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UNMANNED AERIAL SYSTEMS

New technology has endless applications for natural resources management

Understanding landscapes and their assets is vital for sound management of natural resources. But in remote areas, the time and cost associated with data collection can hinder research efforts. Through the use of unmanned aircraft systems (UAS), commonly referred to as drones, college researchers are working to overcome those limitations.

According to John McGee, professor and Virginia Cooperative Extension geospatial specialist, unmanned aircraft systems — comprised of the aircraft, flight-planning software, camera and sensor technology, and data post-processing software — represent a new opportunity for scientists to understand and interact with natural areas. “This technology provides data on demand,” he said. “We can capture images and data about abiotic, biotic, and cultural resources and can more efficiently ‘map’ a landscape.”



UAS aircraft come in many shapes and sizes. The eBee is a fixed-wing unit weighing 1.5 pounds and measuring 38 inches across.

McGee tested the technology’s versatility during a trip to Panama in 2015. Data collected by a UAS were used to generate a detailed, high-resolution baseline map of the Cocobolo Nature Reserve, a 1,000-acre rain forest and biodiversity hot spot. Researchers from Panama and the U.S. have been working to inventory natural resources in Cocobolo, but struggled to obtain the necessary imagery from high-resolution satellites.

Working with Daniel Cross, a UAS operator and GIS technician with the college’s Conservation Management Institute, McGee and his

team collected imagery of the rain forest with approximately 1-inch resolution. “With these data, local scientists can identify individual tree species based on the imagery by examining canopy size, shape, texture, and color,” Cross explained.

The college currently uses three UAS devices, including a small 1.5-pound fixed-wing eBee. They can be outfitted with a variety of cameras and sensors depending on the specific needs of each project.

The eBee flies autonomously, operating on parameters provided through the flight-planning software prior to launching. It continually monitors wind speed, wind direction, and other data, and adjusts its flight to current conditions. The operator can also monitor environmental conditions and modify the flight plan while the aircraft is airborne.

“Infrared cameras can help us to discern chlorophyll vigor to determine whether a section of a field might be stressed due to low nitrogen levels, or we can use thermal sensors to identify areas that might be experiencing heat loss,” McGee pointed out. Sensors can even indicate where historical structures or foundations may be buried underground. There are countless potential applications for the technology in natural resources management, including inventorying and monitoring forest health, assessing soil erosion and crop health, and conducting wildlife inventories.

In addition to providing incredibly diverse sets of data, UAS aircraft like the eBee can cover hundreds of acres in a relatively short amount of time, making them a potentially cost-effective option for conducting inventories on large tracts of land. “In the past we had to contract with an aerial photography company, and then wait until their schedule and the weather both allowed for a flight,” McGee said.



UAS operator Daniel Cross monitors the eBee’s flight on a laptop during a test at Clermont Farm, a Virginia Department of Historic Resources site in Clarke County.

Now, researchers can collect data much more rapidly and frequently. According to Cross, UAS technology collects data in near-real time. “A 20- to 30-minute flight takes about three to four hours of preparation, and we can get results back within hours or days,” he said. In addition, UAS technology can collect information over several occasions and at specific times that cannot be obtained relying on commercial image providers, and may reduce the need for extra manpower during field studies.

Cross, a licensed pilot who is currently the college’s only UAS operator, begins each flight with extensive planning. “You have to know the area you’re flying well, and understand property boundaries, obstacles, and airspace restrictions before you can develop a flight plan. Safety is our primary concern.”

Once the preplanning is complete, there is very little actual flight time. “I prepare a flight plan, specify what information to collect, and then I monitor the flight via laptop,” he said. The bulk of the work comes in the post-processing stages. After a flight, Cross reviews the data to determine if the UAS retrieved the information needed.

Until late August, the Federal Aviation Administration required that anyone piloting a UAS have a pilot’s license, but new regulations have paved the way for others to pilot the aircrafts. The college will soon train additional faculty and staff to become FAA certified UAS pilots.

For McGee, this development represents an exciting opportunity for growth, particularly within the Virginia Tech community. “This industry is getting ready to explode,” he explained. “Demand for technicians who can operate

(Continued on page 2)



*Professor John McGee launches the eBee UAS at Panama’s Cocobolo Nature Reserve, home to several threatened and endangered species, including a toad, *Atelopus limosus* (above). Once believed to be extinct in the wild due to an invasive fungus, *Atelopus* has recently been found at Cocobolo. The UAS is being used to gather land cover data across the rainforest to aid in conservation efforts.*

Photos courtesy of CREA (Conservation through Research, Education, and Action)



For the second year in a row, USA Today has ranked the college as the nation's best for studying natural resources and conservation! Our forestry program also received a top ranking. No doubt, we are immensely proud of this recognition, and benchmarking against national peers helps us evaluate the quality of our programs. I am immensely proud of this ranking and the spotlight it shines on our faculty, staff, students, alumni, and supporters. Congratulations to all on this recognition.

Not reflected in this ranking is the summary of research awards by academic units at Virginia Tech. The Department of Fish and Wildlife Conservation ranked No. 5 and the Department of Forest Resources and Environmental Conservation ranked No. 8 among all university departments for total research award dollars for the year ending June 30, 2016. Combined, these two departments garnered almost \$16 million in awards.

