DEPARTMENT OF FOREST RESOURCES AND ENVIRONMENTAL CONSERVATION

ANNUAL REPORT 2016

Virginia Tech
College of **Natural Resources and Environment**

Department of
Forest Resourcs
and Environmental
Conservation

2016
Annual Report

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IN THIS ISSUE

From the **Department Head**

Forests comprise nearly one-third of land cover worldwide, cover more than 60% of Virginia, and forested ecosystems and associated watersheds represent a critical aspect of state, national, and worldwide environmental health and human well-being. With their extent and composition, forests play an important role in sustaining the earth's climatic conditions, representing a key component of global carbon and water cycles, and land surface albedo. Forested watersheds are fundamental in providing quantities and qualities of water, both surface and subsurface, to support human life. Forests contain and support floral and faunal populations locally and internationally, and comprise critical habitats for threatened and endangered species. Economic and social systems in many parts of the world are dependent upon healthy forests to provide products ranging from lumber and fiber to commercial biofuels, fertilizer, fodder, and household fuels, as well as many other market and non-market goods and services that sustain local households in developing countries and robust economic conditions in developed regions, including our own Commonwealth. Urban forests provide seemingly innumerable benefits to populated areas, as well.

Conservation/management of forested ecosystems is a complex endeavor, involving biological-geological-chemical aspects which are inseparably linked with social-political-economic institutions and realities, all of which span ownership and political boundaries. The work ranges from hands-on, boots-on-the-ground field effort, remote sensing and data analytics, laboratory science, planning and policy analysis, to assessment of human needs, impacts, and motivations. How privileged we are in FREC to be a part of a program that has been recognized as being at the forefront in addressing and providing the future professionals to address these complex issues, regionally, national, and internationally. We are committed to passing on the science and practice of the field, providing the highest quality education in forestry and environmental resources management, and I believe that is much of the reason we currently are experiencing unprecedented demand for our graduates. That demand has been so strong that growing our enrollment is perhaps our biggest challenge going forward. We appreciate the many who have contributed financially and participated out of their personal time to get the word out and build this program into what it is today, and we continue to look forward toward increased efforts to build and grow in serving our students, our partners, our Commonwealth, and all those who rely on forests in some way.

Thank you all for the part that you play in this important endeavor with us!

Board of Visitors Pays Tribute to Professor Emeritus John Hosner with Honorary Founding Dean Title

John Hosner, professor emeritus of forestry at Virginia Tech, has been recognized with the additional tribute of "honorary founding dean" of the College of Natural Resources and Environment by the Virginia Tech Board of Visitors.

This honor comes as the College of Natural Resources and Environment marks the 25th anniversary of its founding in 1992, when it was known as the College of Forestry and Wildlife Resources. Hosner, who was named professor emeritus in 1992 and at age 91 still comes to his office at the college every day, played a significant role in the establishment of the college.

Hosner also sought the support of industry leaders to grow the program into a college. In 1976, his department became the School of Forestry and Wildlife Resources.

In 1992, the school became the College of Forestry and Wildlife Resources, and Greg Brown became the college's first dean. Over the years, the new college experienced additional name changes to reflect the broadening scope of studies in order to be relevant to society's changing needs.

In his three decades of leadership from 1961 to 1992, Hosner's focus on excellence propelled the college into the national spotlight among peer programs. Today, two of the top 10 research departments at Virginia Tech reside in the college.

Hosner is a Fellow in the American Association for the Advancement of Science and has received many other professional and academic awards during his career. In 1982, Hosner established an endowment fund to ensure the college would always grow, and engaged industry partners to contribute generously to the fund, which was named the John F. Hosner Legacy Fund in 2015.

Excellence......

John Peterson was one of the recipients of The President's Award for Excellence for 2016. The award is presented annually to up to five Virginia Tech staff employees who have made extraordinary contributions by consistent excellence in the performance of their jobs or a single incident, contribution, or heroic act. Each recipient is awarded a $2,000 cash prize.

John has been a lab specialist advanced for the university for 22 years, providing extensive work for administrators, faculty, and graduate students. He has helped develop Virginia Tech's tree biology web, computer and smartphone-based educational material since 1997. More recently he was a part of the team that created vTree, the most downloaded mobile application for tree identification.

Peterson has also been the primary programmer of Woody Plants in North America, a tree identification multimedia tutorial with 960 species and over 25,000 color photographs.

Outside of his official duties, Peterson is known for his outreach, service, and teaching for the department. He often hosts the Virginia Master Naturalists at his farm for a tree walk and picnic dinner. His outreach work includes reaching middle and high school students with forestry knowledge.

Massive Southeastern Pine Research Project Earns National Partnership Award

When people consider large-scale crops that contribute to modern society, wheat and corn often come to mind. But for many in the southeastern United States, pine is key. That's why, when the USDA offered a grant for coordinated agricultural projects, a team of researchers banded together to propose an unprecedented study on southern pine forests.

The Pine Integrated Network: Education, Mitigation, and Adaptation project, better known as PINEMAP, began in 2012 when Tim Martin, professor of tree physiology at the University of Florida, along with representatives from 11 southeastern land-grant universities and a host of other research cooperatives, proposed a five-year research project to determine how changes to climate could affect pine forests in the Southeast. This team of scientists, educators, and extension professionals worked to develop a plan to help forest landowners increase carbon sequestration, increase the efficiency of fertilizer inputs, adapt forest management approaches, and plant a larger variety of trees to increase forest resilience and sustainability under a changing climate. PINEMAP initially had three main goals: research, outreach, and education. The project's recent selection for a Partnership Award by the USDA National Institute of Food and Agriculture is recognition of the successful integration of those three missions.

Tom Fox was the lead principal investigator on Virginia Tech's portion of the project. He also served as the overall lead principal investigator for silvicultural research on PINEMAP as well as the integration team leader for mitigation. Virginia Tech's team, based in FREC, also included faculty members Harold Burkhart, Jason Holliday, John Seiler, Brian Strahm, Quinn Thomas, Valerie Thomas, and Randy Wynne, as well as more than a dozen graduate students, post-doctoral associates, and staff members.

Wynne worked with climatologists to develop climate models that would account for a variety of potential climate changes. They created climate predictions from 2070 through 2100, a time period that will see a net increase in forest growth and plant productivity because of more CO_2 in the atmosphere. Landowners will need to know how to manage these changes.

Seiler helped lead the educational component of PINEMAP. Over the course of four years, 45 undergraduate students from universities across the United States, Puerto Rico, and Canada completed the Undergraduate Fellowship Program. The student fellows spent a summer conducting research alongside PINEMAP investigators. In the fall, they enrolled in a Virginia Tech virtual course called Effective Communication Skills, in which they learned

to communicate what they had learned to a broad range of audiences, including middle and high school students near their home universities. PINEMAP undergraduate fellows presented lessons to over 7,400 students at 95 different public schools.

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Ultimately, the PINEMAP project affirmed that researchers are on the right track to effectively maintaining the Southeast's pine forests. The PINEMAP efforts will continue well beyond the end of the current grant, with continued research on the pine forest ecosystem that is so important to the region's economy and continued education and outreach to landowners.

