



## IN THIS ISSUE

### 2021 USFS Budget

In this Commentary, Michael T. Rains looks at the Trump administration's proposed 2021 budget for the Forest Service. "Budget formulators do not seem to understand the interactions of the direct and indirect roles to achieve a cohesive Forest Service mission," he writes. "The budget's authors appear to see only a series of unrelated accounts. I was especially drawn to the current proposal for the Research and Development (R&D) mission area—a net proposed reduction of \$55,670,000, or 18 percent." **Page 3.**

### New Book by Jim Petersen

A Q&A with *Evergreen Magazine* founder and editor Jim Petersen about his new book, *First, Put Out the Fire!* Subtitle: "Rescuing Western National Forests from Nature's Wildfire Pandemic." Petersen says, "Nothing would please me more than to have this book become a topic of conversation during a presidential election year. I'm going to send a copy to every candidate. I don't care who talks about [the wildfire problem], as long as they talk about it accurately and are actually willing to step up and do something." **Page 12.**

### The Future of SAF

Continuing with profiles of up-and-coming SAF members who will continue managing our nation's natural resources in the coming decades, this month we feature Darrell Street. Street brings experience as a landowner, small business owner, and park ranger to the field of urban forestry. **Page 18.**

### Career Lessons Learned

This month we feature Anil Raj Kizhakkepurakkal (Kizha), an assistant professor of forest operations at the University of Maine and an adjunct professor at Humboldt State University. Kizha writes about the benefits of talking with foresters from other countries and the value of applied research. **Page 19.**

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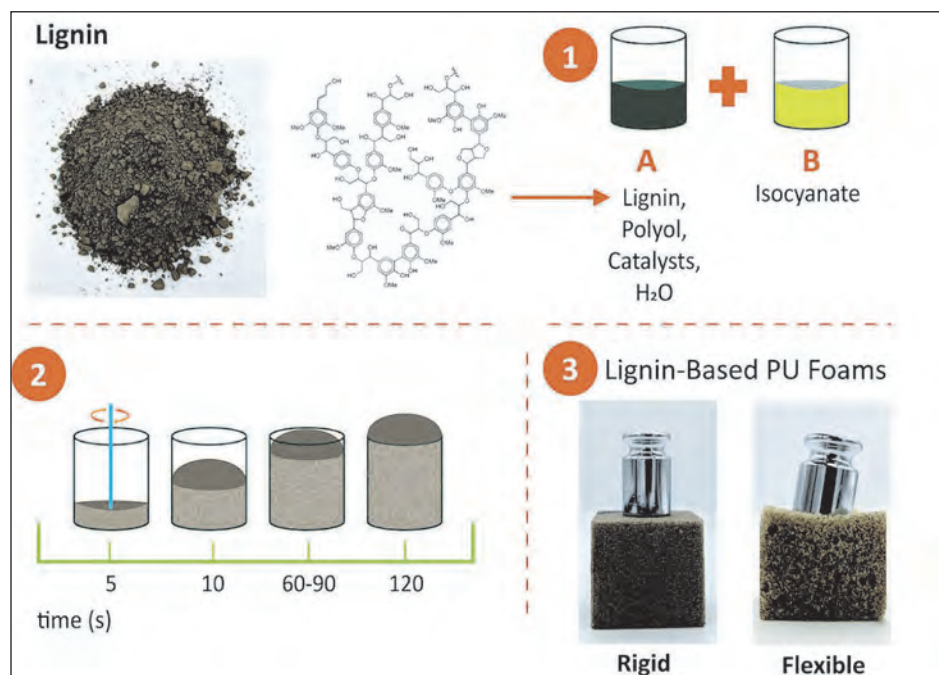
## Innovations in Forest Products Research: From Mass Timber to Nanocellulose

Mention forest products to the general public and they rightly think of lumber, plywood, and paper. However, researchers are working to develop new products made from wood that might seem the stuff of science fiction. In an article starting on page 4, Robert J. Moon, a materials research engineer at the Forest Projects Laboratory's Forest Biopolymer Science and Engineering research unit, explains that cellulose nanomaterials (CNs) produced from wood are already used in numerous products and will one day be used in a range of products now on the drawing board.

For a look at research into a very different forest product, see page 6 to learn about research into mass timber buildings at Oregon State University.

In a Q&A on page 9, Mojgan Nejad, an assistant professor at Michigan State University, talks about research into products such as lignin-based rigid foams for use as insulation in the walls and ceilings of buildings. Not only would such insulation be made at least in part from wood, it would provide significantly better flame retardancy than other foam insulation materials.

Robert Ross, acting assistant director for wood products research at the Forest Prod-



In the not-too-distant future, lignin-based rigid foams may be used as insulation in the walls and ceilings of houses and commercial buildings. See page 9. Image courtesy of Mojgan Nejad.

ucts Lab, describes several avenues of investigation at the lab, from nanocellulose to cross-laminated timbers and mass-timber buildings—see page 10. Ross's specialty is the nondestructive testing and evaluation of wood in standing trees and logs, which can let foresters, loggers, and timber cruis-

ers "make decisions as to what the quality is and, therefore, where it should go in the manufacturing system."

Think you know all about forest products? Think again, and read these four articles in this special edition of *The Forestry Source*. **FS**

## Forest Management Brings the Kirtland's Warbler Back from the Brink of Extinction

By Andrea Watts

Of the bird species Carol Bocetti has studied over the years, the Kirtland's warbler is one she describes as having a lot of character. While other species hide when researchers are out searching for nests or conducting counts, this yellow-breasted warbler will watch the researchers as they work. This bird is "charming as heck, because they have so much personality," she said.

Since 2006, Bocetti, a professor in the Department of Biological & Environmental Sciences at California University of Pennsylvania, has served as leader of the Kirtland's Warbler Recovery Team. Established in 1975, the team, comprised of representatives from academia and state and federal agencies, has worked for more than 40 years to recover the population of this songbird. In March 2016, the Kirtland's Warbler Conservation Team became the new coordinating body as the focus shifted from recovery to sustainability in anticipation of delisting. And October 8, 2019, marked a significant milestone in



The Kirtland's warbler was removed from the endangered species list on October 8, 2019. This success is a result of the collaborative research-management approach of the Kirtland's Warbler Recovery Team. In the 1980s, the bird's population was only 167 breeding pairs; now there are more than 2,300 pairs. Photograph courtesy of the US Forest Service Huron-Manistee National Forests.

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## FOREST PRODUCTS MARKETPLACE

### Coronavirus Case Study: Market Response

By Brooks Mendell

*Editor's note:* This article was originally posted in four parts on Forisk Consulting's blog, [forisk.com/blog](http://forisk.com/blog). Forisk specializes in analyzing forest supplies, wood demand, and timber pricing to develop forecasts and strategic guidance for clients. I am grateful to Forisk president and CEO Brooks Mendell for his permission to use this interesting analysis.—S.W.

#### Part I: Putting Risk in a Box

In a February 26 blog post related to asset values and the coronavirus, I noted, in reference to US Treasuries, that "a low risk-free rate expresses market pessimism and concern rather than economic health, stability and the potential for rapid growth." Then, on March 3, the Federal Open Mar-

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Published monthly by the Society of American Foresters (SAF), *The Forestry Source* (ISSN 1084-5496) provides SAF members and other natural resource professionals with news regarding developments within the forestry profession as well as the activities and policies of SAF.

The opinions expressed in articles, commentaries, and letters do not necessarily reflect the policies or views of SAF.

Publisher: Terry Baker, terryb@safnet.org  
 Editor: Steve Wilent, (503) 622-3033, wilents@safnet.org  
 Associate Editor: Andrea Watts, wattsa@safnet.org

Editorial Offices and Advertising Sales  
 10100 Laureate Way, Bethesda, MD 20814  
 Tel (301) 897-8720 • www.safnet.org

Correspondence: Address all editorial correspondence to the Editor at the above address. Advertising inquiries should be directed to John R. Barnwell at (301) 897-8720, ext. 300.

Subscription rates: \$61 for individuals in the US and Canada \$116 in other countries; \$116 for institutions in the US (\$173 in other countries). Subscriptions for members is included in annual dues. See tinyurl.com/m6xo2x9 for other rates and information. For information regarding subscriptions, address changes, and purchasing single editions, call 866-897-8720.

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Postmaster: Send address changes to *The Forestry Source*, 10100 Laureate Way, Bethesda, MD 20814, Attn.: E. Cooke

Periodicals postage paid at Bethesda, Maryland, and at additional mailing offices. Printed in the USA.

© 2020, Society of American Foresters.  
 ISSN 1084-5496.

