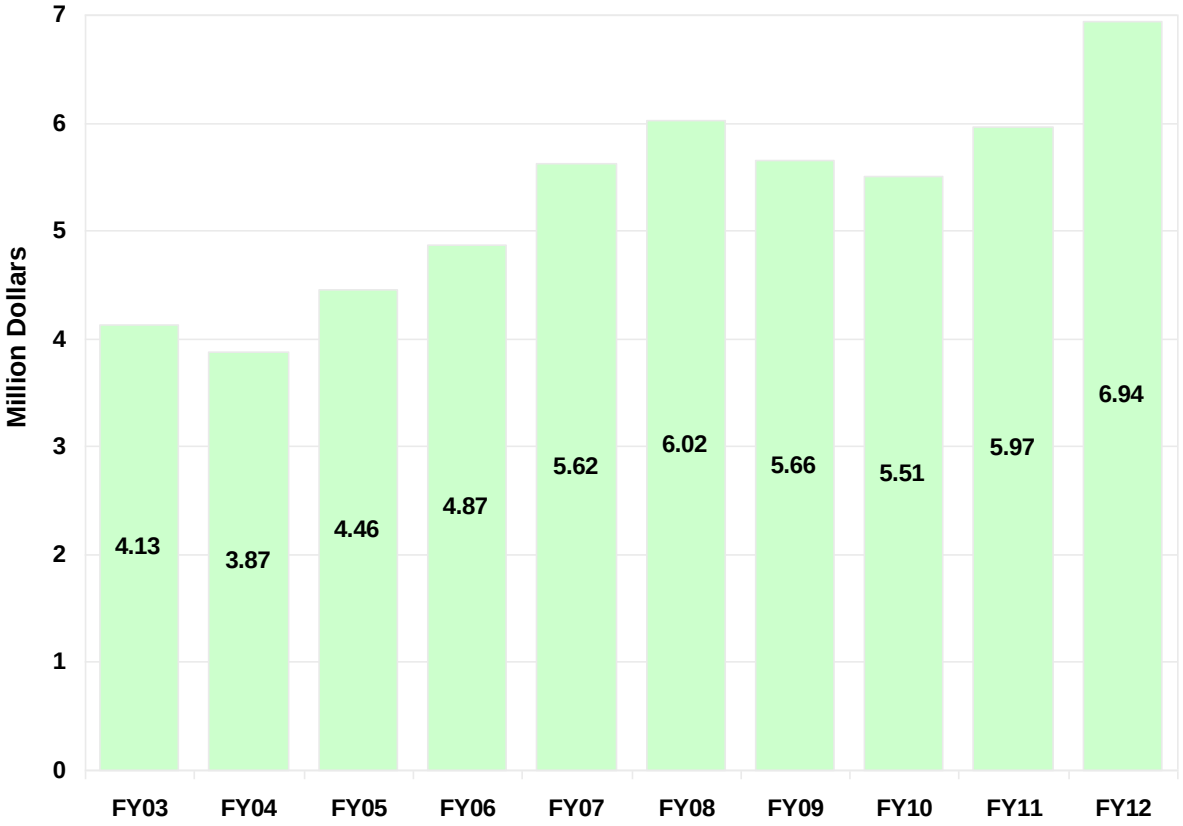
The Department of Forest Resources and Environmental Conservation at Virginia Tech undertakes research in a number of focus areas. These include:

- 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 $3.83 million in fiscal year 2012. Twenty-one students completed graduate degrees in the Department of Forest Resources and Environmental Conservation during the 2011-12 academic year; 4 M.F., 11 M.S., and 6 Ph.D.s were awarded. Thirty-two new students entered our graduate program during 2011-12.

Highlights of research activities during 2012 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.

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.