Teaching and Research Faculty

Jay Sullivan - *Professor and Head*

Greg Amacher - *Julian N. Cheatham Professor of Forestry*

W. Michael Aust - *Professor*

Scott Barrett - *Assistant Professor and Extension Specialist*

M. Chad Bolding - *Associate Professor*

Amy Brunner - *Associate Professor*

Harold Burkhart - *University Distinguished Professor*

Kelly Cobourn - *Assistant Professor*

Carolyn Copenheaver - *Associate Professor*

Susan Day - *Associate Professor*

Thomas Fox - *Garland Gray Professor of Forestry*

Jason Holliday - *Associate Professor*

Bruce Hull - *Professor*

Jeff Marion - *Unit Leader/Scientist, Cooperative Park Studies Unit, USGS Patuxent Wildlife Research Center*

John McGee - *Professor and Geospatial Extension Specialist*

Kevin McGuire - *Associate Professor*

Daniel McLaughlin - *Assistant Professor*

John Munsell - *Associate Professor and Extension Specialist*

Philip Radtke - *Associate Professor*

Stephen Schoenholtz - *Professor and Director of the Virginia Water Resources Research Center*

John Seiler - *Alumni Distinguished Professor*

Michael Sorice - *Assistant Professor*

Marc Stern - *Associate Professor*

Brian Strahm - *Associate Professor*

R. Quinn Thomas - *Assistant Professor*

Valerie Thomas - *Associate Professor*

Eric Wiseman - *Associate Professor*

Randolph Wynne - *Professor*

Research and Multicultural Partnership Uncovers Climate Change in Trees

Funded by a grant from the U.S. Department of Agriculture's Agriculture and Food Research Initiative on Climate Variability and Change, Carolyn Copenheaver, along with student Brittany Butcher and faculty member Ketia Shumaker of the University of West Alabama, studied the effects of climate change on sugar maples. Six U.S. universities will be involved in the climate change study, which is part of a larger three-year project. Each university will be responsible for researching how a different set of tree species reacts to changing climate conditions.

The researchers visited the Allegheny National Forest in northwestern Pennsylvania to understand the effects of climate change on trees on the East Coast. Tree core samples were collected.

The researchers used temperature and precipitation data to analyze the tree rings, but were puzzled to find no real relationship between this data and how fast the trees were growing. A breakthrough came when discussing the project with colleagues at the University of Alaska in Fairbanks, another participant in the Department of Agriculture study.

"They suggested looking at relationships between tree groups before 1950 and tree groups after 1950," said Copenheaver. "The effects of climate change really began to appear during that later time period."

Once the researchers changed their focus, they soon discovered that prior to 1950, sugar maples were not particularly sensitive to precipitation levels. Post-1950, however, they became increasingly sensitive.

According to Copenheaver, drought conditions caused by climate change have put stress on the trees. "Before 1950, these trees didn't experience drought conditions. Now that they do, the trees are changing how they are responding to climate. Even though we don't have mortality in Eastern forests like in some other places, we are seeing stress related to lack of moisture."

The Multicultural Academic Opportunities Program's Summer Research Symposium was held in August, and student Brittany Butcher presented a poster and oral presentation of the group's findings. Hosting 46 interns from around the U.S., the program is designed to increase representation of traditionally underrepresented groups in graduate programs at Virginia Tech and provide holistic support to both undergraduate and graduate students.

Butcher's internship included preparation for graduate school through a variety of workshops, professional development opportunities, and Graduate Record Exam prep courses offered through the program, in addition to conducting research with Copenheaver and Shumaker. Butcher plans to return to Virginia Tech to pursue a master's degree in geography.

Soil Rehabilitation

and shrubs whose roots help the soil continue to develop. This approach works because it doesn't just break up the soil; it also affects biological activity in the soil. This is a useful tool for designers seeking SITES (Sustainable Sites Initiative) accreditation for the U.S. Green Building Council.

The rehabilitation process was developed by Day, faculty colleagues, and graduate students in both colleges over the course of seven years of research at Virginia Tech and in Arlington County, Virginia, in partnership with Vincent Verweij, Arlington County's urban forester.

The researchers evaluated five tree species — red maple, swamp white oak, bur oak, elm, and cherry — over six years in response to soil profile rebuilding in comparison with typical development practices and undisturbed agricultural soil at a long-term experimental plot area.

Virginia Tech researcher Susan Day and other faculty in the College of Agriculture and Life Sciences, and three former FREC students, have developed a soil rehabilitation method that can help fix compacted, rock-hard soils left behind after land development and building construction.

Trees planted in these situations have as much as 84 percent greater canopy than those in untreated soil, as they are stripped and compacted and mixed and layered until they have little in common with soil in agricultural and forested lands. The soil profile rebuilding method uses compost and special subsoiling techniques to create pathways through soil for root and water penetration. A backhoe is then used to break up the compacted soil incorporating compost to a depth of two feet. Four inches of topsoil is then applied and rototilled to a depth of six to eight inches, followed by planting of trees

They measured tree growth and mortality of three additional tree species — ginkgo, scarlet oak, and katsura — one year after planting with and without soil profile rebuilding in 25 plots along major thoroughfares in Arlington. Soil rebuilding resulted in 77 percent greater trunk cross-section area growth after one year.

Research and Extension Faculty

Research Faculty

Timothy Albaugh - *Research Associate*

Ralph Amateis - *Senior Research Associate*

Hua Bai - *Postdoctoral Associate*

Christine Blinn - *Research Scientist*

Evan Brooks - *Research Scientist*

Carol Franco - *Senior Research Associate*

Kevin Horn - *Postdoctoral Associate*

Nathaniel Jones - *Postdoctoral Associate*

Andrew Laviner - *Research Associate*

Kyle Peer - *Senior Research Associate & Superintendent, Reynolds Homestead Forest Resources Research Center*

Xiaoyan Sheng - *Research Associate*

Kirsten Silvius - *Senior Research Associate*

Matthew Sumnall - *Postdoctoral Associate*

Rita Teixeira - *Research Scientist*

David Walker - *Research Associate*

Extension Faculty

Jennifer Gagnon - *Coordinator, Virginia Forest Landowner Education Program*

Michelle Prysby - *Virginia Master Naturalist Director*

Vinson, Andrew - *Project Associate*

South America's Invasive Beavers

Beaver imported decades ago from North America to Tierra del Fuego in South America now number over 100,000 and are causing significant ecological damage. North American beavers have wiped out 30 percent of forests along rivers and streams in Tierra del Fuego, a remote archipelago located at the southern tip of South America. This has caused the greatest landscape change to the forests in the last 10,000 years.

In order to eradicate them, it requires the participation of every landowner in the area. Research shows that payment programs help, but getting all landowners on board is the problem. Michael Sorice and graduate student Anna Santo (M.S. Forestry - 2015) studied landowner preferences in this island chain on the other side of the world. Their research found that landowners were willing to participate in a beaver removal program designed around landowners' unique interests. Specifically, landowner participation increased under certain conditions including increased payments, increased expectations of program success, and low requirements for landowner involvement.