**Society of American Foresters**

The mission of the Society of American Foresters is to advance the science, education, technology, and practice of forestry; to enhance the competency of its members; to establish standards of professional excellence; and to use the knowledge, skills, and conservation ethic of the profession to ensure the continued health and use of forest ecosystems and the present and future availability of forest resources to benefit society.

President: Tamara L. Cushing  
 Tamara.Cushing@oregonstate.edu

Vice-President: Henry Kodama, CF  
 kodama@homesc.com

Immediate Past President: John W. McNulty  
 jmcnulty@bradburyforests.com

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# Notes on the Coronavirus, an R<sub>x</sub> Fire in New Jersey, and Firewood from Europe

By Steve Wilent

The use of “may you live in interesting times” as a curse has never seemed more appropriate for life these days. At this writing in late March, efforts to slow the spread of the novel coronavirus (Covid-19) have led to restrictions on daily life here in the US and around the world that would have been unimaginable only a few weeks ago. Like so many businesses and organizations, SAF responded by closing its national office through the end of March and asking employees to work from home. It remains to be seen how long this and other closures will remain in effect. In the meantime, SAF is open for business, so feel free to call, e-mail, or visit the website, eforester.org.

The many public events that have been cancelled include some SAF meetings and continuing education workshops. As is noted in this month's Continuing Education Calendar (page 22), it will be important to contact the event organizers for updates on cancellations or postponements.

To help keep yourself, your family, and community safe, I urge you to follow the guidelines provided by the US Centers for Disease Control and Prevention (cdc.gov) and state and local governments. It has been shown that these guidelines can significantly reduce the rates of infection. The better we are at following them, the sooner society can begin getting back to normal.

For a look at how the coronavirus may affect the forest products industry, see “Coronavirus Case Study,” by Brooks Mendell, on page 1.

## A Prescribed Fire in NJ

You may recall reading in these pages about a 2016 article in *Rolling Stone*, “Will America's Worst Wildfire Disaster Happen in New Jersey?” by Kyle Dickman, who won SAF's Outstanding Forestry Journalism Award for the article that year. Dickman interviewed New Jersey SAF member Bob Williams for the piece. Said Williams: “Most people don't believe me that the big one's coming. But when the conditions are right, this place is going to burn, burn, burn.”

Williams was in the news again last year, this time for his role in writing the forest management plan for Stockton University, which owns 1,600 acres in New Jersey's Pinelands National Reserve. The university recently conducted a newsworthy prescribed fire in its forest. Members of the university's Environmental Science Club, including students in Ecological Forest Management and Wildlife Management classes, inventoried fuels in the area before and after the burn.

I asked Williams about the need for fire in the university's forest.

“These are fire-adapted forest ecosystems that need fire!” he said. “We wanted



SAF member Bob Williams took this photo of a label on a bundle of Latvian firewood for sale in a retail store in New Jersey.

to begin to reduce concerns for uncontrolled wildfire and lower risks to life and property. We also wanted to begin to restore the ecological integrity of the pine forest with the use of prescribed fire.”

Williams has been quoted and mentioned in numerous news articles in recent years. He routinely reaches out to newspapers and TV stations to point out potential articles that highlight forestry in the Pinelands, and has developed constructive relationships with several reporters. You might say that he's been a forest management activist. In my book, Williams is performing a vital service to the state and to the forestry profession, not to mention the Pinelands. He is a role model we all would do well to emulate.

## Firewood from Europe?

The importance of this topic pales in comparison to the coronavirus, but it deserves a look. Earlier this year, Williams sent me a photo of a label on a bundle of firewood on sale at a New Jersey home improvement store. He was surprised to see that the white birch firewood was imported from Latvia. Intrigued, he looked for such bundles at other stores and found them at several other hardware and grocery stores. Some were from Latvia, others from Estonia. I've seen sim-

ilar firewood for sale in Oregon. Home Depot's website offers “European White Birch” that is “dried in the air for many months, before it is kiln dried to the USDA standard and packed by hand into eco-friendly fishnet bags.” The bags contain 10 small pieces and sell for \$9.55.

Europe seems like an awfully long way to ship firewood. Well, I'm no economist. There must be profit in it. Still, with the need for so much forest thinning and fuels reduction in the US, it seems odd to import firewood.

Personally, I enjoy cutting my own stovewood, but if I were going to buy firewood from a store, I'd buy local wood, as long as it was heat-treated to kill any invasive insects.

For what it's worth, Amazon sells 32.8-pound boxes of “White Birch Split Firewood” for \$44.99, from Wilson Enterprises. It's a “Product of the USA. Proudly made in Michigan's Upper Peninsula.” But it sure is spendy. At \$1.37 per pound, that works out to \$2,743 per cord, assuming a cord weighs a ton. Maybe it's too expensive to burn. I can imagine neat piles of that pretty birch on hearths next to fireplaces and woodstoves that aren't used much. They probably even get dusted now and then. Designer firewood, anyone? **ES**



## The 2021 President's Proposed Budget

*Advancing a Cohesive Land Stewardship Role or Just Proposing a Conglomeration of Accounts for the Forest Service?*

By Michael T. Rains

I joined the United States Forest Service in 1968 and retired almost 50 years later. One of my proudest achievements while in the agency was that I worked in every mission area—the National Forest System, State and Private Forestry, Research and Development, and Business Operations. It became very clear to me early on that the mission of the Forest Service is very complex, and it takes the complete integration of all programs to effectively and efficiently “care for the land and serve people *where they live*” [emphasis added]. The true magic of the Forest Service is its direct and indirect role in the stewardship of about 885 million acres of forestland across America, including the 138 million acres of urban forests. No other agency can match this scope. But from time to time, the agency seems afraid to act its earned boldness and proposes budgets that are far too narrowly defined and disconnected.

For example, in the mid-1990s, a budget was proposed that included only the direct role of the agency—the management of national forests. Luckily, cooler heads prevailed, and the final appropriations bill was more mission-centric. By working in every mission area, it was—and still remains—quite clear to me that the proper management of the 193 million acres of national forests and grasslands is extremely critical. But so is the indirect role in the management, protection, and use of the other 692 million acres. Again, it's what makes the Forest Service great; indeed, magical. That is, its total stewardship portfolio across America's landscapes.

As I review the 2021 President's Proposed Budget for the Forest Service, unfortunately, I am brought back to that similar proposal in the mid-1990s. That is, the elimination or significant reduction of programs. Budget formulators do not seem to understand the interactions of the direct and indirect roles to achieve a cohesive Forest Service mission. The budget's authors appear to see only a series of unrelated accounts. I was especially drawn to the current proposal for the Research and Development (R&D) mission area—a net proposed reduction of \$55,670,000, or 18 percent. From the current 2020 program level of \$305,000,000—which is just 4 percent of the total agency discretionary budget—the 2021 proposal of \$249,330,000 for R&D—calls for:

- A \$2,876,000 increase for administration provisions;
- A \$1,454,000 increase for the Forest Inventory and Analysis (FIA) program;

- A \$60-million reduction in scientific research, including the closure of the Pacific Southwest Research Station and the International Institute of Tropical Forestry, the complete elimination of two science programs, and partial reductions in a variety of others.

Let's consider the proposed closures first. To be very clear, I am not opposed to doing without specific research stations, as long as they exist as part of a more optimal organizational configuration. In 2018, for example, I wrote an essay that suggested executive leaders in science and technology transfer (station directors) should be assigned to regional directors (regional foresters). The dominant feature of this type of organizational design is a corporate Forest Service, bolstered by a consistent voice of one overall leader. Research would be accentuated by being more closely aligned to all the direct and indirect roles of the Forest Service within different geographical areas. However, to simply eliminate research stations would have unfortunate consequences: While some facility savings would occur, the level and quality of scientific research would greatly suffer due to a lack of focus. I know. I have seen it happen.

The 2021 budget proposal concludes that closing the administrative headquarters of the Pacific Southwest Research Station in California (-\$18.5 million) and the International Institute of Tropical Forestry (-\$2.5 million) in Puerto Rico will not disrupt science. This seems implausible. And, when the overall proposal concludes that 278 staff years will be eliminated, there will be a significant disruption in scientific research.

The mission of the Forest Service is characterized by the slogan, “caring for the land and serving people.” When I was with the agency, I added “where they live” to the end of the statement to better acknowledge people who live in urban areas, yet use the forests, including the national forests. Making sure that the capacity of the land and people's recreational wishes, for example, are in sync depends on clinical information, its analysis, and timely input into management decisions. Forest Service science obviously plays a key role. With about 150 million visitors each year, maintaining a high level of leading-edge science into the type and level of recreation use on forestlands is fundamental to the vibrancy—the magic—of the Forest Service. So, what does the proposed budget suggest? Completely eliminate the recreation research program (-\$8.5 million).