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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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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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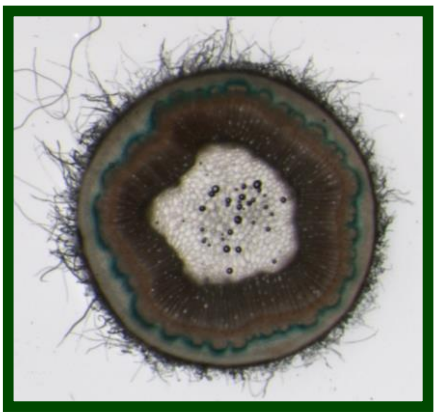
Genomics and Biotechnology

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 Tobacco Indemnification Commission.

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/). In addition to the mapping, doctoral students Isaac Jia and Earl Petzold are studying how these interacting proteins affect wood development in order to ultimately guide design of new strategies for molecular breeding of woody biomass crops.



Tree crown architecture determines light interception and photosynthesis; thus, it has a major influence on wood production. Researchers in Dr. Brunner's lab and collaborators at West Virginia University are using various approaches to identify genes controlling shoot phenology and tree form and how these genes can be manipulated to breed optimal crown structures. A high level of sylleptic branching is often associated with high biomass yield. Research Associate Xiaoyan Sheng and undergraduate researcher Joe Edwards identified a poplar gene that regulates sylleptic branching in response to soil nitrogen levels, suggesting the possibility that the MAX1 gene could be used to optimize biomass production under specific environmental conditions (e.g., lower fertilization).

In collaboration with Harold Burkhart, Carl Zipper (Crop and Soil Environmental Sciences), and GreenWood Resources, Inc., 100 hybrid poplar clones were field tested on Piedmont and Appalachian reclaimed mine land sites. The top 12 performing clones from the screening trials will be validated in yield-verification trials on Appalachian mine land and at 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, local populations will be forced to adapt, migrate, or be extirpated. In order to determine the potential for adaptation under climate change, we must first have a comprehensive understanding of the genomic basis for variation in climate-related phenotypic traits. 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* (poplar), *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 to finely map adaptive genes. To these ends we employ contemporary high-throughput sequencing to address the above questions on a genome-wide scale. A significant current focus is the genus *Populus*, for which the National Science Foundation has funded a study aimed at elucidating the genomic architecture of climatic adaptation. We are using a recently developed sequence capture technology to retrieve exons and regulatory sequences for all expressed genes in *P.* trichocarpa (black cottonwood), which will be 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 will be 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 selective constraint 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. We also recently collaborated on a successful proposal to Genome Canada to use association and landscape 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 will be 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.

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. Now we recognize the important role this green infrastructure plays 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 stormwater mitigation, 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. For more information see http://urbanforestry.frec.vt.edu/stormwater/.

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. For more information on the Virginia Urban Tree Canopy project, visit http://gep.frec.vt.edu/. To learn how Virginia Tech is assisting communities with urban forest assessment, visit http://urbanforestry.frec.vt.edu/eco.html and http://urbanforestry.frec.vt.edu/streets/.

Soil Rehabilitation to Improve Urban Tree Growth and Soil Function

Urbanization typically damages soils because of construction activities such as heavy equipment use and grading. These activities produce compacted soils with low organic matter, even in the lower soil horizons. These unfavorable conditions result in decreased tree health and life expectancy, as well as decreasing stormwater infiltration. This long-term experiment is assessing the effects of a subsoil rehabilitation technique on soil carbon dynamics, greenhouse gas emissions, infiltration, and root growth, as well as canopy growth. Results will be used to improve tree ordinances and land development practices. See http://urbanforestry.frec.vt.edu/SRES/ for more information.

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://urbanforestry.frec.vt.edu/
http://www.landcarecentral.org/
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 hardwoods and pure stands of yellow-poplar. Current work includes development of models for South American pine plantations and models for longleaf pine in the U.S. 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. 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 partnership working to create innovative solutions to enhance forest productivity and value through the sustainable management of site resources. The partnership is led by faculty at Virginia Polytechnic Institute and State University (Thomas Fox), North Carolina State University (Jose Stape), and the Universidad de Concepción (Rafael Rubilar). The FPC conducts research in plantation silviculture, forest nutrition, ecophysiology, soils, plant community ecology, growth and yield modeling, remote sensing, spatial analysis and GIS, and statistics.