We held two major events over the past few months. In September we hosted our fifth annual career fair. We first started with a small group of agency partners and corporate friends — less than 10 participants — and held the event in Cheatham Hall. It has grown to almost 50 participants, and we welcomed over 300 students to Owens Banquet Hall. As we grow the college and our impacts, linking our students to opportunities is a responsibility we all share. It was very encouraging to learn about a multitude of internships, summer positions, and permanent positions with our partners.

In October we hosted a conference titled Women in Natural Resources: Leading, Mentoring, and Connecting. We reached capacity for the conference within two

weeks of opening registration, welcoming more than 200 participants. It is important for us to address all issues of diversity and inclusion in our disciplines, and we recognize the paucity of women in some areas. Keynote speaker Carolyn Finney, a cultural geography professor at the University of Kentucky, delivered an inspiring address about her work on issues related to identify, difference, creativity, and resilience.

Our cover story on the use and applications of unmanned aerial systems is a glimpse into the future of advanced data collection and decision-making at the landscape scale. The strength and depth of our faculty expertise in remote sensing, geospatial information systems (GIS), and now unmanned aerial systems will play an even more important role in our teaching, research, and outreach programs. In addition to filling a current faculty vacancy in GIS, we will be adding another new faculty position in GIS in the coming months.

Thomas Olson, our long-serving assistant dean of business and finance, will retire at the end of the year. Thomas, who joined Virginia Tech 28 years ago and has served the college faithfully since 2000, is a critical and strategic member of our college leadership team. I rely on him nearly daily in our behind-the-scenes management and strategic decision-making, and greatly value and appreciate our close working relationship. The college is successful in part because of Thomas' contributions to everything that we do. I want to publically thank Thomas and wish him and his wife, Martha, the very best of what's to come. Thank you, my good colleague!



This year's CNRE Career Fair welcomed almost 50 employers and over 300 students.

Best wishes to you all as 2016 comes to a close. We in the college continue on our aspirational path, and the promise of 2017 will bring progress towards all of our goals. Thanks to each of you for your support of all we do. Plan to join us on campus June 2-4, 2017, for our 25th anniversary celebration!

Warm regards,

Paul M. Winistorfer
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Unmanned Aerial Systems (Continued from page 1)

all facets of a UAS is going to increase significantly. Industries everywhere will be using this technology, so we need to make sure the foundation is in place."

To help ensure that students are well equipped to handle the rapidly changing technology, McGee has partnered with the Virginia Space Grant Consortium and the Virginia Community College System on a project to develop academic courses and pathways to help students master the skills necessary to become UAS operations technicians in a range of industries. Through a grant from the National Science Foundation, he is working with faculty to develop courses designed to teach students how to plan and fly UAS missions and analyze the geospatial data they collect. The grant is the latest in a long-term partnership to bring geospatial technology to community college curriculums in order to meet the growing workforce need for trained technicians.

"This project is directly serving Virginia's communities, by providing workforce development opportunities associated with an emerging and potentially transformative industry," McGee explained. "In addition, it is important to provide community college students with a technical-based educational pathway prior to attending a four-year college or university. This way, the students who come to Virginia Tech will have the UAS operational skills already in place to further enhance their academic experience, contribute to research programs, and support UAS-based outreach and service learning initiatives."

Cherie Aukland (left), head of the GIS program at Thomas Nelson Community College, and two students examine a DJI Phantom 2 aircraft. Aukland is one of several partners who assist Professor John McGee in developing the UAS education program for community colleges across the state.



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Correction

In the summer 2016 issue, the photo accompanying the story on master of natural resources student Lowaeli Damalu incorrectly identified her mentors. Nancy Gelman of

the U.S. Fish and Wildlife Service appears on the left of the photo, and Heather Eves, faculty member at the college's Center for Leadership in Global Sustainability, appears on the right. We apologize for this error.

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Hosner named honorary founding dean



John Hosner, named professor emeritus of forestry in 1992, 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.

Hosner, who at age 91 still comes to his office in Cheatham Hall almost every day, played a significant role in the establishment of the college, which today commands a worldwide

reputation of excellence in responding to society’s emerging needs for a sustainable planet.

“We needed to recognize John with this title as he sacrificed much to set the foundation to create the college at Virginia Tech,” said Dean Paul Winistorfer. “He was a visionary, and we thank him.”

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, which has been named the country’s top program in natural resources and conservation for the second year in a row.

Center for Natural Resources and Decision Support transitions leadership



Scott Klopfer has been named director of the Center for Natural Resources Assessment and Decision Support (CeNRADS), succeeding Stephen Prisley, who accepted a position with the National

Council for Air and Stream Improvement. Prisley will be the council’s representative to CeNRADS and will maintain office space at the center.

Klopfer, director of the college’s Conservation Management Institute, said he is excited for the opportunity to work with CeNRADS’s staff and partners. He plans to expand the great work done to date and leverage it for broader applications and impact.

“CeNRADS was established as a visionary effort to work with external stakeholders in leading an

assessment and modeling effort to provide better data and better predictions of our forest resource inventories in Virginia and beyond,” said Dean Paul Winistorfer.