I do not hunt or fish. But I enjoy

watching wildlife, and more importantly, I want to be confident that the world's premier conservation organization is taking good care of wildlife and fish across our landscapes. It is unconscionable that the entire wildlife and fish research program is proposed to be eliminated in 2021 (-\$22.5 million). This science program is a cornerstone of the Forest Service's magic. To me, this proposed reduction is just not logical. I simply cannot believe the Forest Service would even consider making forest management decisions while ignoring the implications to our wildlife and fisheries populations and habitat.

Another \$8 million is proposed to be cut from all the other research programs—forest and grassland health, forest soils, air quality, hydrology, silviculture, and forest ecology, as well as in applied science to improve forest conditions, forest inventory and trend analysis, and wood products and market innovations.

Reductions in funding for “wood products and market innovations” is perplexing, to say the least. Over the last 25+ years, more and more of the agency's resources have been shifted to the fire effort, leaving fewer funds available to support forest management work—paradoxically, the same restoration projects that reduce the fire threat. Cost-effective biomass uses delivered through scientific research create high-value markets from low-value wood (for example, hazardous fuels). This helps restore forests so that they become more resilient to wildfires, which in turn reduces fire suppression costs. Simply put, it makes good economic sense to aggressively invest in innovative biomass uses.

I am a big fan of FIA—Forest Inventory and Analysis. However, FIA is certainly not a bastion of efficiency. Yet, year after year, it is earmarked within the R&D account at ever-increasing rates. The program seems to be beyond question. However, with today's technologies, it needs to be questioned. Not to be too cynical, but maybe \$2.5 million in FIA cost inefficiencies might be found, so that the proposed closure of the super cost-effective International Institute of Tropical Forestry can be avoided.

Another example that seems very questionable to me is the proposed increase of \$65 million for hazardous fuels treatment—to a level of \$510 million. In 2001, when the National Fire Plan was developed, the estimate of needs at that time for hazardous fuels treatment was \$850 million annually to address the 38 million acres of national forests that were “high risk to fire.” Now, with more than 90 million acres at high risk to fire, the need for hazardous fuels treatment

is about \$2 billion annually. Thus, the tiny proposed increase—about 4 percent of needs—of an overall inadequately funded program—about 22 percent of needs—will have no real impact. Essentially, \$65 million will be largely wasted.

On the other hand, a proposal to increase wood products and market research by \$33 million (a figure I have often publicly discussed) would indeed be a game changer. The Forest Products Laboratory in Madison, Wisconsin, would lead the effort. Three universities that I am aware of—Oregon State, Maine, and Mississippi State—are doing fabulous work to advance technologies in wood utilization. Can you imagine what \$33 million would do for an aggressive partnership in innovative biomass uses? Wood-based nanotechnology, for example, advanced composites with cross-laminated timber, and torrefied wood for energy? I can. And, it would be exciting and very effective in helping produce forests that are more resilient to disturbances like wildfires.

To be clear, I am a strong advocate for investments in hazardous fuels reduction. But you cannot expect a 4 percent increase, coupled with an overall funding shortfall of about 80 percent, to lead to any real change on the landscape. Why not take this \$65 million being proposed and invest it more wisely, so that better land management choices can be made? Specifically, invest it this way: Again, +\$33 million for wood products and marketing, +\$12 million toward evaluating the impacts of a changing climate, +\$5 million on wildlife and fish research, +\$6 million in the i-Tree program targeting the highest priority areas in the wildland-urban interface, and +\$9 million for optimal tactical approaches to fire suppression (overwhelming mass vs. minimalist approaches). Adding this \$65 million to the current 2020 R&D budget would bring the overall mission area back to the 2011 level of about 5 percent of discretionary funds and begin to restore the notion that the Forest Service is truly a science-based organization. The 2021 budget proposal at 3 percent seems to make this notion just a catchphrase.

The R&D mission area is such a key part of that Forest Service magic. I am reminded what a former Forest Service chief Jack Ward Thomas said to me: “Never forget that we are a science-based organization. Reducing science in our



# The Brave New World of Cellulose Nanomaterials

By Steve Wilent

Foresters often think of trees in terms of products, such as lumber, veneer, and chips. Future foresters will also think of these products, of course, but they are likely to add another product to the list: cellulose nanomaterials. And for good reason. Like other forest products, the cellulose nanomaterials (CNs, or sometimes CNMs) produced from wood are renewable, sustainable natural resources of great value to society. And the range of uses for CNs is already wide and destined to expand to products now on the drawing board and yet to be imagined.

Lignocellulose, or lignocellulosic biomass, is the most abundant organic substance on Earth. It is composed of three major constituents: cellulose, hemicellulose, and lignin. (See the article on page 9 for a look at how lignin is being used.) Cellulose—wood pulp—can be broken down into three general types of CNs, each of which come in different sizes and has different properties:

- Cellulose microfibrils, produced through mechanical processes;
- Cellulose nanofibrils, produced through chemical/mechanical processes; and
- Cellulose nanocrystals, produced through acid hydrolysis.

The addition of CNs to concrete may have the greatest global impact. Research by Purdue University, Oregon State University, and the US Forest Service's Forest Products Laboratory (FPL) has shown that the addition of CNs to concrete makes concrete stronger. What's more, because less concrete is required to provide the same strength, less carbon dioxide is emitted during the production of cement, which currently accounts for an estimated 8 percent of global carbon dioxide emissions. See "P3Nano's Michael Goergen: The Promise of Cellulosic Nanomaterials," in the July 2017 edition of *The Forestry Source*. Goergen said this would be "a tremendous win for the planet."

Examples of other innovative uses for CNs include paper food packaging

with a CN coating that serves as a barrier to oxygen and is impenetrable to oils and grease. Even more groundbreaking, CNs for use in biomedical applications have great promise, according to "Versatile Application of Nanocellulose: From Industry to Skin Tissue Engineering and Wound Healing," a 2019 paper in *Nanomaterials*:

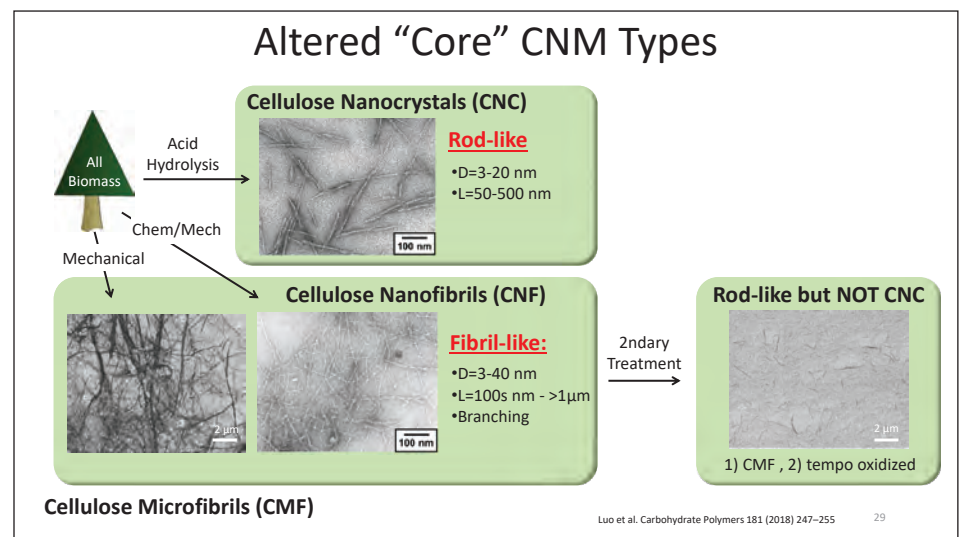
*Nanocellulose is promising for use in scaffolds for engineering of blood vessels, neural tissue, bone, cartilage, liver, adipose tissue, urethra and dura mater, for repairing connective tissue and congenital heart defects, and for constructing contact lenses and protective barriers. This review is focused on applications of nanocellulose in skin tissue engineering and wound healing as a scaffold for cell growth, for delivering cells into wounds, and as a material for advanced wound dressings coupled with drug delivery, transparency and sensorics.*

In the not-too-distant future, large batteries that store renewable energy from solar- and wind power-generating facilities may be made more efficient and more environmentally friendly with the use of mesoporous cellulose nanocrystal membranes.

To learn more about CNs and their uses, I talked with Robert J. Moon, a materials research engineer at the FPL's Forest Biopolymer Science and Engineering research unit. Moon, an internationally recognized CN researcher, has worked closely with scientists at Purdue University and the Georgia Institute of Technology, where he holds adjunct professor appointments in the School of Materials Engineering and in the School of Materials Science and Engineering, respectively.

Moon joined the FPL in 2005 and in 2007 was detailed to Purdue to lead its Forest Nanotechnology Center.