The research suggests that identifying landowner preferences during the design phase of a conservation program can result in innovative agreements better adapted to the local context. "Payment programs for ecosystem services are about more than just payments," Sorice said. "When they are codesigned with local stakeholders, they will achieve wider participation."

Appalachian Trail Study

Virginia Tech is conducting a National Park Service-funded four-year study of the Appalachian Trail to assess the condition of the tread, visitor-created side trails, and associated recreation sites (shelters, campsites, and day-use sites).

The study is led by Jeff Marion (FREC and the U.S. Geological Survey) and Jeremy Wimpey, a recent FREC Ph.D. Field staff include Johanna Arredondo (FREC M.S. student), Mitch Rosen (FREC undergraduate), and Fletcher Meadema (a recent VT undergrad).

During the summer of 2016 they assessed the southern one-third of the A.T., from Blacksburg to Springer Mountain, GA. The study will establish baseline resource conditions from a 10% sample of the trail, and enable statistical modeling aimed at identifying the influential factors that affect recreation-related impacts.

Results will be applied to develop Best Management Practices for the sustainable design and management of the Appalachian Trail's tread and recreation sites, and to improve low-impact Leave No Trace practices.

Adjunct and Emeritus Faculty

Adjunct Faculty

Janaki Alavalapati - *Professor*

Christopher Anderson - *Professor*

Scott Bailey - *Research Geologist*

Gwenlyn Busby - *Research Associate*

David Chojnacky - *Unit Leader (retired)*

John Coulston - *Research Forester*

Alex Finkral - *Senior Forester*

Jennifer Knoepp - *Research Soil Scientist*

William Lakel - *Water Quality Program Supervisor*

Christopher Maier - *Research Biological Scientist*

Rafael Rubilar - *Associate Professor*

Erik Schilling - *Senior Research Scientist*

David Soucek - *Associate Research Program Leader*

Jared Westbrook - *Assistant Professor*

Emeritus Faculty

Robert E. Adams

Gregory N. Brown

Gregory J. Buhyoff

James A. Burger

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

Different Tree Species Use the Same Genes to Adapt to Climate Change

An international research team from six universities, including Virginia Tech, is working to better understand how trees adapt to changing climates. Their results, published in the journal *Science,* discovered that two distantly related tree species use the same genes to adapt to the range of temperatures in their geographical region.

Jason Holliday and Haktan Suren are part of the team investigating how trees adapt to different climatic conditions. "A central question in biology is: How repeatable is the evolutionary process? One way to address this question is to study different species adapting to similar environments and ask whether the same genetic solutions enable that adaptation," said Holliday, who is one of the study's co-authors, along with Suren.

The team studied two different conifer tree species, lodgepole pine and interior spruce, collecting seed from more than 250 locations in western Canada and then sequencing more than 23,000 genes in each tree. Analysis revealed that both pine and spruce use the same suite of 47 genes to adapt to geographic variation in temperature and to appropriately time acquisition of cold hardiness, allowing plants to tolerate the adverse conditions of winter.

One implication of this work is that environmental adaptations may be genetically constrained. While variation in observable traits, such as cold hardiness, likely involves hundreds of genes, Holliday explained, a subset is required for adaptation to occur, even when comparing species that diverged long ago. This result has implications for ongoing adaptation of tree populations to climate change.

Drone Technology

Geospatial Education To Bring Drone Technology to Virginia's Community Colleges

The National Science Foundation's Advanced Technological Education Program provided a grant to the Geospatial Technician Education-Unmanned Aircraft Systems project. This brings the project closer to offering training on operating drones to Virginia's community college students.

John McGee has worked for almost nine years alongside the Virginia Space Grant Consortium and the Virginia Community College System expanding geospatial technician education. "There's a lot of activity in this field in Virginia already and we want to make sure that Virginia's workforce is well poised to meet emerging industry needs," McGee said.

The Virginia Space Grant Consortium and McGee have partnered with faculty from Thomas Nelson, Mountain Empire, and John Tyler Community Colleges to develop curriculam that will help instructors establish courses that will benefit students. The project seeks to provide a range of options, from individual courses to various levels of certificate programs. McGee expects that students could see small unmanned aircraft system (sUAS) courses in Virginia's community college system within the next year.

Courses will focus on helping students develop skills necessary to maintain and pilot devices safely, use and analyze data from a variety of sensors, and pass the Federal Aviation Administration's remote pilot certificate exam. McGee says that now is the ideal time to introduce the technology into Virginia community colleges because new regulations have paved the way for others to pilot aircrafts, not requiring them to have a pilot's license.

The Virginia Community College System serves as a pipeline for the workforce and for universities. John McGee is a professor within FREC and a geospatial specialist with Virginia Cooperative Extension.

What Happened at the Climate Change Conference in Marrakech?

Carol Franco and Randy Wynne participated in the negotiations of the 22nd Session of the Conference of the Parties (COP 22) of the United Nations Framework Convention on Climate Change in Marrakech, Morocco, November 7-18, 2016, as members of the government delegation of the Dominican Republic. Franco and Wynne negotiated the agenda items of Land Use, Land Use Change, and Forestry, Issues related to Agriculture, and Financing. The meeting brought together around 22,500 participants, including 15,800 government officials, 5,400 representatives of UN agencies, intergovernmental organizations and civil society organizations, and 1,200 members of the media.

The Conference focused on three main areas: (1) better understanding of the architecture of the Paris Agreement; (2) identification of areas of convergence and divergence between developed and developing countries; and (3) the adoption of a road map to achieve the necessary decisions for finalizing the operationalization of the Paris Agreement by 2018.

The Paris Agreement was adopted on December 12, 2015, in Paris, and 178 parties signed it in New York on April 22, 2016. The Agreement entered into force on November 4, 2016, after 55 parties from the convention ratified it. As of January 5, 2017, 122 parties have ratified the Agreement, while others are in the process. COP 22 in Marrakech confirmed the world's support for its implementation, with over 70 heads of state, besides ministers and heads of delegations, expressing the need and urgency to move forward to the operationalization stage.

What Happened at the Climate Change Conference in Marrakech? *continued*

Some of the main outcomes of COP 22 were:

1. Operationalization of the Paris Committee on capacity building.
2. Forward movement on discussions about the periodic "adaptation communications" (potential elements) and accounting for developing countries' adaptation actions.
3. Start of discussions on public finance accounting.
4. Start of considerations on the scope of the mechanism, what can or will trigger it, and ways to account for parties' different circumstances and capabilities.

5. Request from parties for guidance on how to organize the facilitative dialogue in 2018.

Also, during COP 22, heads of state, governments, and delegations issued a political declaration called the "Marrakech Action Proclamation for our Climate and Sustainable Development." The main goal of this proclamation was to issue a signal for a transition to a new phase of implementation and action. his proclamation calls for fast and high political commitment and further action to reduce greenhouse gas emissions, increase resilience, and foster adaptation actions. Furthermore, developed countries confirmed their pledge to mobilize US$100 billion per year by 2020 to support climate action in developing countries.