“Steve Prisley accomplished what many of us could only envision, pulling together a research team and data to invoke an entirely new modeling effort in forest inventory geared towards predictions of future conditions,” Winistorfer continued. “We have a tool that is extremely important for the current and future management of our forest resource in Virginia and beyond. We have every intention of continuing this pioneering effort under Scott’s direction.”

As CeNRADS continues to refine and improve its model, it will begin to look at other attributes like water and carbon, as well as management techniques, which are important in forest harvest operations. “This work is critically important for the future sustainability of our forest and natural resources, and we are excited to embark on the future under Scott’s leadership,” Winistorfer said.

Achievable Dream Academy students visit CNRE



Professor Brian Murphy engages the students during a session on electroshocking fish.

Sixteen high school students from An Achievable Dream Academy in Newport News, Virginia, experienced a one-of-a-kind internship this summer. Hosted by Virginia Tech’s Biocomplexity Institute, the students spent two weeks on the Blacksburg campus in an intensive program designed to remove obstacles that discourage many first-generation college students from pursuing careers in scientific research.

The students’ jam-packed, hands-on/minds-on itinerary included a full day with faculty and graduate students in the college, where they worked with aerial drones at Kentland Farms, mapped and measured the forest at Stadium Woods, experienced a weather balloon launch with the National Weather Service, and helped record a segment for Virginia Water Radio, among other activities.

“Working with these students was very enjoyable,” said Professor Brian Murphy, who co-led a session on electroshocking fish. “They were always engaged and clamored to get close to the fish we collected. They jumped right in and got their hands dirty in order to learn about the traits and ecology of fish, with no ‘yuck’ factor at all. They asked more questions, and even better ones, than I hear from many groups of college students.”

Kline named Charles Blakeslee Nettleton Faculty Fellow



D. Earl Kline, professor of wood process control in the Department of Sustainable Biomaterials, has been named the Charles Blakeslee Nettleton Faculty Fellow in Forest Products by the Virginia Tech Board of Visitors. The fellowship recognizes teaching and research excellence; recipients hold the honor for a period of three years.

The Nettleton Faculty Fellowship in Forest Products was established by a gift from Blakeslee Chase. Her father, Charles Blakeslee Nettleton,

was a successful entrepreneur and land manager who bought and managed a 10,000-acre parcel of forestland in Alleghany County, Virginia, and built a lumberyard that became Lumber and Building Supplies. His wife, Carrie, was the first Virginia woman to hold the title of president of the National Council of State Garden Clubs.

A member of the Virginia Tech community since 1988, Kline leads the Wood Enterprise Institute, a business start-up learning environment in which students take a product from concept to market. This two-semester course sequence focuses on the higher order learning skills of inquiry, problem solving, innovation, entrepreneurship, and teamwork. Since its inception, the institute has grown in recognition as a premier learning venue for creativity, innovation, entrepreneurship, and business leadership.

Kline is a dedicated teacher who brings his industry and real-world connections to the classroom, emphasizing the skills of inquiry and entrepreneurship to address applied problems and arriving at solutions. He fosters a hands-on environment, leveraging practitioners from industry to augment classroom experiences.

Order 2017 wildlife calendar highlighting students’ research

Students in the college’s Fish and Wildlife Graduate Student Association (FIWGSA) are selling 2017 calendars highlighting their work around the world. Each month features a photo taken by a student and showcases research on a variety of captivating species, including cheetahs, shorebirds, foxes, big cats, lemurs, bears, arapaima, leaf-tailed geckos, and more.

Proceeds support a guest speaker visit and fund business and social events. The FIWGSA mentors new students, engages in outreach, and serves as an intermediary between graduate students and faculty. One calendar is \$15; two or more are \$12 each. They make ideal holiday gifts! Order online at squareup.com/store/fiwgsa. Email the FIWGSA at fiwgsa@gmail.com with any questions.



Photo by Anne Hilborn

The calendar features photos taken by students of their research around the world.

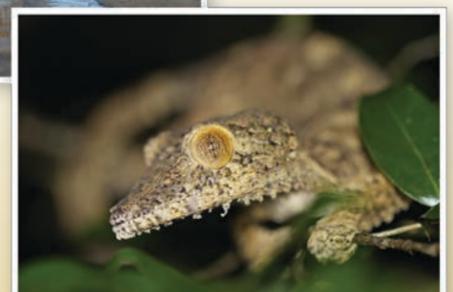


Photo by Brandon Semel

Crane's passion takes her to Tanzania and Madagascar



Senior wildlife conservation major **Paige Crane of Blacksburg** has a passion for wildlife matched only by her sense of adventure, taking her far beyond the classroom.

Crane received a \$10,000 Townsend-Crews scholarship after applying to the Odyssey Fellowship, a program designed to help honors students design their own learning opportunities tailored to their specific interests. The rigorous application process included submitting a portfolio and completing several interviews.

The award enabled Crane to participate in the School for Field Studies, a month-long study abroad program with 35 other students from around the United States. The students, who lived in a camp in Tanzania roughly four hours from the base of Mount Kilimanjaro, took courses on wildlife policy, management, and research techniques. They also participated in Swahili classes, allowing them to greet locals in their native language. "It was so rewarding to see how happy and surprised people were," Crane recalled.

Through visits to national parks and game areas, the students learned about the socioeconomic role that wildlife management plays in Tanzania. "It's a very underdeveloped country right now, but wildlife management will help people improve their lives," Crane explained.