"We didn't know much about these materials at that time," he said. "The Forest Service didn't really have the tools to work with them. Purdue was trying to spearhead a lot of work in the nanotechnology field—they had just built a nanotechnology center at the university. And Purdue was the only partner that we [at the FPL] reached out to that was willing



The production and characteristics of cellulose microfibrils, cellulose nanofibrils, and cellulose nanocrystals. Images courtesy of Robert Moon.

to work on cellulose-based nanoscale materials."

Cellulosic nanocrystals were discovered in the 1940s, but relatively little research has been done into their production and uses. Moon reckons that in the mid-2000s there may have been 30 papers at most on the technology, and a number of patents on fibrillated cellulose from scientists who saw the utility in the material, such as for rheology modifiers for salad dressings and other foods. However, the forest products industry showed little interest.

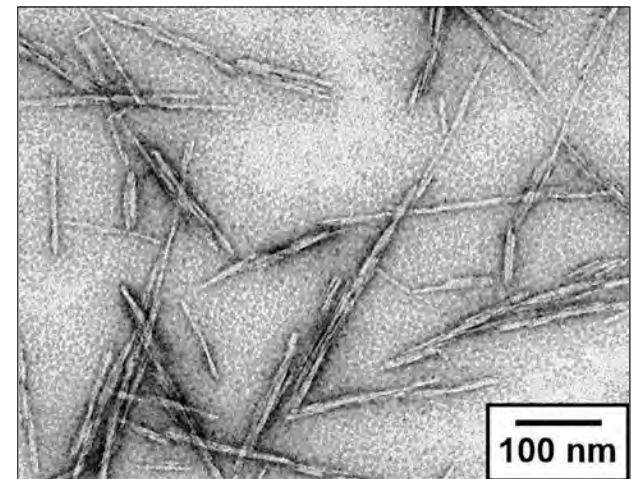
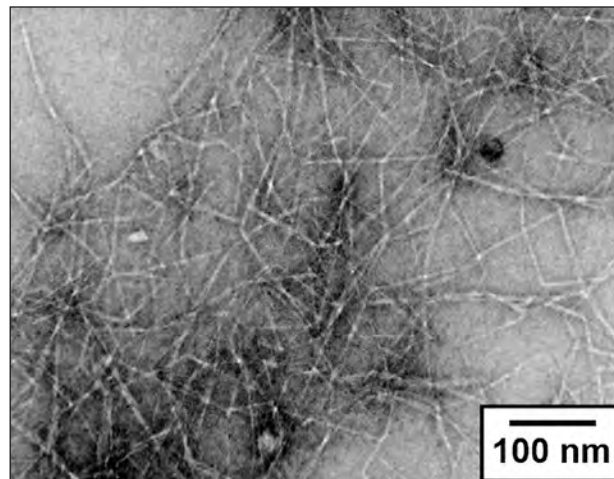
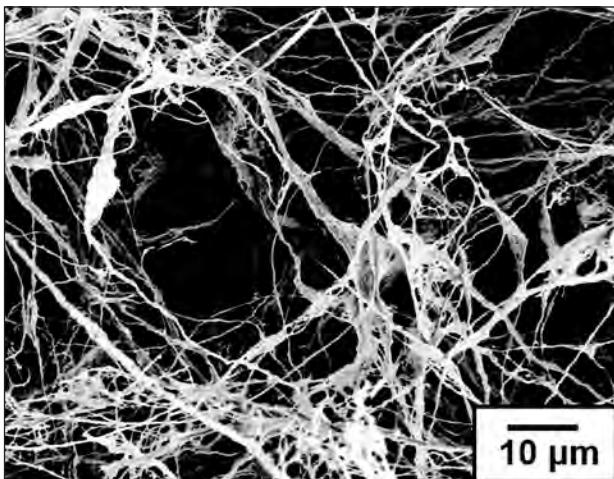
Much of the initial research into CNs began with material from a source far from forests: crystalline cellulose from a tiny sea creature called the tunicate, a marine invertebrate also known as the sea squirt. (Other sources include algae and bacteria.) The tunicate exoskeleton is composed of proteins and complex carbohydrates, including tunicin, a type of cellulose. According to Moon, tunicin, the nanocellulose crystals extracted from such exoskeletons, has an ideal shape, size, and properties for conducting fundamental research.

"Researchers put these crystals into polymer composites, which showed stiffness and strength improvements, and they didn't have to add very much to the polymers to make this happen," he said. "That started getting people interested in work-

ing with these materials."

However, the prospect of obtaining CNs from wood was attractive, because it is so abundant, and the pulp and paper industry has the forest resources, harvesting capabilities, and efficient processes for breaking down wood into pulp and chemicals, at very large scales. The FPL assigned Moon to look into characterizing and modeling CNs. With the paper industry in decline, the FPL viewed research into CNs as important for the future of forestry. In 2006, the FPL and Purdue formally established a partnership to study CNs.

"We had some general ideas about how to produce these materials, but only at the laboratory scale—maybe in gram-size batches," Moon said. "We could capture images of these particles in order to study them, but we didn't have a good understanding of how our processing modified the particles that we made. People were throwing many types of cellulose source materials into various blenders, grinders, and acid digesters, and then trying to characterize what they had, and more importantly, [they wanted to know] 'Was it nano?' It was kind of like the wild, wild west—people from many different research disciplines, often with minimal knowledge of wood or cellulose, were just starting to work with these materials.



Three basic types of cellulose nanomaterials, left to right: cellulose microfibrils produced at the University of Maine [1]; cellulose nanofibrils produced at pilot plant located at FPL [2]; and cellulose nanocrystals produced at a pilot plant located at the Forest Products Laboratory [3]. Each type of CN has a range of sizes, shapes, and other properties. Images courtesy of Robert Moon. Sources: [1] The Process Development Center at the University of Maine (umaine.edu/pdc/nanocellulose). [2] R. Reiner, A. Rudie, in: M. Postek, Robert, A. Rudie, M. Bilodeau (Eds.), *Production and Applications of Cellulose Nanomaterials*, TAPPI Press, 2013, p. 177. [3] R. Reiner, A. Rudie, in: M. Postek, R. Moon, A. Rudie, M. Bilodeau (Eds.), *Production and Applications of Cellulose Nanomaterials*, TAPPI Press, 2013, p. 21.



“First, we had to characterize these materials,” he said. “Second, we had to be able to model them. We wanted to do predictive analyses, so we wouldn’t have to run as many experiments. Modeling also gives you the ability to begin to study mechanisms. You can play around with idealized systems in a model, and then do experimental testing to make sure that the fiction predicted in your model is similar to reality.”

Researchers also needed to have larger amounts of CNs for study. In 2011, the FPL and the University of Maine established a partnership to produce large quantities of CNs from wood.

“Instead of dealing with grams of these materials, we wanted to have pounds or kilograms, dry weight,” said Moon. “If industry sees that you can produce it in quantity, then they become interested. Some industries could potentially need tens of thousands of tons per day.”

Today, the university’s nanocellulose research program is part of the Cellulose Nanotechnology Research Consortium, which is led by the FPL and includes six other universities: Georgia Institute of Technology, North Carolina State University, Oregon State University, Pennsylvania State University, the University of Tennessee, and Purdue. Consortium members are working to develop scalable methods to convert wood components into novel, high-performance nanomaterials and to improve methods to isolate, characterize, and develop standards for the various forms of CNs.

One of the industries taking note of

CNs is the cement manufacturing and concrete sector.

“We found a 20 to 30 percent increase in flexural strength with a very small amount of nanocellulose added to cement—0.2 percent by weight. That was work we initiated at Purdue, and it continues today with a collaborative program between Purdue, Oregon State University, FPL, and other research institutions,” Moon said.

In testing so far, CN-enhanced concrete has proven to flow and handle like the regular concrete used for sidewalks, parking lots, roads, and bridge decks. Long-term monitoring will be required to show that CN-enhanced concrete consistently performs as well or better than traditional concrete.

“California likes it, because if there is a potential to make concrete stronger and tougher, then you don’t have to use as much of it. And if you don’t have to use as much, that’s a plus because the process of making cement is a big source of carbon dioxide, worldwide. So using CNs in concrete would help to lower greenhouse gas emissions,” Moon said. “The research on this has accelerated worldwide. It is crucial to understand the mechanisms for how this works with the different types of concrete, cements, and CNs, as well as in various environmental conditions, so you always get a consistent product.”

#### Flexible Electronics

What’s the killer application for these materials?

“That’s always been the million-dollar

question, and in the early days, we put a lot of effort into answering it,” said Moon. “In hindsight, it really depends on what industry you’re talking about. These materials have such a wide applicability.”

One promising use of CNs is in producing flexible, transparent films that serve as a platform for electronic circuits—flexible electronics.