The negotiations will resume in May 2017 with the annual Subsidiary Bodies Meeting, and Fiji will assume the presidency of COP 23 to be held in Bonn in November 2017. Progress was made in Marrakech, but there is still a lot of work to be done to achieve the goals agreed upon in the Paris Agreement.

Administrative and Technical Staff

Administrative Staff

Tiffany Brown
Program Administrator

Kathryn Hollandsworth
Program Support Technician

Stacey Kuhar
Office Support Specialist

Tracey Sherman
Web and Program Support Technician

Mary Williams
Assistant to the Department Head

Technical Staff

Deborah Bird
Forest Research Assistant

David Mitchem
Senior Laboratory Specialist

John Peterson
Laboratory Specialist Advanced

E. Tal Roberts, Jr.
Laboratory Mechanic

Tyler Weiglein
Laboratory & Research Technician

Selected Honors and Awards for Faculty and Graduate Students

Susan Day was awarded the College of Agriculture and Life Sciences' Certificate of Teaching Excellence, 2016.

Tom Fox was awarded University of Maine SFR Distinguished Alumni Award.

Michelle Prysby, Adam Downing and **Jennifer Gagnon were** awarded the Bronze award for Website/Social Media/Online Courses by the Association of Natural Resources Professionals for the Virginia Master Naturalist Basic Training Curriculum: Forest Ecology and Management module. Other awardees include Ellen Powell and Karen Snape of DOF, Alycia Crall of NEON, and Matt Brinckman of the American Chestnut Foundation.

Stephen Schoenholtz was elected President of the National Institutes of Water Resources for 2016-2017.

Eric Wiseman was awarded the Alex L. Shigo Award for Excellence in Arboricultural Education in 2016 for the International Society of Arboriculture.

Selected Honors and Awards for Graduate Students

Ben Ahlswede received a 1-year fellowship from the Virginia Tech Global Chance Center.

Catherine Bukowski was awarded the Byron Fellowship. The Byron Fellowship is available by application only to 20-40 emerging leaders per year, entrepreneurs, intrapreneurs, and social entrepreneurs who are both making a profound difference in their own communities and keenly attuned to the challenges we share globally.

Carrie Jensen was awarded the VWRRC Student Research Grant, 2016 and the Pathfinder Fellowship Award, Consortium of Universities for the Advancement of Hydrologic Science, Inc., 2016.

Joshua Rady was admitted to the Interfaces of Global Change Interdisciplinary Graduate Program.

Tony Timpano was co-author on a paper published in *Science*.

Graduate Research

Amy Blood is pursuing her Ph.D. studying urban forest structure in relation to stormwater interception at large spatial scales. Blood is a Cunningham Fellow enrolled in the Geospatial and Environmental Analysis (GEA) interdisciplinary graduate program.

She is from the Pine Barrens of New Jersey where, while studying environmental science for her bachelor's degree, she fell in love with forestry and statistics. She completed her M.S. at the University of Alabama in Biological Sciences studying urban forest biometrics. Urban forestry appeals to her because she sees potential for novel uses of spatial data as well as opportunities for making a positive change in the world. Blood is working with Susan Day and Valerie Thomas.

Charlie Neaves has nearly completed a M.S. degree under the direction of Mike Aust and Chad Bolding. His research examines the long-term (25-year) effects of wet weather harvesting on soil physical properties and loblolly pine survival and growth. Neaves has presented his study at one regional meeting and has developed two manuscripts that will be submitted to peer reviewed journals.

He has served as a teaching assistant for Forest Boundaries and Roads, Forested Wetlands, and Forestry Field Experiences, and has helped numerous other graduate students with research study implementation and field data collection. Furthermore, Neaves has made presentations and provided logistical support to several professional workshops and field trips. His M.S. program epitomizes the Virginia Tech motto of "That I May Serve" as well as fulfilling the three missions of a land grant university.

Keith O'Herrin completed his Ph.D. in forestry in December 2016. His doctoral research was the centerpiece of a multi-institution project funded by the US Forest Service entitled Urban Forestry 2020. The aim of this project was to examine the current status of the urban forestry profession in the United States and provide research-based recommendations to the US Forest Service to advance the profession. O'Herrin conducted two nationwide surveys of college students and the professional peers of urban foresters to ascertain perceptions of career opportunities and professionalism in urban forestry. He also conducted a document analysis of nationwide job postings for urban foresters to characterize the qualifications, competencies, job duties, and compensation at various points on the career ladder. O'Herrin has presented his research at national meetings of both the Society of American Foresters and the International Society of Arboriculture. He is currently preparing manuscripts for all three of his studies.

Morgan Schulte (M.S. planned for May 2017) focuses her research on the hydrologic drivers of wetland structure and function in the Great Dismal Swamp (GDS) National Wildlife Refuge. Her work has included two intensive field seasons for surveying vegetation composition and peat soil characteristics to couple with continuous hydrologic data. As such, her work integrates ecology and hydrology, and has required long field days in extremely harsh conditions and a suite of laboratory analyses. Schulte's findings will advance our understanding of wetland hydrologic controls on stand diversity, organic carbon storage, and fire vulnerability in GDS and more broadly. Understanding these controls is critical for the current hydrologic restoration occurring at GDS that is aimed at reducing maple dominance, increasing peat soil accumulation, and decreasing large peat fires (e.g., two ca. 4,000 acre events in 2008 and 2011).

After graduating with a B.S. degree in forestry from National Taiwan University, **Sheng-I Yang** enrolled in the Master of Science degree program in forest biometrics at Virginia Tech in August 2014.

As part of his M.S. degree, Yang excelled in a strong set of foundational courses in statistics that prepared him well to conduct a challenging master's thesis research project that used long-term observations from a loblolly pine spacing trial to estimate maximum carrying capacity for the species. He demonstrated superior talent for conducting original research and published his thesis results in *Forest Ecology and Management* in January 2017.

During summer 2016, Yang extended findings from his M.S. thesis. That work was recently accepted for publication in *Forest Science*. Findings in these two publications have important implications and great utility for developing silvicultural prescriptions and managing forest stands.

Yang is now dual enrolled as a M.S. student in statistics and a Ph.D. candidate in forest biometrics. He is talented in quantitative analysis, highly motivated, focused, and a pleasure to have as part of our graduate student body.

Undergraduate Research

Andria Greene has been involved in undergraduate research involving the effects of forest harvesting on stream macroinvertebrates in the Ridge and Valley Region of Virginia under the direction of Dr. Mike Aust. Greene is majoring in Environmental Resource Management with an option in Watershed Management. She is enthusiastic about environmental protection and using her professional knowledge in an effective and positive manner.

Alexandria Cassell was the Virginia Big Tree Program's 2016 summer intern.

The mission of The Virginia Big Tree Program (VBTP) states that, "Our mission is to increase the care and appreciation for all trees – big and small – and educate the Commonwealth about the value of trees and forests."