The students also visited community wildlife management areas, which are operated under a concept that Crane described as cutting edge. Local residents are responsible for protecting and maintaining wildlife areas within their own communities and villages, empowering residents to take control over the natural resources that surround them.

Once Crane completed her studies in Tanzania, she used the remaining scholarship funds to travel to Madagascar to assist in research being conducted by Brandon Semel, a doctoral candidate in wildlife conservation. Crane spent several weeks assisting with Semel's research on golden-crowned sifakas, a critically endangered species of lemur.

"I expected to learn about wildlife, but I learned more about people," she said. "It was so rewarding to learn deeply about culture and gain insight into the importance of wildlife in people's daily lives."

Water Center welcomes first intern

Protecting water resources needs a multi-faceted approach. Last spring, senior **Taylor Richmond of Virginia Beach** got to experience what that means through a new semester-long paid internship in the Virginia Water Resources Research Center, housed in the college. "The internship gave me a glimpse into the political and professional world of water resources," said Richmond, who majored in environmental resource management. "It takes both science and policy."



"We wanted our intern to be exposed to many aspects of water resources but also to focus on some of the student's areas of interest," said Research Associate Alan Raflo. Richmond participated in research on the process of leaf litter decomposition in headwater streams, attended a public meeting for citizens about local water quality, and worked on outreach efforts including the center's radio program and blog.

Richmond said that the opportunity to take part in a meeting of the National Institutes of Water Resources and also work with the team meeting on Capitol Hill to convey to legislators the value of supporting the reauthorization of the Water Resources Research Act gave her insight to the policy side. She also visited the Virginia General Assembly and met with the House of Delegate's member who serves on the State Advisory Board.

Richmond's experiences led to her securing a job as a biological technician with Nature's Capital, an ecological assessment service provider in Boise, Idaho, after graduating in May.

Service-learning projects a part of green building course

In Associate Professor Daniel Hindman's Green Building Systems course (SBIO 3324), students not only discuss the definition of green building, concepts in green building structures, and the various green building certification systems, they participate in service-learning projects to practice what they've learned. Last year's group projects include the following:

- Storage space is a priority at Plenty!, a local food bank that includes a cannery and kitchen where people can learn to cook healthy meals. Students built and installed a custom shelving unit from recycled materials with materials obtained from the Wood Engineering Lab and donations from local builder Shelter Alternatives.
- Tiny house is a minimal living concept, with home sizes ranging from 80 to 300 square feet. Students designed a tiny house unit to be built onsite at Highland Farm, a local farm and music venue.
- Springhouse Community School, a private high school located in Floyd, Virginia, emphasizes project-based learning and a focus on the environment. SBIO 3324 students served as mentors and coaches to a group of the school's students who wanted to design and specify a tiny house to be built at the Floyd Eco-Village.
- While green building education has long been offered at Virginia Tech, there is little such education at the high school level,

particularly for trade-oriented students. One group developed a lesson and interactive activity to share the concepts of green building with high school students.

- Understanding the current attitudes of the architecture, engineering, and contracting community to green building is important. One group worked with Hindman to devise a contractor survey to understand their opinions and feeling about green building. Students became Internal Review Board (IRB) certified surveyors, developed the survey based upon previous research, and submitted all the paperwork to the IRB.
- Many students were interested in learning more about energy sources that could be used to make a home off-grid. One group examined different energy solutions for housing and discussed the positive and negative aspects. Various items explored included using a generator powered by a small stream, a Tesla Powerwall, and other residential battery systems.



Students built custom shelving for the Plenty! food bank, among other service-learning projects.

HNN

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Students selected as undergraduate research ambassadors



Alexandra Flevarakis

Two students from the college have been selected in a competitive search as ambassadors for Virginia Tech's Office of Undergraduate Research for the 2016-17 academic year. **Alexandra Flevarakis of Fairfax, Virginia**, a senior majoring in sustainable biomaterials, is returning for her second year as a student research ambassador. **Ryan Mowrey of Blacksburg**, a junior double majoring in water: resources, policy, and management and in biological sciences, is new to the program this year. As ambassadors, Flevarakis and Mowrey will host office hours during which their student peers can come and ask questions about getting involved in research on or off campus. They will also give presentations on undergraduate research to classes and student groups.



Ryan Mowrey

Peterson receives President's Excellence Award



Laboratory Specialist **John Peterson** has received the university's 2016 President's Award for Excellence. The award, which carries a \$2,000 cash prize, is presented annually to up to five Virginia Tech staff members who have made extraordinary contributions by consistent excellence in the performance of their job or a single incident, contribution, or heroic act.

Peterson has been with the Department of Forest Resources and Environmental Conservation

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 materials since 1997. More recently, he was a part of the team that created vTree, the most-downloaded mobile application for tree identification. He 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.

He is the first to volunteer to accompany graduate students on their fieldwork, which often takes place in hostile and uninviting environments, such as a snake-infested Alabama swamp or South Carolina pinelands overrun with ticks and chiggers.

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.

Hallerman advises FDA on approving world's first genetically modified animal

When federal regulators declared the AquaAdvantage salmon fit to eat last fall, it became the world's first genetically engineered animal approved for human consumption. Professor **Eric Hallerman** advised the U.S. Food and Drug Administration (FDA) on the environmental issues surrounding transgenic Atlantic salmon as part of the agency's investigation. "The FDA is respected globally," Hallerman said. "Now that the U.S. has approved an animal for food, other countries might follow."