“The substrate is fully recyclable, and you can put electronic circuits on it,” Moon said. “You take regular pulp and disintegrate it about 10,000 times. The particles are super small, and they don’t interact with light in the same way, so instead of having an opaque substrate, you have a transparent substrate. And because the particles are so small and they’re packed together very tight, the surface roughness is much less. When you try to print micron-size lines or smaller on regular paper, they get lost in the roughness of the paper and you lose your connection. But on substrates made from much smaller particles, cellulose nanocrystals, you can print circuits on it and do a lot of other things to it.”

Nanocellulose films are strong, flexible, and less prone to thermal expansion—a critical property for electronic circuits.

“Polymers are typically horrible at that,” said Moon. “When you heat them up, they expand; they sometimes lose their mechanical properties. Nanocellulosic films don’t show that behavior—in this context they behave more like ceramics than typical polymers. That means you can put a device [an electronic circuit]



**Robert J. Moon, a materials research engineer in the Forest Biopolymer Science and Engineering research unit at the US Forest Service’s Forest Products Laboratory. Photo: USFS.**

on it, and when it warms up, it doesn’t expand too much. If you put a device on a polymer substrate, it expands when it heats up. The expansion mismatch between the film and the electronic device creates a lot of stress at the interface, and over many cycles that device may break or pop off the substrate.”

The prospect of substrates less prone to developing such defects is crucial to the electronics industry as circuitry becomes ever smaller. However, CNs do conduct small amounts of heat, an important

**MOON ■ Page 22**

**COMING SOON**

# A NEW COST EFFECTIVE WAY TO CONTROL EAB

LALGUARD AZA is a new azadirachtin formulation that allows for a lower dose rate and up to 2 years of efficacy against multiple pests including emerald ash borer (EAB). LALGUARD AZA is a natural choice for your forest pest management needs, and offers an environmentally sensitive alternative to conventional products.

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## New Lab at Oregon State Gears Up for Mass-Timber Research

By Steve Wilent



A TimberPress X 225, made by Minda Industrieanlagen GmbH, a German company, will allow researchers at Oregon State University's Advanced Wood Products Laboratory to produce cross-laminated timbers for testing. The press can handle CLT panels up to 18 feet long, eight feet wide, and six inches thick. Photo by Steve Wilent.

Oregon State University's College of Forestry made a splash in October of last year when it opened its A.A. "Red" Emmerson Advanced Wood Products Laboratory, which is dedicated to furthering research and collaboration in timber building design, engineering, fabrication, and construction. The 17,500-square-foot lab is itself a prominent example of the use of mass timbers—its interior and exterior walls are made of mass-plywood panels (MPPs) manufactured by Freres Lumber Co. in Lyons, Oregon. See the September 2018 edition of *The Forestry Source* for an article about Freres and its MPPs.

The lab is part of Oregon State's \$79.5-million Oregon Forest Science Complex, which will include the George W. Peavy Forest Science Center, to be completed this spring. The walls, floors, and roof of the Peavy building are made of another mass-timber product, cross-laminated timber (CLT) panels manufactured by the D.R. Johnson Lumber Co., in Riddle, Oregon.

The lab is named for Red Emmerson and his father, R.H. "Curly" Emmerson, founders of Sierra Pacific Industries, one of the largest lumber producers in the United States and, with 1.9 million acres, one of the nation's largest landowners. The company donated \$6 million toward the construction of the complex.

The Oregon Forest Science Complex also is home to the TallWood Design Institute (TDI), a partnership between OSU's Colleges of Forestry and Engineering, and the University of Oregon's College of Design. TallWood focuses on the advancement of structural wood products and mass-timber design in constructing high-rise and other multistory buildings. (In sports, OSU and the University of Oregon [UO] are fierce rivals; annual "civil war" games between the universities' sports teams draw huge crowds. OSU's mascot is the beaver; UO's is the duck. For the sake of maintaining cordial relations be-

tween science complex research personnel, the TallWood team members adopted the duck-billed platypus as a compromise mascot.)

To learn more about the lab, I visited with TallWood's outreach coordinator, Evan Schmidt, in February. Schmidt earned a master's degree in wood science at OSU, with research focusing on moisture performance of CLTs and CLT buildings. Prior to attending OSU, he studied architecture and worked as an independent contractor, providing landscape design, drafting, and permitting services for residential construction projects.

**I gather that there's a great deal of collaboration between TDI and the departments of the two universities.**

Definitely. We are very tightly interconnected. TDI is headquartered within and administered by the College of Forestry.

The interest that the College of Forestry has in mass timber is a very logical one. What I like about it is that it spans ecosystems and social services through actual forest engineering and resource management—from conducting forestry on the ground all the way through to wood products and how they are used. From the college's perspective, this is a natural outlet for the resources we are stewarding. There's a big demand for wood products and a lot of interest in mass-timber products, and it all starts with forestry. "Forest to frame" is a common way to think about this connection between sustainably managing our natural resources and a built environment that is environmentally friendly, sustainable, and better for human health.

**The lab is just getting up and running. What's in store in the near future, in terms of the new equipment and research projects?**

This lab has two primary functions. On one side, we have an advanced manufacturing and fabrication bay. Essentially, we



Advanced Wood Products Laboratory staff built hundreds of small CLT assemblies in various configurations for studying the impact of moisture on connections between mass timbers. Photo by Steve Wilent.

have equipment that lets us take dimension lumber, plane it, cut it up into whatever sizes we need, press them up into beams or panels in our Minda press, and mill them using either our Kuka robot cell or our Biesse milling center.

The milling center is a five-axis CNC—computer numeric controlled—machine. This is a device used in advanced timber construction to allow designers to work ahead of time in coordination with builders and subtrades to come up with a design for a building that will be assembled all at once. They know exactly where all of the cutouts are in each panel or beam for plumbing and electrical hardware. The designers build a model that can be read by the machine, and the machine very accurately mills products that are ready to assemble on-site.

The manufacturing and fabrication side of the lab is mostly dedicated to training and education, but there are some elements of research that come into play, with digital design—a big area of interest—

and building mass-timber samples for research.

One example of how the CNC has come in handy so far on the research side of things is in a joint USDA (US Department of Agriculture) and TDI project, with \$750,000 in joint funding. The project is a study of moisture in mass timber—studying the impact of moisture on mass timbers and the connections between them. Under typical construction conditions, these connections may get wet, and the wood swells and then shrinks when it dries out, and maybe it cracks. The researchers are looking at the impact on the long-term performance of the connections—typically, steel or alloy internal or external hardware. Or, let's say you had some flooding, and there was some exposure to fungi. What's the effect on the connections?

**I see hundreds of small CLT assemblies on pallets throughout the lab. Are these to be used in the project you just described?**





The Advanced Wood Products Laboratory includes a structural testing bay with a 25-foot-tall, four-foot-thick strong, or reaction, wall for anchoring model buildings up to three stories high during structural tests. The bay features a reinforced concrete floor 60 feet wide, 80 feet long, and five feet thick. This is one of the largest strong wall/floor systems for wood-products research in the US. Photo by Steve Wilent.

Yes. If you want to get statistically significant results, you have to have a lot of samples. And you want every single sample to be as close to exactly like every other sample as possible. Of course, wood is a very heterogeneous material, so each one of the samples is unique to the species of wood, the different pieces of dimension lumber used to make the samples, the varying density of each piece, and so on. But we do want to make sure that all of the samples are the same size and that all of the hardware is mounted in exactly the same position and with similar tension,

and so on.

Each one of the samples is marked with the species. We have four: Douglas-fir, spruce-pine-fir, Norway spruce, and southern yellow pine. The many hundreds of samples you see here are for just one subset of this research project.

The CNC helped us make the samples uniform. Without it, that would have meant very long and arduous hours for grad students to make everything by hand, and the samples wouldn't have been as uniform. Even using the CNC, it took a lot of work to prepare the samples. A



Two cross-laminated timber sections: one made of southern yellow pine (top) and the other of spruce-pine-fir lumber. Photo by Steve Wilent.



Researchers atop a two-story CLT structure that uses post-tensioned rocking shear walls as its lateral force resisting system. The structure rests on a "shake table" designed to simulate an earthquake. The researchers are examining load cells, sensors that measure tension in the steel rods inside the CLTs. The tests were completed in San Diego in 2017 as part of a multi-institutional collaboration funded by the National Science Foundation's Natural Hazards Engineering Research Infrastructure unit. The researchers will make similar tests of a 10-story timber structure in 2021 as part of continuing research into the seismic performance of timber buildings. Photo: Erik Jepsen.

CNC milling center is only capable of so much—sometimes people think they can do anything, but in reality, they have quite a few limitations. In this case, we used the CNC to cut long strips of CLT and drill all of the holes for the hardware. Then, student workers cut the strips to length and installed the hardware.