Cassell writes, "As the 2016 intern, I worked closely with our volunteers and tree owners to re-certify trees measured 10+ years previously that are listed in the Virginia Big Tree database. The total number of trees that needed to be re-certified this year was 136. I personally made trips to 15 of these with Dr. Wiseman or with VBTP volunteers to help complete measurements. We checked and recorded the locations, health, and current measurements circumference, height, and crown spread of the trees. Another of my duties included error detection/correction and database management. With over 1,800 trees in the VBTP database errors are possible. I spent time examining records to find errors and correct them. Along with this I would enter or update information for

trees in our system."

"I appreciate what I gained and learned from this experience. This was an incredible opportunity to strengthen my communication skills and manage a project. Without the diligent work of the volunteers, this program would not be nearly as successful or enjoyable. I was grateful to have worked as Dr. Wiseman's intern since he makes this program so phenomenal due to his dedication. This was a wonderful internship and it was a pleasure working with the Virginia Big Tree Program."

2016 FREC Advisory Board Members

Michael P. Cerchiaro - Forest Investment Associates, Atlanta, GA

Keith W. Cline - Department of Public Works and Environmental Services, Fairfax, VA

Ethan Crockett - Bartlett Tree Experts Richmond, VA

Kyle Dingus - Virginia Department of Forestry, Warrenton, VA

Brad Fuller - Huber Engineered Woods, LLC, Crystal Hill, VA

Mike Hincher - The Forestland Group, LLC, Abingdon, VA

Brent Keefer - Hancock Timber Resource Group, Boston, MA

James Kuykendall - Glatfelter Company, Spotsylvania, VA

Easton Loving – WestRock, Appomattox, VA

Ed Milhous – TreesPlease, Haymarket, VA

Chuks Ogbonnaya - Mountain Empire Community College, Big Stone Gap, VA

Danette Poole - Virginia Department of Conservation and Recreation, Richmond, VA

Greg Scheerer – WestRock, Appomattox, VA

Lauren Stull - USDA Forest Service, Natural Bridge Station, VA

Darrel Williams - Global Science & Technology, Inc., Greenbelt, MD

Ex-Officio Members

Bill Burkman - USDA Forest Service Southern Research Station

Bettina Ring - Virginia Department of Forestry, Charlottesville, VA

Paul Howe - Virginia Forestry Association, Richmond, VA

Robert L. Doudrick - USDA Forest Service Southern Research Station

Extension

In 2016, Virginia Cooperative Extension, the Virginia Forest Landowner Education Program, and partners, celebrated the 40th Anniversary of the Fall Forestry & Wildlife Field Tours. For the past 40 years, the Fall Forestry & Wildlife Field Tours have combined education, networking, sightseeing, good food, and opportunities to experience local communities, to offer an incredible outdoor classroom experience about sustainable forest and wildlife management. The tours showcase best management and multi-use practices for private, public, and industry-owned lands, and visit wood product manufacturing facilities.

In 2016, 170 landowners, teachers, and natural resource professionals attended one of the four tours offered. Exit surveys indicated that attending a tour resulted in increased participant awareness of the importance of active management practices to improve forest health and wildlife habitat and to meet ownership goals. In addition, of the attendees who hadn't done so already, 67% planned on creating a list of ownership goals, 77% planned

on meeting with a natural resource professional, 57% planned on obtaining a written management plan, and 78% planned on implementing at least one sustainable woodland/wildlife management practice as a result of attending a tour.

To promote the 40th anniversary, articles were published in *Virginia Forests, Forest Landowner*, the Virginia Forest Landowner Update, the Richmond Times-Dispatch, and the CNRE magazine. Additionally, a logo was created. We also gave out a special 40th anniversary gift to all participants. This was an autographed copy of the *"Trees Up Close"* book by Nancy Ross Hugo and Robert Llewellyn.

Extension

(continued)

Virginia SHARP Logger Program

The Virginia SHARP Logger program (http://sharplogger.vt.edu/) has been a Virginia Tech Forestry Extension Program since 2002. The SHARP Logger program provides training in the principles of sustainable forestry, environmental protection, and workplace safety. The program receives support from Sustainable Forestry Initiative (SFI) program participants operating in Virginia through the Virginia SFI State Implementation Committee (http://virginiasfi.org/). The vast majority of all logging businesses in Virginia have received training through the Virginia SHARP Logger program. The SHARP Logger program offers a three-part "core" program for participants to become SHARP Loggers, and then there is a continuing education (CE) requirement to maintain their SHARP Logger status. In 2016, there were a total of 7 core programs and 17 CE classes offered across Virginia. Over 1,100 individuals attended at least one training to receive credit through the SHARP Logger program in 2016.

In addition to traditional classes offered across Virginia, the SHARP Logger program also has a total of eight online CE trainings, including a new online training on "BMPs for Temporary Haul Road and Skid Trail Closeout" which was completed in 2016. At the beginning of 2017, Andrew Vinson was hired as an Extension Associate to assist with implementation of SHARP Logger programs across Virginia. He will work with the District Forestry and Natural Resources Extension Agents and others to provide training opportunities to loggers across Virginia.

Extension (continued)

Virginia Master Naturalist (VMN) Program

The Virginia Master Naturalist (VMN) program is a statewide corps of volunteers providing education, outreach, and service dedicated to the beneficial management of natural resources and natural areas within their communities. The program aims to extend the capacities of both state and local natural resource agencies and organizations to be able to achieve their missions in new ways, engage new audiences, and work towards creating a citizenry more informed about and involved in natural resource conservation and management.

The VMN program currently has 1,756 active members who reported volunteer service hours in 2016. These volunteers contributed significant service in the areas of education (35,432 hours), citizen science (43,517 hours), stewardship (29.852 hours), and chapter administration and travel time (37,195 hours). These hours amount to more than $3.8 million in contributions to natural resource conservation in Virginia (based on IndependentSector.org value of a volunteer hour), and represented a 21% increase in contributed time compared to 2015.

The program team includes Michelle Prysby (VMN Program Director and FREC Extension faculty), Tiffany Brown (VMN project assistant and FREC administrative staff), and Terri Keffert (VMN volunteer coordinator and part-time FREC staff).

Some of the new and significant initiatives for the program in 2016 were:

- A series of regional Leadership Days, which provided training in volunteer management, effective communication, and other leadership skills to approximately 120 volunteer leaders in local Virginia Master Naturalist chapters.
- Project RareQuest, a new statewide project to document occurrences of rare species in partnership with the Virginia Natural Heritage Program. Eighty-one volunteers contributed more than 770 hours to the project, and they successfully found 28 of the 80 rare species occurrences they sought. The Virginia Native Plant Society provided a small grant to pilot this project.
- VMN Statewide Conference, an annual gathering of VMN volunteers from across the state, which provided continuing education to build the volunteers' skills and knowledge. The 2016 conference was the largest conference to date, with more than 200 attendees coming together to attend 40 different concurrent sessions at the Skelton 4-H and Conference Center and neighboring natural areas.
- A mini-grant program, funded by an anonymous private donor, which provided nine VMN chapters with grants to conduct chapter focus projects, designed to make long-term positive impacts for natural resources in their communities while also involving a significant number of chapter members.
- Development and release of VMN basic training curriculum on Aquatic Ecology and Management and Virginia Biogeography.