The firm AquaBounty Technologies, which produces AquaAdvantage salmon, asked Hallerman to lead research on the fish's environmental impact. Hallerman had pushed for a better framework for risk assessment and management in genetic engineering since the late 1980s, and in the early 1990s helped develop the performance standards the USDA uses to evaluate the safety of aquatic genetic engineering projects.

Hallerman and his co-investigators discovered that AquaAdvantage fish could potentially breed in the wild, passing down their engineered genes, so AquaBounty developed a system of redundant safeguards to confine their salmon. The company grows only sterile females and raises them in aboveground tanks in Panama. If these cold-water fish escaped, they would probably die in the warm, muddy rivers downstream from the facility, 4,000 miles from their spawning grounds along the North Atlantic.

The FDA invited Hallerman to present his findings in September 2010. "At the hearing, I was asked flat out, 'Would you approve this?' I said yes," Hallerman recalled. "That recommendation sat around for five years." The FDA finally approved the salmon grown in AquaBounty's existing facilities in November 2015. If the company wants to expand production, it must re-apply for approval to sell fish from its new operations.

Munsell awarded \$1.4 million for agroforestry projects

Associate Professor and Extension Specialist **John Munsell** has been awarded a total of \$1.4 million to expand uses of agroforestry to enhance farm and forest production while achieving strategic conservation goals. Many practices fall under the broad category of agroforestry, which is the integration of trees into agricultural systems. The trees can be managed for timber, livestock fodder, fruits, nuts, florals, and more, offering landowners opportunities to produce marketable forest products in addition to agricultural products.

The projects and funding represent a wide range of federal, state, and local agencies and organizations. Munsell received over \$560,000 to support a public-private partnership that will work to integrate agroforestry practices into Virginia's water quality

trading program and demonstrate and evaluate associated practices. "The objective is to increase tree-based nutrient offset opportunities on farmland in Virginia's region of the Chesapeake Bay watershed and beyond," he explained.

He also received over \$880,000 to support initiatives that include citizen science 2.0, management based on traditional ecological knowledge, and geodesign techniques and high performance computer simulation to promote precision forest farming. "The overarching aim of the work is to expand the cultivation and conservation of nontimber forest products and to prepare forest farmers to supply verified and organic forest-grown raw materials to nutraceutical and herbal product industries," Munsell emphasized.



Farewell to Steve McMullin!



Steve McMullin (left) and his wife, Leslie, enjoy a laugh at the retirement celebration.

Co-workers, colleagues, family, and friends gathered to thank **Steve McMullin** for a job well done and offer best wishes for him during retirement. McMullin, associate professor of human dimensions in the Department of Fish and Wildlife Conservation, retired in May after 27 years in the college. Although he and his wife, Leslie, have since relocated to Florida, McMullin will continue to co-lead the college's Leadership Institute, which he has directed since its inaugural session in 2010, through the current academic year. Congratulations Steve!

Carstensen earns Distinguished Mentor Award



Professor **Bill Carstensen** has received the 2016 Distinguished Mentor Award from the National Council for Geographic Education.

Carstensen cites his work developing summer field experiences for K-12 teachers as the primary reason for the award. This summer institute, organized through the Virginia Geographic Alliance, is designed to equip teachers, many of whom do not have a geography background, to teach geography in their classrooms.

"This is an extremely powerful experience because teachers visited many places that they would probably not see normally," explained Carstensen, whose goal is to help educators understand the value of geography education. "The best mentoring comes from helping teachers to 'be there' and experience a place with all of their senses and emotions."

Of the Distinguished Mentor Award, Carstensen shared, "It's so rewarding to feel as though you're making a difference. To take a teacher who, often without prior geographic education, feels forced to teach geography and turn that person into someone who wants to teach geography is very exciting. Nothing feels better than that."

Faculty promotions

The Virginia Tech Board of Visitors has granted several college faculty promotions. Promotion to professor: **Kathleen Alexander** and **Marcella Kelly**, fish and wildlife conservation. Promotion to associate professor: **Kyrille Goldbeck-DeBose**, university libraries.



Kathleen Alexander



Marcella Kelly



Kyrille Goldbeck-DeBose

Research is a critical component of the college's mission of Advancing the Science of Sustainability. The short summaries below provide a glimpse into the wealth of research for environmental sustainability being conducted by our world-class faculty members. Visit vtnews.vt.edu/feeds/natural-resources.html to read the full stories behind these summaries as well as other press releases pertaining to the college.

Researchers look to expand market for cross-laminated timber

Associate Professor Daniel Hindman has researched high-performance wood composites for the better part of a decade. Four years ago, he seized the chance to help develop a material made from North American lumber that would be strong enough to replace concrete. Cross-laminated timbers (CLTs) are solid wood panels up to a foot and a half thick glued together from planks, like massive blocks of plywood. "The panels themselves are wood and glue, things we've had for a century," Hindman said. "The innovation is in the concept, in thinking about the problem differently: how can we make a large-scale panel out of wood?"