**The samples here are relatively small. Are you also conducting tests on larger pieces?**

Absolutely. Conducting tests on a variety of scales is very important, especially in structural research. Some testing will be done at the fastener scale—you may need to test the withdrawal or bearing strength of a single type of nail, screw, or some other kind of fastener. From there you scale up to the connection scale, and all the while you're building models, verifying assumptions, and gaining design values that you can apply at larger scales. The ultimate goal is building and testing full-scale assemblies and building systems, so we can verify our assumptions and show how these systems perform.

**And this large lab space is designed for testing these full-scale structures?**

That's exactly what this structure was designed for. On one side of the lab, we have a so-called reaction wall, or strong wall, and we are standing on a reaction, or strong, floor. The wall and the floor have embedded hardware so that we can connect model buildings to the wall and to

the floor. In structural testing research—when you're testing according to a standard—typically, you're wanting to understand how much deflection or movement you have in the structure, relative to how much force you're placing upon it. That's your force-displacement curve.

If you're mounting hydraulics and steel to the floor and the wall to test a three-story building, and you're pushing on that structure with hundreds of pounds of force, you want to make sure you're measuring how much the building is moving—the timber components—not the wall or the floor. The wall is about four feet thick and the floor is about five feet thick, and they're reinforced with high-strength rebar.

**So, researchers can build full-size structures inside this building. What kind of test might they do?**

The strong wall is 25 feet tall, and we can mount steel frameworks to go even higher, so we can test up to a three-story building in here. This year, we will be testing two three-story rocking walls tensioned to the same degree as the walls in the Peavy Forest Science Center building. The structure will be monitored using digital image correlation, which basically allows us to observe deformation and deflection in mass-timber panels. The lab is a controlled environment, where we will be able to collect data to compare with the data we're getting in the field.



### Data from the Peavy building?

Right. The new Peavy Science Center is a unique building because it has a so-called rocking-wall system using cross-laminated timber walls with steel tendons running through them that are embedded in the foundation and then tightened at the top of the wall. This allows the walls to rock during an earthquake and then to return to their center positions.

Mariapaola Riggio, an OSU assistant professor of wood design and architecture and the principal investigator, will be monitoring the new Peavy building, including structural as well as environmental factors—the effect of humidity and temperature inside and outside of the building and the moisture content inside the panels themselves. And she'll be looking at structural behavior in terms of the slow changes in dimensions of the panels and the relative movements of walls and other structural components over time and with tensioning of the panels. This is a really good example of the work we're doing at TDI.

### The CLT walls will have to be retensioned at some point?

Yes, to accommodate those dimensional changes. The data we collect will inform us about whether the procedures we're taking are appropriate, in terms of when and how they should be tensioned. It's complicated, because you have to monitor

changes in steel, as well as in the CLT panels. The dimensions of the steel tendons is heavily affected by temperature, whereas the wood is more affected by ambient humidity.

Having a lab like this with a mass-timber building a short distance away ought to offer a variety of opportunities for research in the coming years.

Our goal is to do applied research, applied science. We're focusing on deliverables—how mass-timber buildings are constructed and maintained in the field.

**Society is expressing more interest in forest products these days, perhaps more than ever before. They often see news articles about tall wood buildings, cross-laminated timbers, and so on, and the sustainability and carbon sequestration inherent in these products. It's interesting that there is a strong social aspect to the development and use of mass-timber products.**

It's a huge driving factor for mass timber. I think people are ready for change, and this is a narrative that speaks to them. They're beginning to understand that it's more about a proper process and that mass-timber wood is a sustainable alternative to conventional building materials. People connect with wood—wood is a very warm material. So I think this is easy for people to get on board, in terms of how being in one of these wood buildings makes them feel good, and with the whole “forest to frame” concept. Wood is good! **FS**



Oregon State University's A.A. “Red” Emmerson Advanced Wood Products Laboratory under construction in fall 2018. Mass-plywood panels (MPPs) manufactured by Freres Lumber Co. in Lyons, Oregon, were used to build interior and exterior walls. Image: OSU.



A six-axis robotic arm made by Kuka AG, a German company, will cut holes and channels for hardware in mass-timber panels for testing by researchers. Image: OSU.

## FOREST PRODUCTS RESEARCH

# Developing Lignin-Based Polymeric Resins: A Q&A with Michigan State University Professor Mojgan Nejad

By Andrea Watts

In vascular plants, lignin comprises up to 30 percent of a plant's biomass and provides a number of vital functions. This complex organic polymer enables the conduction of water throughout the plant and serves as a glue to hold fibers together. In trees, it provides structural strength and resistance to decay. Because pulp and biofuel producers desire the cellulose in biomass to make paper and bioethanol, the lignin produced as a byproduct often has no marketable value except to burn for energy.

However, researchers around the world are exploring how lignin can be turned into a high-value product as a replacement for petrochemicals. One of these researchers is Mojgan Nejad, an assistant professor in green bioproducts who has a joint appointment in the Forestry and Chemical Engineering and Material Science Departments at Michigan State University (MSU). Nejad earned an undergraduate degree in applied chemistry from K.N. Toosi University of Technology in Tehran, Iran, and PhD in wood science from the University of Toronto.

Nejad, who joined MSU in 2016, focuses on developing lignin-based bioproducts. In 2017, her lab successfully developed a lignin-based phenolic adhesive that replaced 100 percent of the phenol with lignin, as well as a biobased glue with similar properties to a petroleum-based adhesive. In recognition of her research, Nejad was awarded the Adhesive and Sealant Council's Innovation Award in 2018.

In February, I spoke with Nejad about her research and the goal of replacing petrochemicals in the wood manufacturing process. What follows has been edited for length and clarity.

### What prompted the idea of using lignin to replace petrochemicals in coating and adhesive formulations?

The pulp and paper industries were looking at producing new wood products because they can't sell paper as much as they used to, due to the move toward a paperless society. Pulp and paper production have dropped significantly during the last decade; people are not reading newspapers on a piece of paper, and, for that matter, people are reading less overall, including printed books. Even though online shopping has increased the production of paper-based packaging products, producers still thought they should find applications for their underutilized products, such as lignin.

Another driver is from the biorefinery and biofuel industry. For example, a biofuel producer can use corn stover—not the corn itself, but corn cobs, stalks, and leaves—to make bioethanol. But if producers only focus on the biofuel pro-

duction, it's not going to be economically feasible. They need to create value-added opportunities for their lignins. The value of lignins for use as an energy source is around \$100–\$150 per ton, whereas selling isolated lignin for about \$500–800 per ton to replace petrochemicals (polyol, phenol, and bisphenol-A [BPA] use polymeric resin), which cost around \$1,000 up to \$3,000 per ton, will justify and improve the economics for producing biofuels.

What my group and other groups are trying to do is create value-added opportunities for the lignin that is underutilized and has been used as its lowest value. When we can replace an expensive, toxic petrochemical with one that is biobased, it can make a high value-added bioproduct.

In coatings, one of the main components is called a binder, or resin. We can use lignin to entirely replace polyol in formulations of polyurethane to replace bisphenol-A, which is very toxic, to make 100 percent biobased epoxy.

In addition to developing biobased coatings and adhesives, we are working on rigid and flexible foams and also elastomers. We have a project with the Ford Motor Company to make a lignin-based flexible foam that can be used for automotive seating.

### Is lignin all the same?

Even though the name is the same, like wood, lignin, depending on its source or isolation process, is going to be different. We need to measure the properties of lignin before considering it for a product. For example, Verso, a pulp and paper company in Upper Peninsula Michigan, always uses hardwoods to make pulp and paper. The company's process is kraft, which will produce kraft hardwood lignin. The first thing we did was to characterize the lignin and then told the company that its lignin would be a very good candidate to replace polyol in production of polyurethanes. Choosing the right lignin for a specific application is key to ensuring we get the performance similar to the commercial formulation of paints and adhesives on the market.

We have more than 50 different lignin samples in our lab and have characterized their physical, thermal, and chemical properties. Based on these measured properties, then we decide whether they could



Mojgan Nejad, an assistant professor in green bioproducts in the Forestry and Chemical Engineering and Material Science Departments at Michigan State University. Photo: MSU.





Examples of rigid foam created at Michigan State University that run the gamut of zero to 100 percent lignin content.

be a good fit for phenolic, polyurethanes, or epoxy applications. For instance, we found that the corn stover biorefinery lignin is good for phenolic resin application, while hardwood or softwood kraft lignins are better for polyurethane applications.