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 three host universities, forest industry, timber management investment organizations, forestry consultants, governmental agencies, private landowners, and others interested in intensive plantation management. There are currently 55 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, Mexico, Uruguay, and Venezuela and collectively own or manage over 25 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
- maintaining a diversity of game and non-game wildlife species
- 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
- building relationships between experienced and less-experienced private forest landowners
- creating dialogue and cooperation within Virginia's natural resources community and among private forest landowners.

Real Forestry for Real Estate

Transfer of forest ownership presents an excellent opportunity for forestry Extension professionals to make contact with new landowners, share management information, and encourage a view of woodlands as potential sources of income, wildlife habitat, recreational opportunities, firewood, and ecosystem services, all of which may be improved by active forest management. To reach landowners early in their tenure, the VFLEP developed a new program, *Real Forestry for Real Estate (RFRE)*.

This program has two components. First, we developed New Landowner Packets. The goal of these packets is to make new forest landowners aware of (1) the importance of the resource they now own, (2) opportunities for education and technical assistance, and (3) voluntary conservation programs such as Tree Farm. Packets contain a broad array of information including materials from the public, private, and forest industry sectors. The materials were selected to appeal to a wide array of forest landowner motivations and to increase awareness of the many natural resource services available. Included in each packet is a postage-paid postcard which can be returned to the VFLEP to receive more information on forestry Extension programs.

The second component of this program involves dissemination of the New Landowner Packets. We decided to recruit professionals with whom new landowners have already established a relationship—their real estate agents. To recruit real estate professionals, the VFLEP developed real estate continuing education courses which are offered 6-10 times per year throughout Virginia. The courses focus on the importance of forests and forestry and provide real estate professionals with tools which may help them better market their product (i.e., rural land). At the end of each class, we discuss the New Landowner Packets and distribute a set number to each participant with instructions to hand them out to clients interested in purchasing forested lands.

To date 14 classes have been offered to 454 attendees. Over 1,500 New Landowner Packets have been distributed to be handed out to their clients. Participants' reactions have been favorable: "I have attended 2 of your programs and they are outstanding. The instructors are great and the material is great. This hands-on approach is so much better than the canned programs. I realize that it probably has a limited market, but for the professionals that are serious about knowing the facts, these are the best programs I have taken in my 40 years of real estate experience. Keep up the good work!"

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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:

- *Marketing in a Virtual World* – provides instruction to owners of small/rural businesses on how to include their businesses on location-based service applications (car navigation systems, smartphone applications, etc.)

- *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.
- *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
- *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)
- *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 1,221 active volunteers. Since the program's inception in 2006, these volunteers have contributed 293,139 hours of service—with a value of $6.4 million—to the Commonwealth of Virginia.

In 2012 Virginia Master Naturalist volunteers completed more than 20,000 hours of service on projects to educate the public about natural resources. They made more than 89,000 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 20,000 hours of service on stewardship projects, such as habitat restoration and trail maintenance, in 2012. Their efforts positively impacted more than 1,200 acres of land and more than 1,000 miles of trails and streams in Virginia. For example, Master Naturalists of the Arlington Regional chapter have supported efforts to protect Barcroft Park from the spread of non-native, invasive species. The park has been identified by Arlington County in its Natural Resources Management Plan as one of the most valuable ecological sites owned by the county with globally rare and state rare wetlands and locally rare native plants, as well as State Champion, County Champion, and significant trees. In 2012 chapter members reported some 250 hours in volunteer service at the park, helping conserve this valuable natural area.

Also in 2012 Virginia Master Naturalists completed more than 22,000 hours of citizen science, collecting data on wildlife populations, urban forests, and aquatic habitats in their communities. This data will help natural resource agencies and scientists better understand the current status of and changes in plant and animal populations and their habitat quality in the Commonwealth.