To produce a CLT panel, pieces of lumber are placed side-by-side and glued together along the edges. The resulting sheets are then stacked with the grain perpendicular to the sheets above and below, spread with polyurethane or phenol formaldehyde — the same weatherproof, low-emitting adhesives used in plywood — and sandwiched together in a giant press. The panels can measure up to 10 feet wide, 50 feet long, and from four to 20 inches thick, depending on the number of layers.

The panels' thickness and alternating grain pattern make buildings constructed with CLTs much stronger



Daniel Hindman (left) and doctoral student Hourli Sharifniay examine failures in a southern pine cross-laminated timber beam during testing.

than traditional wood-frame structures. Designed to handle vertical and lateral loads, CLTs can be made to be stiffer and more stable than conventional wall systems. CLTs behave more like precast concrete: A single panel can form an entire section of wall, floor, roof, or even an elevator shaft without the need for

additional structural support. CLT construction requires less energy and generates almost no onsite waste. In addition, CLTs weigh up to six times less than concrete, which reduces foundation costs.

Along with fellow faculty members in the Department of Sustainable Biomaterials, Hindman has designed CLTs from yellow poplar. He has also been working with the Southern Virginia Higher Education Center to study the use of southern pine CLTs. In the team's tests, CLTs matched concrete's performance in soundproofing and, perhaps surprisingly, fire resistance. "In a catastrophic fire, steel loses its tensile strength and collapses, and concrete cracks up, but wood beams this large will smolder and put themselves out," said Department Head Bob Smith.

Hindman and Smith hope a plant will eventually open in Southwest Virginia. "We have to prove CLTs will work before anybody will invest in a plant," Smith said. "Daniel's research is helping us solve these issues." Hindman is also researching with manufacturing variables, including the optimal amount of time in the hot press and the best treatments for adhesives, to help potential plant owners perfect their process quickly.

New mapping approach reveals benefits, shortcomings of flood-control strategies



Beatriz "Tiz" Mogollón completed several studies on the landscape processes that influence river flooding.

It should come as no surprise that urban areas, with impenetrable rooftops and parking lots, contribute to flooding. But natural and manmade structures within the watersheds that serve urban and rural areas can influence the path and speed of water, for better or worse.

Landscape features such as vegetative cover, soil type, and slope affect the magnitude and duration of only small floods, according to research by Beatriz "Tiz" Mogollón of Bogotá, Colombia, who earned her master's degree in fish and wildlife conservation in 2014.

To regulate flooding, urbanized watersheds require engineered features, such as storm-water ponds, buffer strips, and other strategies for holding water.

For her thesis research, Mogollón examined the landscape processes that influence river flooding to better understand the circumstances under which watersheds regulate flooding, as well as the prospects for managing floods by manipulating landscape structure. She focused her analysis on 31 watersheds across Virginia and North Carolina that had at least 20 years of records about river flow. Her research has been published in the *Journal of Environmental Management*, the *Journal of the American Water Resources Association*, and *Ecological Indicators*.

Mogollón's approach to mapping flood-regulation capacities incorporates technological capacity, high spatial resolution across watersheds, and the changes in and importance of such landscape features as cropland, grassland, wetland, forest, and urban development, which vary significantly among watersheds. The more finely tuned mapping approach can help ensure that investments in flood management account for the limitations of landscape features.



An international, multi-institutional team of researchers recommends ways that humans can protect fresh water from salts in an article in the journal *Science*. Aquatic life can suffer when high concentrations of dissolved salts enter freshwater ecosystems, a process known as salinization.

"We've written the paper as a call to action, or at least a call to awareness, and we've tried to describe what we think will be an effective path forward," said team member Tony Timpano, a forestry doctoral student. Increased salinization in fresh water is an issue that hasn't gotten much attention in terms of science policy, according to Timpano.

Graduate student Tony Timpano examines salinization in fresh water.

Recommendations include using less water for agricultural practices and less salt for road de-icing, reducing salt waste during mining operations, and re-routing of urban salt discharges to retention basins rather than treatment plants or streams. Of the two dozen streams that Timpano monitors, those located near coal mining operations have shown the highest salt concentrations and insect losses.

"I've been focusing on trying to understand the pattern of salinization through time because it does change seasonally, and they're trying to understand that related to the diversity of stream insect communities," Timpano said. "These insect communities are currently being used as a bio-indicator of water body health for Clean Water Act compliance."

Fish species, rural livelihoods threatened by new dams

Advocates of huge hydroelectric dam projects on the Amazon, Congo, and Mekong rivers often overestimate economic benefits and underestimate far-reaching effects on biodiversity, according to an article in *Science* by a cadre of scientists representing 30 academic, government, and conservation organizations in eight countries. "These three river basins hold roughly one-third of the world's freshwater fish species," said lead author Kirk Winemiller of Texas A&M University. "The 450 additional dams being planned or under construction in these basins put many unique fishes at risk."



Scientists are concerned about Brazil's Belo Monte power complex because its placement threatens several species of fish that do not exist elsewhere. Photo by Kirk Winemiller

Impacts of the proposed Amazon dams include forced relocation of human populations and expanding deforestation. "Even when environmental impact assessments are mandated, millions of dollars may be spent on studies that have no actual influence on design parameters, sometimes because they are completed after construction is underway," explained Assistant Professor Leandro Castello, a co-author, who studies how global change affects the ecology and conservation of fish and fisheries. "A lack of transparency during dam approval raises doubts about whether funders and the public are aware of the risks and impacts on millions of people."