#### Can you tell me a bit more about the lignin-based foam research?

The rigid foams project is funded by the Department of Energy (DOE) in collaboration with Clemson University; we are trying to replace 30 to 100 percent of petroleum-based polyol with lignin to make polyurethane rigid foams. These lignin-based rigid foams would be used in insulation applications in the walls and ceilings in houses. It would have significantly better flame retardancy and fire performance, which are inherent properties of lignin. A previous study that tested the flame retardancy of this foam reported that the addition of 2 percent lignin meant it took much longer for the flame to start on the foam. Basically, you're going to have a house that has more fire retardancy. If you have fire in the house, it's going to take much longer for the flame to start, which gives people in the house more time to leave—even a few minutes before spreading the fire is significant in saving many lives.

Another benefit of using lignin is you're not using petrochemicals; the price isn't going to fluctuate because of gas prices. And you're getting the benefits of sustainability, while using a cheaper, sustainable material.

Having said that, companies only become interested if we show them that performance is similar or better than petroleum-based products at a comparable price. In all of our work, whenever we are replacing petrochemicals with lignin, we try to ensure that final products would have lower cost, and in some cases, they

cost half of current commercially formulated products. That's why lignin is getting a lot of attention from industry. We are hoping that soon lignin-based bioproducts will be produced at industry scale, which would be a step to moving toward a bioeconomy.

#### What's the timeline for taking what you develop in the lab to making it available on the market?

We have a couple of patents that we've filed in the last few years. One of our projects is supported by Michigan Translational Research and Commercialization (MTRAC). They are helping us scale up the adhesive we are making. At the same time, I'm constantly working with lignin, adhesive, and wood-panel producers, who are helping us by providing technical advice and raw materials, and in some cases, funding the projects. This will help us ensure that the formulations can be scaled up for use on a wood panel production line with no or minimal change. Most companies don't want to change their production lines, and we don't want them to have to do that. If this goes at the rate that we plan, we can easily implement these lignin-based polyurethane and phenolic adhesives to the market in the next two to five years.

#### Does the industry approach you with a product in mind, or does your lab come up with products that the industry could use?

Usually we come up with the idea, and then I contact industry to discuss our proposed work. If a company is interested, it supports the project, or we get funding from the government, such as the US Department of Agriculture, DOE, MTRAC, or Wood-Based Composite Center [see [www.wbc.vt.edu/center](http://www.wbc.vt.edu/center)]. As soon as we get initial good results, that's usually when indus-

try starts funding individual projects.

Sometimes industry approaches us. For example, for the epoxy project, a company in Thailand was producing biobased epichlorohydrin, which is a raw material for epoxy resin. Representatives visited my lab and said, "Okay, we are making these biobased products, but now we are mixing it with BPA. We are interested in using lignin to replace BPA. Can you help us with that?" I wrote a proposal, and we started a project. That's one where we replaced 100 percent of the BPA with lignin and formulated 100 percent biobased epoxy resin using biobased epichlorohydrin and a biobased curing agent.

#### What makes your research successful?

I have a multidisciplinary group with background education in chemistry, chemical engineering, and material science. We start by selecting the most suitable lignin for each specific application and focus on developing products and optimizing both process and performance. I think we have been successful in developing lignin-based bioproducts because of support and invaluable technical advice we are getting from industry.

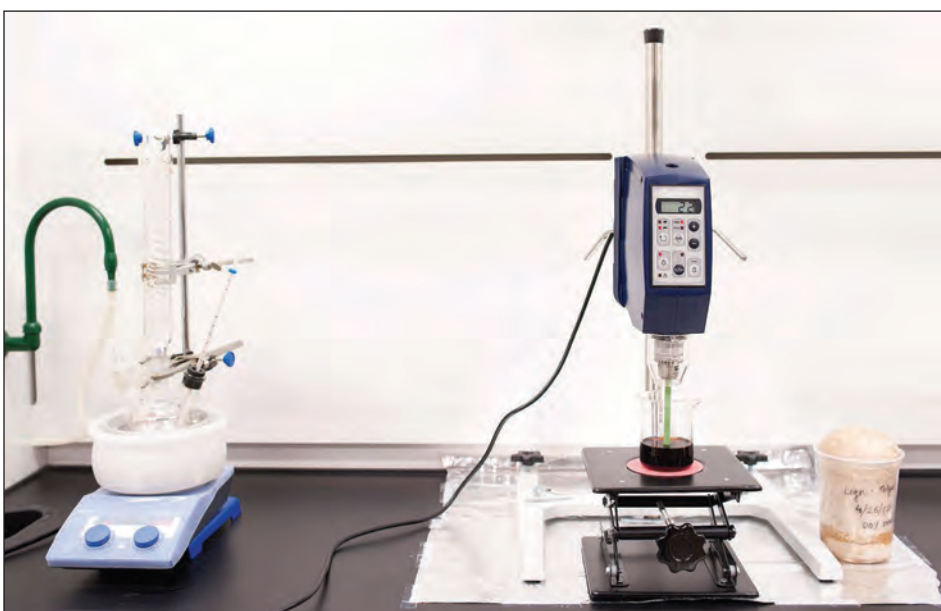
For example, for the adhesives industry, I am working with scientists who have been formulating adhesives for 30 years or more. They send us raw petrochemical materials that they use, they tell me what performance they need, and how we should test it. Based on that, we formulate the lignin-based adhesive, and test the performance versus the commercial formulation to make sure we absolutely meet the required standard performance. Knowing what criteria they have in mind is very helpful for us to optimize our formulation and process to get similar performance.

And, of course, having good graduate students who do all the lab work, good support from the department and university, and funding from industry or government agencies all play a big role in getting good results. I really hope that we can scale up our work and see biobased products we developed in the lab used by people.

#### What excites you about your research?

The lignin itself. Lignin is such a complex molecule; there is always something new we are learning about lignin. Scientists are still debating about the main structure of lignin!

Imagine that everything we are using on a daily basis, every product made from petrochemicals, can be made from biomass. There's so much potential in making biobased products to replace the majority of the petrochemicals—that will keep the scientists working in this field busy for a very long time. **ES**



A high-speed mixer that is mixing lignin in alkane solution (right), and a dry bath used to formulate lignin-based phenolic adhesives.

#### Agromining: Metal Farming

Phytoremediation—using trees and plants to remove heavy metals or toxic compounds from soil or water—can be a cost-effective means of cleaning up pollution. A similar process, phytoextraction, or using plants to “mine” heavy metals, also can be profitable. In a 2018 paper in the *Journal of Geochemical Exploration*, Philip Nti Nkrumah and eight coauthors described using *Phyllanthus rufuschaneyi*, a shrub or small tree native to Malaysia. *P. rufuschaneyi* is one of hundreds of plants known to be hyperaccumulators of valuable metals such as zinc, cadmium, and nickel. The authors concluded that the plant has a “high potential for economic Ni [nickel] agromining,” potentially at commercial scales.

A February 26, 2020, article in the *New York Times*, “Down on the Farm That Harvests Metal From Plants,” notes that this “metal farming” has been successful on a small parcel of land on the Malaysian side of the island of Borneo: “Every six to 12 months, a farmer shaves off one foot of growth from these nickel-hyper-accumulating plants and either burns or squeezes the metal out. After a short purification, farmers could hold in their hands roughly 500 pounds of nickel citrate, potentially worth thousands of dollars on international markets.”

Agromining is promising on serpentine (ultramafic) soils, which are typically rich in elements such as nickel, chromium, and cobalt, but are deficient in essential nutrients needed for traditional agriculture. The practice also may hold promise for remediating polluted soils: The *Times* notes that “mining companies might use these plants to clean up their former mines and waste and even collect some revenue.”

Fast-growing tree species such as poplar and willow are favored for phytoremediation in many cases, because they can take up larger amounts of pollutants than smaller plants.

#### Zapping Bugs

A technology that uses dielectric heating and radio frequency (RF) energy to destroy destructive pests within wood products is closer to reaching the marketplace after a recent commercial trial at Penn State's University Park campus. According to the university, the demonstration validated the effectiveness and cost efficiency of technology for pallet sanitation. The patent-pending wood treatment system heats wood by using electromagnetic wave penetration, similar to that of a microwave oven. It heats wood from the inside out, first causing the core temperature to elevate rapidly, making it an ideal method to destroy pests inside.

“RF treatment is more efficient and uses fewer resources than conventional kilns and chemical drying methods, and that is not only better for a company's bottom line, but it is also better for the environment,” said Mark Gagnon, Harbaugh Entrepreneur and Innovation Faculty Scholar in the College of Agricultural Sciences.

For more information, see [tinyurl.com/udnjbb](http://tinyurl.com/udnjbb).