Geospatial Extension Program

Geospatial Technician Education - Unmanned Aircraft Systems (GeoTEd-UAS)

The goal of the GeoTEd-UAS (Geospatial Technician Education - Unmanned Aircraft Systems) project is to support Virginia's communities and future sUAS industry/workforce, by providing sUAS instruction to 2-year faculty. A 'train the trainer' workshop was held in the fall 2016. The Geospatial Extension Program hosted a panel of sUAS technicians and experts to support the development of a sUAS DACUM (developing a curriculum) during the Fall 2016.

Currently, we are organizing a week-long sUAS workshop for 2-year college faculty (including the VT Agriculture Technology program) in May. This workshop will provide cohort participants with the knowledge necessary to plan flights and to safely and professionally operate a sUAS. In addition, the cohort will gain exposure data collection options and an introduction to image processing tools. This project includes instruction, mentoring, and service learning opportunities for workshop cohort members. Project partners include: Virginia Tech, the Virginia Space Grant Consortium, the Virginia Community College System. Mountain Empire Community College, and Thomas Nelson Community College. This 3-year project is funded through the National Science Foundation.

National Extension Webmapping Tool (NEWT)

The Geospatial Extension Program, in partnership with Univ. of New Hampshire Cooperative Extension and the VT Center for Geospatial Information Technology (CGIT), is designing, developing, and implementing an online web-mapping system to benefit cooperative extension agents, specialists, and administrators from across the U.S. This online system will provide basic demographic, agricultural, and health variables at the county level to support Extension planning, reporting, and programming efforts. Users will be able to generate customized maps, tables, & graphics. This project is funded through eXtension.

Education Abroad Panama

Each January, a select group of Virginia Tech students embark to Panama for a two-week Wintermester experience. Through this course, students explore Panama City, experience "the canal", live among the indigenous Guna, and camp in the rain forest, while working side by side with scientists from Panama, Colombia, the Netherlands, and the United States. Through this program, students are active learners as they contribute to ongoing research at the Cocobolo Research Station.

International Activities

Timothy Albaugh participated as a visiting scientist of FONDECYT grant "Sustainability of water and nutrient use in short rotation woody crops for bioenergy" with Rafael Rubilar from the University of Concepción, Chile.

Harold Burkhart collaborated with researchers and graduate students in Brazil through a Letter of Agreement between Federal University of Lavras and Virginia Tech.

Carolyn Copenheaver attended the Third American Dendrochronology Conference in Mendoza, Argentina, from March 28-April 1, 2016. She presented a talk titled, "False ring formation in bald cypress (*Taxodium distichum*)." In June 2016, Copenheaver collaborated with Ketia Shumaker from the University of West Alabama and Michael Pisaric from Brock University in Ontario on a USDA-funded research project to forecast the growth response of sugar maple to climate change. The team's research sites spanned from Pennsylvania to Ontario.

Carol Franco and **Randy Wynne** participated in the negotiations of the 22nd session of the Conference of the Parties (COP 22) of the United Nations Framework Convention on Climate Change (UNFCCC), as members of the government delegation of the Dominican Republic. Franco and Wynne negotiated the agenda items of Land Use, Land Use Change, and Forestry (LULUCF), Issues related to Agriculture, and Financing. COP 22 was held in Marrakech, Morocco, from November 7 - 18, 2016. The meeting brought together around 22,500 participants, including 15,800 government officials, 5,400 representatives of UN agencies, intergovernmental organizations and civil society organizations, and 1,200 members of the media.

Franco also participated in the Global Practitioners' Dialogue on Climate Investments (PDCI), sponsored by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ). The PDCI's main goal was to "facilitate a better understanding of policy instruments and transformative processes that shape enabling framework conditions for private climate investments."

International Activities

(continued)

It offered a platform for the engagement of government and policy makers with academia, private, and financial sectors, bringing together 55 practitioners from 18 different countries.

The PDCI focused on the provision of innovative and effective incentive schemes, regulatory frameworks, and financial mechanisms to increase private support and investment in climate resilience, energy efficiency, and renewable energy initiatives. The PDCI met three times in 2016; the first meeting was in March in Pretoria, South Africa; the second was in May in Bonn, Germany; and the last meeting was in October in Prien am Chiemsee, Germany. Franco contributed to the working group "implementing climate resilience measures in industry" and is the lead author of a policy brief on "strengthening climate resilience in small and medium enterprises (SMEs)" to be published by GIZ in 2017.

Franco is also a Co-PI in a research project that started in 2016 analyzing transboundary ecosystem services in La Hispaniola. The main objective of the project is to assess the health of the ecosystem and the economic and social value of the ecosystem services provided by a National Park, Nalga de Maco, and the Artibonito watershed. The project is funded by the Dominican Government through the Ministry of Higher Education, Science, and Technology and is being led by the Instituto Tecnologico de Santo Domingo (INTEC).

She co-organized and co-facilitated a Professional Development Seminar on "Transdisciplinary approaches to integrating policy and science for sustainability." The main objective of the seminar is to "train future leaders in global change science, policy, and management." The two-part seminar is being organized and funded by the Inter-American Institute for Global Change Research (IAI) with resources provided by the United States National Science Foundation (NSF). The first session of the seminar took place in the Dominican Republic on November 28-December 2, 2016, and was attended by 27 representatives from 17 IAI member countries. The second session will be held in Calgary, Canada, on May 29-June 2, 2017.

Susan Day was an invited speaker at the 1st Asia-Pacific Urban Forestry Meeting in Zhuhai, China, where she spoke on links between urban forest science and policy in the Chesapeake Bay and led workgroups to identify urban forest priorities for the Asia-Pacific region countries.

Day also traveled to Australia in 2016 and worked with the Green Infrastructure Research Group at the University of Melbourne, where she gave a seminar and developed collaborations.

International Activities

(continued)

John McGee taught an Education Abroad course, "Issues in Natural Resources Conservation in Panama," in Panama during the 2016 Wintermester. The Panama education abroad program is all about "interconnections" as students examine the intersections of the local and global economies with ecology and culture. They experience urban environments, rainforest, and marine environments. The accommodations are pretty rustic. Participants sleep in tents in the rainforest and stay in bamboo huts on the San Blas Islands. For part of the time in Panama, they hire a local cook from the Darien region of Panama. Students work with local scientists, as well as researchers from all over the world. This year, for example, they conducted research with an entomologist from Belgium, a biologist and geneticist from Panama/England/U.S., an ornithologist from Colombia, and a global studies professor from North Carolina. It is a great opportunity for students to gain real world research and field experience in an international setting and provides them with new perspectives.

Daniel McLaughlin collaborated with Nandita Basu from the University of Waterloo (Canada) on a project focused on improving water sustainability in rural South India. Specifically, this project employed monitoring and analysis to quantify hydrologic flows in reservoirs being used for irrigation supply, with the goal of informing village-based management of these systems. This work resulted in a 2016 publication; funding for new work is pending at the National Science Foundation.