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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 2012 the core SHARP Logger Program was offered at five locations throughout the Commonwealth, and 101 "new" SHARP loggers completed the core program. Twenty-four continuing education classes offered for SHARP Logger CE credits were offered across Virginia, and 983 individuals attended at least one program to earn SHARP Logger CE credits. These SHARP Loggers received a combined total of over 7,700 hours of training in 2012. As of January 1, 2013, there were a total of 1,360 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 2012 include:

- Biomass harvesting workshop and equipment demos
- Logging business management workshop
- Chainsaw safety
- GPS for loggers
- Basic timber cruising workshops
- Logging safety awareness workshop & OSHA refresher
- Basic finance 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 traveled to Colombia to participate in meetings and events associated with VIII International Symposium: Access to Energy and Sustainability.

GREGORY AMACHER traveled to Finland to give the keynote talk at the Fourth Faustmann Symposium on forest economics, and he hosted Markku Ollikainen of the University of Helsinki for the purpose of working on research related to forest economics and ecosystem services. Dr. Amacher also continued to work on two internationally focused projects, a USAID-funded grant to consider adoption of conservation-based agriculture and adaptation to climate change for poor farmers in the Central Plateau of Haiti and a NASA-funded grant to consider the value of various institutional arrangements for fishing and grazing in the flooded lowlands of the Varzea of the Amazon basin in Brazil.

As part of a USAID SEED grant awarded to Dr. Alice Muchugi of Kenyatta University, *AMY BRUNNER* travelled to Kenya to become familiar with the ecology of the native Kenyan poplar, *Populus ilicifolia*, present a North American perspective on *Populus* research, and discuss plans for future collaborative work with Dr. Muchugi and colleagues from the World Agroforestry Centre and Kenya Forestry Research Institute. Dr. Brunner also served on the Scientific and Economic Advisory Council (SEAC) of the Malaysian Rubber Board. She attended the SEAC annual meeting in Kuala Lumpur to review proposed and ongoing projects in rubber tree genomics and biotechnology and presented a seminar at a post-meeting scientific session.

HAROLD BURKHART traveled to Oslo, Norway, to participate in the first annual workshop of a project aimed at developing decision support models for guiding forest management policies in Norway. As part of the workshop he presented an overview of research on growth and yield of loblolly pine following thinning. He also traveled to Beijing, China, to provide an overview of field studies installed and analyses conducted by Virginia Tech for purposes of growth and yield modeling of pine plantations.

CAROLYN COPENHEAVER collaborated with a doctoral student and faculty members in the forestry program at the University of Tehran on a research project examining patterns of coarse woody debris in old-growth Oriental beech forests in northern Iran.

THOMAS FOX is Co-Director of the Forest Productivity Cooperative (FPC). He works with colleagues at North Carolina State University, the University of Concepcion in Chile, the Institute of Forest Research (IPEF) in Brazil, and with forestry industry throughout Latin America. The FPC is dedicated to creating innovative solutions to enhance forest productivity and value through the sustainable management of forest and site resources. There are currently 62 private industry members of the FPC who own and manage more than 10 million acres of pine and eucalyptus plantations in Latin America. The FPC has active research and outreach programs in Mexico, Guatemala, Colombia, Venezuela, Ecuador, Brazil, Uruguay, Argentina, and Chile. In partnership with its members, the FPC has established and maintains an extensive network of research sites in these countries that also serves as a demonstration network throughout the region. The Cooperative's approach to problem solving includes a mix of fundamental research, applied research, graduate education, technology transfer, continuing education, and outreach. This mix provides an excellent environment for addressing pertinent questions and immediately incorporating research results into appropriate forest management practices throughout Latin America. To facilitate technology transfer and outreach activities, the FPC maintains a website (http://www.forestproductivitycoop.org/) that is produced in English, Spanish, and Portuguese.