There is a better way, according to the researchers. For the first time, spatial data on biodiversity and ecosystem services are adequate to support sophisticated analyses that balance the costs and benefits of hydropower.

Call to decrease salt introduction in fresh water to protect biodiversity

Alumni Profile

Paul Trianosky uses forestry to promote conservation values

Paul Trianosky ('83 B.S. forestry) has devoted his career to the belief that sustainable forestry management promotes conservation values. As chief conservation officer for the Sustainable Forestry Initiative (SFI), Trianosky works to develop conservation standards and programs for landowners and companies who want to become engaged in conservation efforts.

The nonprofit Sustainable Forestry Initiative began in 1994 with the goal of providing certification to forest lands committed to responsible management practices. The organization works to promote sustainable practices in forestry by helping landowners make good choices to promote conservation values. "Customers who buy products with our label are assured that they come from forests managed at the highest quality level," Trianosky explained.

Trianosky's journey toward combining forest management with conservation was a long one. After graduating from Virginia Tech, he spent time working as a forester for both the Chesapeake Corporation and the Virginia Department of Forestry, but found that something was missing. "I felt the strong desire to engage with conservation efforts on a deeper level," he said. "I asked myself, 'what should my contribution be?'"

This desire to make a meaningful contribution prompted Trianosky to enroll in graduate school. After earning a master's of environmental management from Duke University, he worked for The Nature Conservancy



for almost 20 years, including leadership roles in forest conservation strategies, before circling back to his roots in forest management with the American Forest Foundation and then the Sustainable Forestry Initiative.

In addition to developing certification programs, Trianosky is also responsible for SFI's Conservation and Community Partnerships Grant Program, which encourages institutions and nonprofits to engage in projects promoting responsible forest management and conservation.

For Trianosky, providing others with the tools and knowledge to appreciate conservation initiatives is more than a career — it is a passion. "The best part of my job is developing collaborative relationships and bringing together individuals, conservation organizations, and companies to achieve common conservation goals."

"SFI's work connects from the work on the ground all the way to the brand owners and consumers who encounter our labeled products," he continued. "I get to interact with everyone in between."

Trianosky relies on the credibility and knowledge he gained during his time at Virginia Tech for success on the job. "It's all about the technical abilities I developed there," he said. "Not everyone who does conservation understands forestry, but I can really appreciate those approaches now."

WEI tables stay in the CNRE 'family'

In the winter issue, we reported that the Wood Enterprise Institute (WEI) had taken on the challenge of producing several large tables using historic oak and sycamore wood from sites on campus. **Mike Hinchey** ('88 B.S.), who purchased one of the tables for the conference room of his firm, The Forestland Group, said, "Thank you all for allowing me to purchase what is truly a one-of-a-kind table." **Paul McDaniel** ('01 B.S., '03 M.S.) bought another as a gift for his parents' 40th anniversary. "My dad was speechless," he reported. "He was able to show it off to all of his friends." Thanks to Mike and Paul for supporting this student-run enterprise!



The handcrafted tables were made primarily of 300-year-old white oak with customized sycamore inlay.

Wildlife graduate student *(Continued from page 8)*

Rich hopes that her approach to camera trapping will be helpful to other researchers seeking to make an impact in wildlife conservation. "This technique of expanding analysis to entire mammal communities can be applied to camera-trap studies worldwide," she explained. Currently, two other nonprofit organizations working in the region are interested in adapting Rich's methods in different areas. "It's very exciting to do applied research that will be used to directly impact conservation efforts," Rich said.

In addition to her research, Rich also developed an outreach program for children in Botswana to help build relationships with the local community. "I've always thought that it's important to do outreach in the countries where you're researching," Rich said. She hopes that her efforts will help combat the often negative perceptions of these animals passed on by older generations "Sometimes the children's only experience with these animals includes incidents of carnivores killing livestock or large mammals destroying crops. Changing the local perception of these mammals will help aid in conservation efforts in farming communities."



In addition to her research, Lindsey Rich developed an outreach program for children in Botswana to help build relationships with the local community.

Hyman making a difference in Tanzania

Amanda Hyman earned her master's in fish and wildlife conservation last December and within a month was on her way to Tanzania. Awaiting her was a position with Korongo People's Lion Initiative, or Kope Lion, a nongovernment organization dedicated to inspiring local action to promote sustainable human-lion coexistence in multi-use landscapes.



Within the first 12 hours of her arrival, she was out in the field with two local Maasai, unfamiliar with the language and disoriented. Hyman recalls her first days in Africa as some of the greatest yet most demanding moments of her life but credits her education and experience with preparing her for the challenge. "My studies helped me learn the hard skills: the stats, the coding, the analyzing of techniques," she said. "Many classes taught me to think critically, to remain skeptical, and to question how or why. Those on-the-fly problem-solving skills really come in handy."

"In the Department of Fish and Wildlife Conservation, I also created a really great network of peers and mentors," reported Hyman, who served as president of the Fish and Wildlife Graduate Student Association and initiated the group's calendar fundraiser featuring photos taken by students during their research (see p. 3). "Learning how to utilize others' skills and knowledge bases — and accepting it is okay to do so — is incredibly helpful here."