McLaughlin was also an invited participant in the North American Wetland Connectivity Workgroup, supported by the USGS Powell Center. This workgroup includes researchers from the United States and Canada and focuses on wetland connectivity at continental scales, which is relevant to both U.S. and Canadian environmental policy.

John Munsell, Priya Jaishanker, and **Benjamin Addleston** traveled to Cameroon to meet with old and new partners and visit and document (with video) potential project sites and locations. The primary aim was to close out previous work and evaluate potential partner collaboration and project development. Expected outcomes are robust long-term projects with research and fundraising potential in which Virginia Tech actively engages in multinational development centered on agroforestry production, water quality and quantity, and conflict resolution. The three main project locations visited and evaluated were Mt. Bamboutos, Oku and Santa/Baba II in the western and northwestern regions of Cameroon, respectively.

Quinn Thomas is collaborating with a colleague at the University of Edinburgh, Scotland. The project is focused on modeling forest canopy structure.

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Theses and Dissertations

Dissertations

Allen, M.G. 2016. Stand density management for optimal volume production.
    Chair: H. Burkhart.

Coleman, K.J. 2016. The role of trust in collaborative natural resource management.
    Chair: M. Stern.

Cristan, R. 2016. Effectiveness of state-developed and implemented forestry best management practices in the United States.
    Chairs: W.M. Aust, M.C. Bolding.

Lang, A.J. 2016. Potential sediment delivery from forest haul roads at stream crossings as influenced by road attributes.
    Chairs: W.M. Aust, M.C. Bolding.

O'Herrin, K.T. 2016. Urban forestry at a crossroads: Development of an emerging profession.
    Chair: S. Day.

Raymond, J.E. 2016. Use of stable isotopes to trace the fate of applied nitrogen in forest plantations to evaluate fertilizer efficiency and ecosystem impacts.
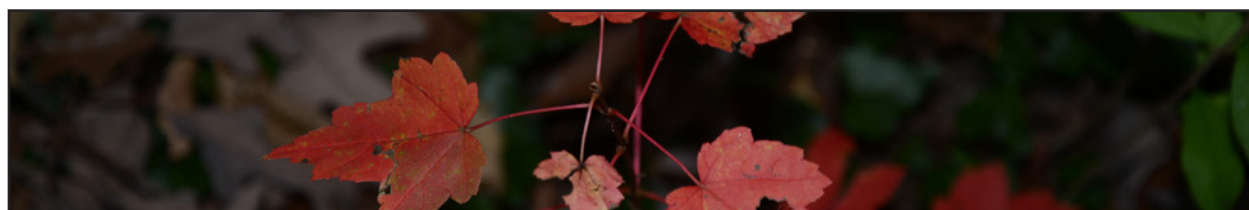   Chair: T.R. Fox.

Siriwardena, S.D. 2016. Essays on the non-market valuation and optimal control of bio-invasions in urban forest resources.
    Chairs: K. Boyle, K. Cobourn.

Zhang, M. 2016. Genomics of climatic adaptation in populous trichocarapa.
    Chair: J. Holliday.

Theses and Dissertations

(continued)

Theses

Commender, K.E. 2016. Factors affecting the adoption and retention of conservation buffers. Chairs: J.F. Munsell, J. Sullivan.

Gondran, A.C. 2016. Vegetative potential to reduce total dissolved solids generated from reclaimed mine lands in central Appalachia. Chairs: K. McGuire, B. Strahm.

Grieve, A.J. 2016. Street trees as a source of timber in Washington, DC. Chair: E. Wiseman.

Hemby, T.L. 2016. Exploring the "where" and the "why" of conservation easements: The role of community-level factors in the likelihood of adoption. Chair: M. Sorice.

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Kaplan, A. 2016. Genomic selection and genome-wide association study in populous trichocarpa and pinus taeda. Chair: J. Holliday.

Reed, W.P. 2016. Long-term fuel and vegetation responses to mechanical mastication in northern California and southern Oregon. Chair: J.M. Varner.

Sanwal, T. 2016. Economic analysis of biofuel production from switchgrass (Panicum virgatum) and sweet sorghum (Sorghum bicolor) in the United States. Chairs: J. Alavalapati, H. Quesada Pineda.

Stephens, B.A. 2016. Understanding the Tea Party response to local environmental initiatives: A conflict between individualism and collectivism. Chair: R. Hull.

Vinson, J.A. 2016. Assessment of erosion rates of bladed skid trail closure best management practices in the Virginia Mountains. Chair: S. Barrett.

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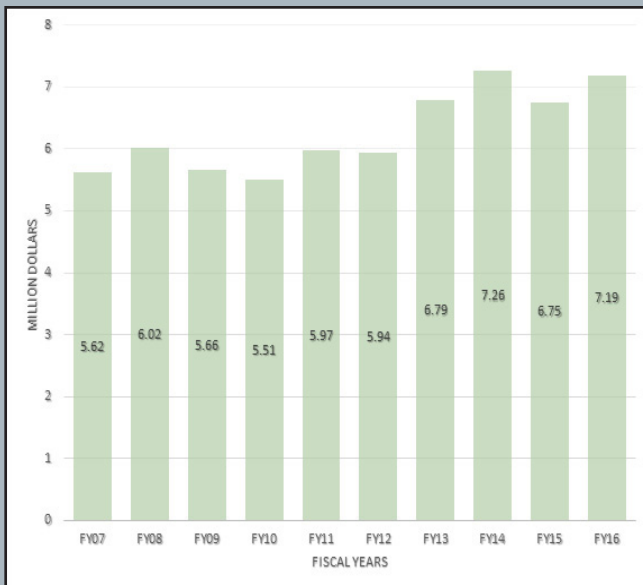# Theses and Dissertations

(continued)

Whitmore, K.M. 2016. Selenium in headwater streams: Evaluating enrichment and bioaccumulation in the streams of the central Appalachian coalfields. Chair: S. Schoenholtz, C. Zipper.

Yang, S-I. 2016. Estimation and determination of carrying capacity in loblolly pine. Chair: H. Burkhart.
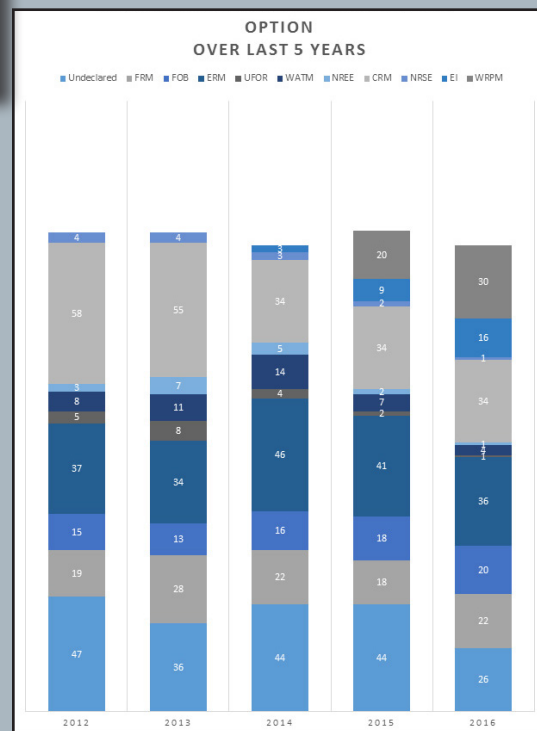
Statistics