JASON HOLLIDAY is collaborating with co-PIs at the University of British Columbia and the University of Alberta on the Genome Canada-funded "Adaptree" project, which aims at better understanding the genomic basis for climatic adaptation in lodgepole pine (*Pinus contorta*) and interior spruce (*Picea glauca* x *Engelmanii*). This information will then be used to develop new seed transfer policy aimed at maximizing productivity and adaptability of reforested lands.

BRUCE HULL traveled with other Virginia Tech faculty for research sponsored by the Center for Leadership in Global Sustainability and The Nature Conservancy to study a market-system

innovation involving collaborations among Cargill, The Nature Conservancy, Brazilian landowners, and Brazilian government agencies. These organizations are motivated to partner by concerns about loss of ecosystem services from conversion of tropical rainforest to soy fields, the overrunning of Brazilian law and internal capacity to direct its land use, biodiversity loss, climate change mitigation, soil depletion and consequent threats to long-term food security, displacement of indigenous cultures, and unfair labor conditions. The group critically examined the relationships and the implications for Brazil's Forest Code, which has been widely noted for curtailing Amazon deforestation.

JOHN MUNSELL is leading research on the roles of identity, cooperation, and technique preferences in the adoption of agroforestry systems by Central African Republic refugees and host-national Cameroonians in the Adamaoua Province of Cameroon in Western Africa. The objective is to improve food security and resource sustainability in the region by helping aid agencies such as the International Medical Corps successfully integrate trees into gardening and farming systems in areas where refugee populations have increased. Elizabeth Moore, the graduate student investigator, was recently recognized as an Outstanding Young Scientist by the International Union of Forestry Research Organizations' Small Scale Forestry Working Group.

STEPHEN SCHOENHOLTZ was an invited participant on the evaluation panel for the Swedish Foundation for Strategic Environmental Research (MISTRA) Future Forests Research Program. This is the largest forest research program in Sweden and is reviewed by an international panel every five years. He also co-led 28 students from Virginia Tech, Clemson, and San Diego State University for Virginia Tech's 2012 Study Abroad in New Zealand.

MARC STERN worked with Nabin Baral (Ph.D., 2009) and Dr. Tom Hammett on a project assessing ecotourism in the Annapurna Conservation Area in Nepal. He also worked with Daniel Waiswa (Ph.D., 2012) and Dr. Stephen Prisley on research in Uganda examining the drivers of deforestation in the Lake Victoria Crescent. Dr. Stern traveled to Edmonton, Canada, to present research results on natural resource planning processes at the International Symposium for Society and Resource Management and served as a grant reviewer for the Social Sciences and Humanities Research Council of Canada. Dr. Stern is a member of the IUCN (World Conservation Union) World Commission on Protected Areas and the IUCN Commission on Education and Communication.

BRIAN STRAHM served on the Planning Committee of the 12th North American Forest Soils Conference held in White Fish, Montana.

JAY SULLIVAN attended and presented a paper at the Fourth International Faustmann Symposium, "Forest Economics under Multiple Challenges," in Saariselkä, Lapland, Finland.

VALERIE THOMAS was selected to be the College of Natural Resources and Environment's representative to the International Faculty Development Program in Riva San Vitale, Switzerland, where she participated in a number of collaborative initiatives at higher education institutions in Switzerland, Italy, and Germany. As part of this trip, she visited colleagues at the Max Planck Institute in Jena, Germany, where she presented a research seminar.

SHEPARD ZEDAKER traveled to Belize to attend the Building Capacities for Sustainable Forested Landscapes' Stakeholders Forum at the University of Belize. He met with representatives from the Belize Forest Department, the Yalbac Ranch Forest, Forest Land Group, Belize University, U.S. Embassy to Belize, and Partners of the Americas to discuss forestry capacity-building initiatives for Belize. The focus was on increasing the capacity of forest managers for wildland fire suppression and prescribed fire use.

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