Hyman's work with Kope Lion varies from day to day. "One day I could be sitting at a computer entering data or coding, while the next I am out tracking lions sleeping next to zebras, and the next I could be hosting a community meeting with local warriors." All in a day's work to create harmony between lions and locals.

Alumni news online

We love hearing about the great things going on with our alumni, but we don't have enough space in the newsmagazine to print them all. Catch up with former classmates and fellow Hokies online; scan the QR code or visit cnre.vt.edu/tags/alumni.html.

Recent posts

Calvin DuBrock ('80 M.S.)
Terry Lasher ('01 B.S.)
Susan Liebes ('98 B.S.)
Bradley Shoemaker ('09 B.S.)
Robbie Talbert ('99 B.S.)

In memoriam:

Ernest Seneca ('59 B.S., '61 M.S.)
William Sheaffer ('82 B.S.)
Marshall Stapes ('68 B.S.)



Wildlife graduate student finds camera traps an effective tool for studying African wildlife communities

When most people think of Africa, they picture sprawling savannahs and big cats stalking through tall grasses. But with predator populations in Africa declining by as much as 80 percent, the image of that landscape is changing. To help protect it, researchers are finding new ways to understand animal populations.



Wildlife doctoral student Lindsey Rich collected more than 75,000 camera-trap photos for research on mammals in Botswana.

Lindsey Rich, who recently completed her doctorate in wildlife conservation, conducted three years of camera-trap research in Botswana, where she sought to evaluate carnivore distributions and densities, and understand how local carnivore populations were being affected by humans. She discovered, however, that the data she was collecting could be used to further research on a much wider range of mammal populations.

Rich partnered with the Botswana Predator Conservation Trust, an organization dedicated to studying and preserving Africa's largest predators, including lions, cheetahs, wild dogs, leopards, and spotted hyenas — species that have a huge impact on both the local ecosystem and the local economy.

Northern Botswana is home to the Okavango delta, an area known for its species richness, and tourists often pay top dollar to see wildlife in this authentic setting. With the wildlife-based tourism industry serving as the second largest contributor to Botswana's gross domestic product, preserving these species is vital both ecologically and economically. "Carnivores are among the species most sought after by tourists when they come to Africa," Rich said.

Rich installed camera traps in areas with varying degrees of human disturbance — near livestock grazing areas where human impact is fairly high, in community wildlife management areas, and in the Moremi Game Reserve where human impact is fairly low — to determine the relationship between human and wildlife activity.

"Camera traps are a popular field research technique in many places around the world, but they've gained less traction in Southern Africa, so it's a relatively new technique in that region," Rich explained. "They're an amazing tool for collecting information on the entire mammal community and on human activity."

Rich placed camera traps at 221 locations. The cameras, attached to trees or metal fence posts, allow researchers to collect data 24 hours a day

and in all weather conditions. They rely on motion- and heat-sensing technology to detect passing animals and then generate time- and date-stamped photographs.

"In the beginning, my research was focused specifically on carnivore populations. I wanted to know where species were, how many there were, and how habitat variables and human-related variables were affecting the distributions and densities of those species," Rich said.

Rich collected data, including more than 75,000 photographs, over three field seasons. Then came the painstaking task of entering and analyzing the data, as Rich and her team looked at each individual image to identify the species or to determine if the camera had been triggered by moving grass or sage. For seven of the carnivore species, such as leopards, they also identified individual animals based on their unique markings and coat patterns.

Many of the photographs included species that were outside the scope of Rich's research, which led her to expand her project to include not only carnivores but terrestrial mammals in general. She ended up collecting and analyzing data on 44 separate mammal species. "My focus was the carnivore community, but I thought it was important to take advantage of the wealth of data being collected on other species as well," she explained.

To assess how a species' life history traits may influence its response to environmental conditions or human activity, Rich divided the mammal species by body size and diet, categorizing them as extra-large, large, medium, or small body types, and as carnivores, herbivores, or omnivores.

The photo data collected revealed the importance of grasslands and floodplains to the area's mammal populations. According to Rich's research, these areas featured greater species richness, on average, than areas with dense vegetation. Grasslands and floodplains were particularly important to large species and carnivores.

The presence of humans also played a role in shaping species richness, Rich discovered. Traps in livestock grazing areas frequented by humans captured fewer species than those in less disturbed, protected areas. "Overall, the further you got into protected areas, the greater the species richness," Rich said.

The data collected will be used to help inform a sustainable monitoring program in Botswana that can contribute to the understanding and management of many native wildlife species. In addition, the data can help the government in Botswana make land management decisions that will help preserve vital mammal species.

While camera trapping offers a low-cost method for monitoring animal populations, Rich explained that the technique is not without its difficulties. She recalled several cameras being turned off or even destroyed by hyenas and elephants. "The animals showed a high level of interest in the cameras."

(Continued on page 7)



All camera-trap photos courtesy of Lindsey Rich and Panthera, a nonprofit organization devoted to preserving big cats and their ecosystems around the globe.

Still No. 1 in the nation!

For the second year in a row, USA Today has ranked Virginia Tech as the nation's best for studying natural resources and conservation. Read the full story at vtnews.vt.edu/articles/2016/09/cnre-topranking.html.



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