Research Expenditures

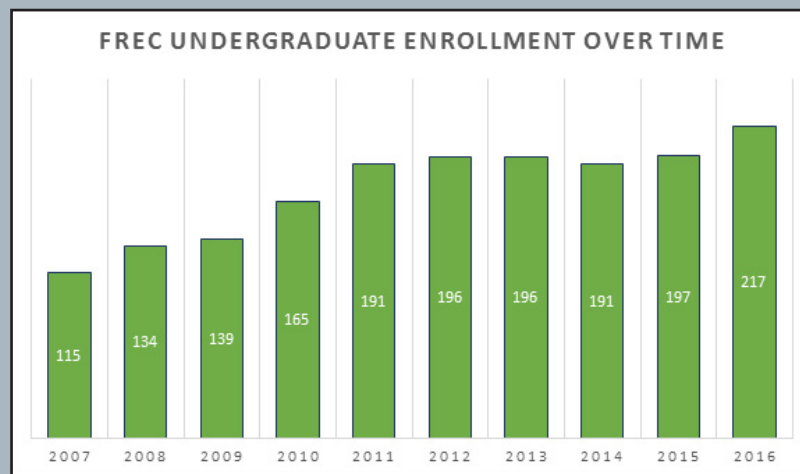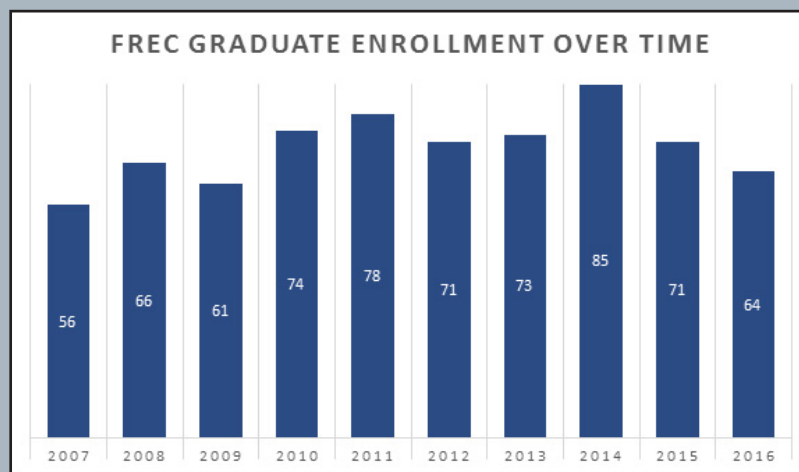## FREC Undergraduate Enrollment by Options Over the Last Five Years

Statistics

(continued)
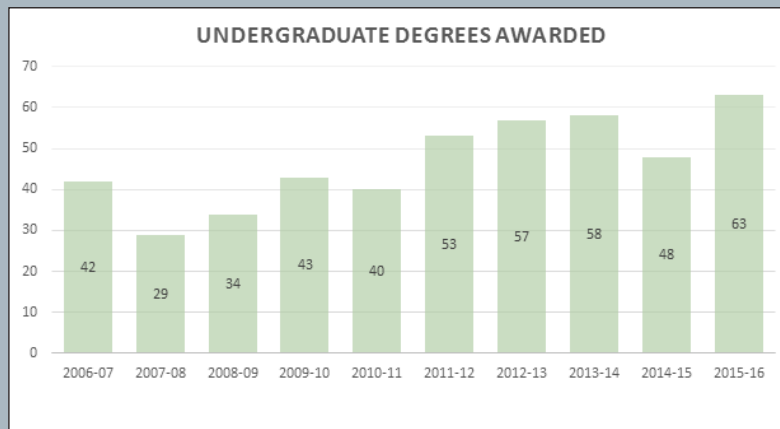
FREC Undergraduate Enrollment Over Time
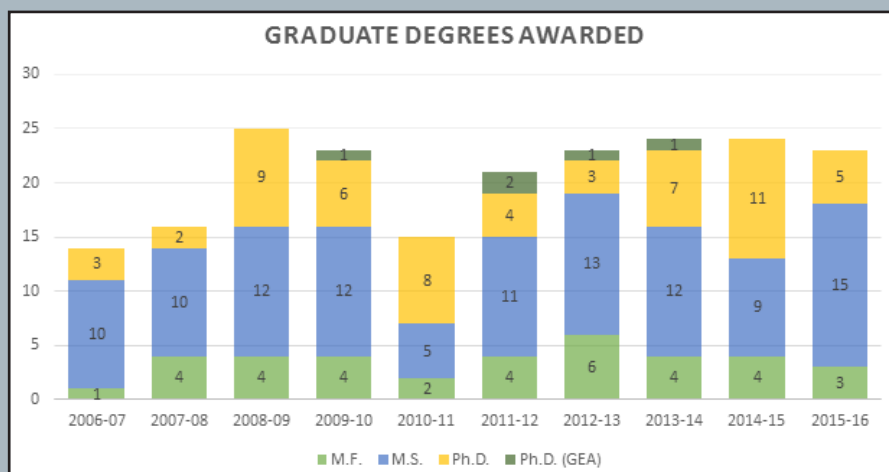
FREC UNDERGRADUATE ENROLLMENT OVER TIME

2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
115	134	139	165	191	196	196	191	197	217

FREC Graduate Enrollment Over Time

FREC GRADUATE ENROLLMENT OVER TIME

2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
56	66	61	74	78	71	73	85	71	64

Statistics

(continued)

FREC Undergraduate Degrees Awarded

UNDERGRADUATE DEGREES AWARDED

Year	Degrees
2006-07	42
2007-08	29
2008-09	34
2009-10	43
2010-11	40
2011-12	53
2012-13	57
2013-14	58
2014-15	48
2015-16	63

FREC Graduate Degrees Awarded

GRADUATE DEGREES AWARDED

Year	M.F.	M.S.	Ph.D.	Ph.D. (GEA)
2006-07	1	10	3	
2007-08	4	10	2	
2008-09	4	12	9	
2009-10	4	12	6	1
2010-11	2	5	8	
2011-12	4	11	4	2
2012-13	6	13	3	1
2013-14	4	12	7	1
2014-15	4	9	11	
2015-16	3	15	5	

Research Sponsors

The American Chestnut Foundation
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Superior Pine Products Company
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   State Implementation Committee
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US Endowment for Forests and
   Communities
US Fish & Wildlife Service
USDA Agricultural Research Service
USDA Forest Service

USDA Natural Resources Conservation
   Service
USDA NIFA
USDA Sustainable Agriculture Research
   and Education Program
USGS
Valor Florestal
Virginia Department of Conservation and
   Recreation
Virginia Department of Environmental
   Quality
Virginia Department of Forestry
Virginia Department of Game and Inland
   Fisheries
Virginia Forestry Association
Virginia Forestry Association and SFI
   Implementation Committee
Virginia Institute of Marine Science-
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   Management
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