## Inside the Forest Service's Forest Products Lab

*A conversation with Robert Ross, the lab's acting assistant director for wood products research*

By Steve Wilent

Like many foresters, Robert Ross grew to love forests while hunting, fishing, and camping as a young man. He always loved and appreciated wood, too, for its variability, versatility, renewability, and beauty, and that set him on a course toward a career in wood research. Ross earned a bachelor's degree in wood science and a master's in engineering mechanics at Michigan Technological University, and then a doctorate in engineering science at Washington State University. His first jobs were engineering positions at Weyerhaeuser, Trus Joist, and Metriguard, a producer of lumber and veneer grading and testing equipment. He joined the US Forest Service's Forest Products Lab (FPL) in 1988.

As FPL's acting assistant director for wood products research, Ross oversees several units:

- The Engineering Properties of Wood, Wood-based Materials, and Structures Research, which includes work on mass-timber buildings.
- Durability, which investigates the effects of wood preservatives and other treatments on wood products and buildings in a wide variety of environments throughout the world.
- Lifecycle Analysis and Economics. "They've been instrumental in doing basic life-cycle analyses of mass-timber products and other wood products. It's so important to show the value of these wood products in comparison with other construction materials," Ross said.
- Fire Performance. "This research has been a critical part of using mass timbers, especially in multistory buildings."
- Fundamental Wood Anatomy. "Researchers in this unit look at how various forest management regimes affect growth characteristics and, thus, wood quality. One of the project leaders in this unit, Tom Eberhardt, does a lot of work in this area, in cooperation with a number of universities, to determine how the performance characteristics of wood from different species are affected by various forest management approaches."

Ross's research specialty is nondestructive testing and evaluation of wood products.

"The purpose is to come up with non-invasive ways to assess wood quality, be it in a manufacturing environment for lumber and veneer," he said, "or, most recently, for wood in standing timber or logs. What's the quality of the wood? What uses is it best suited for?"

To Ross, this is crucial work.

"There's always pressure on our forests, pressure to use them for the highest and best values. I think it's really important to know how our management practices potentially affect wood quality," he said. "We

tend to want to grow trees as fast as we can, but from a wood-quality perspective, that's not always the best approach. Our nondestructive testing technologies are important here, because even within fast-grown stands, there's still fairly high-quality wood, but you have to be able to measure and quantify that quality."

For more on this, see "New Technologies for Assessing Wood Quality," by Ross, Xiping Wang, and Mark Rudnicki, in the February 17 edition of *The Forestry Source*. The article describes products that could be mounted on harvesting heads or carried by timber cruisers to assess wood quality in real time. Since that article was published, additional work has been carried out to deploy the technology in commercial products used all over the world, Ross said.

For example, Fibre-Gen Ltd., a New Zealand-based company, produces a suite of tools that measure wood quality, including handheld units for use by foresters in the woods and in urban areas, and instruments that can be mounted on sawmill equipment and on harvester processor heads.

Such products let loggers, timber cruisers, and researchers "make decisions as to what the quality is and, therefore, where it should go in the manufacturing system," said Ross. "All of the anecdotal information that we get is that it can increase significantly a company's bottom line. We also know that the handheld units that detect decay inside standing trees are being used by arborists in urban environments."

### Mass Timber

One of two broad areas of research at the lab in this area is in the design and performance characteristics of CLTs (cross-laminated timbers) and other mass-timber products. This includes the performance of various adhesives and decay resistance.

"We also have a lot of work going on in mass-timber building design, particularly in taller structures, such as how they perform in earthquakes and high winds," said Ross. "Quality control procedures and in-place quality evaluation procedures are going to be critical, so that you can guarantee that mass timbers have good bonds within them, that they come out of the manufacturing plant well put together and durable."

FPL researchers also are studying the ability of mass-timber buildings to withstand fire, including the wood panels and beams themselves, as well as the hardware used to connect them.

Another area of study: life-cycle analyses of mass-timber buildings.

"There's a constant debate about whether sequestering carbon in a building is a good thing or not. I'm still convinced that it's the best building material out there. My opinion is that it's an environmentally responsible material, and when you look at the alternatives, wood is far superior. The life-cycle analyses the lab is doing are

designed to look at this in a very rigorous way."

### Future Research Priorities

As you'll read in the article on page 4, cellulosic nanomaterials hold great promise for a wide range of products, from stronger, more environmentally friendly concrete to innovative new biomedical products.

"There's been some excellent work on cellulosic nanomaterials done here at the lab, in partnership with industry and various universities, to investigate how to manufacture nanocellulose materials and, more recently, how to use them in various applications, such as in concrete, adhesives, and other common construction materials. But there's also a lot of work to look at using these materials in higher-value products, such as electronic components. There are myriad applications for this kind of material," Ross said.

Personally, Ross would like to continue his research in techniques for evaluating wood quality.

"I would like us to spend more time on research to come up with better ways to grade and assess woody materials. We've done a lot of great work in this area, but



Researchers test devices that test the quality of the wood in standing trees using acoustic velocity measurements that gauge wood stiffness. Image courtesy of Robert Ross.

PRODUCTS LAB ■ Page 17



Fibre-Gen's Hitman PH330 is an automated, real-time wood-quality measurement tool that can be mounted on harvester processor heads. Data from the sensors (circled) are displayed on a screen in the cab, allowing the operator to sort logs for hauling to the appropriate destination. The New Zealand-based company makes several other tools for measuring wood quality. For more information, see [fibre-gen.com](http://fibre-gen.com).



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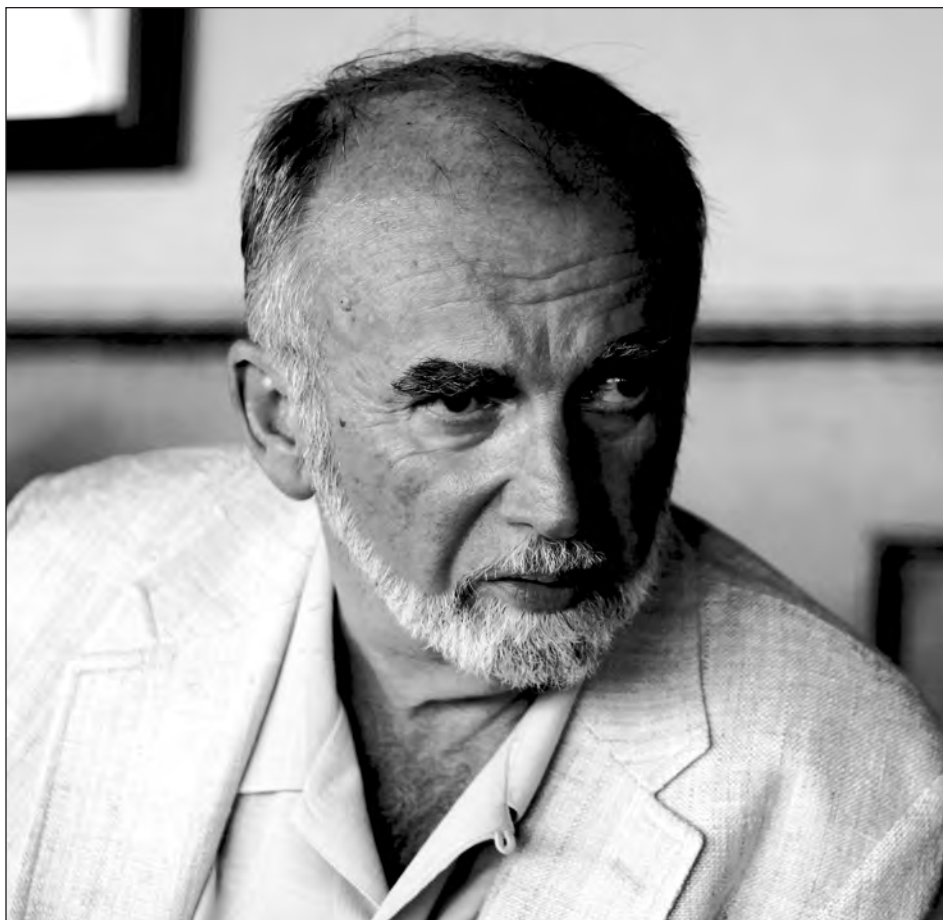
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# Jim Petersen: *First, Put Out the Fire!*

By Steve Wilent



Jim Petersen, founder of the Evergreen Foundation and author of a new book, *First, Put Out the Fire!* See [evergreenmagazine.com](http://evergreenmagazine.com). Photo courtesy of Jim Petersen.

Jim Petersen is the best storyteller I know. He wasn't always Number One in my book, not while Bill Hagenstein was alive. Petersen and Hagenstein, who served as SAF's president from 1966 to 1969, were friends for 42 years. Hagenstein died at the age of 99 in 2014. In the foreword for Hagenstein's memoir, *Corks & Suspenders: Memoir of an Early Forester*, published in 2010, Petersen wrote, "For the record, no living American has done more to help advance the cause of forestry—real, science-based forest management, free of political betrayal and its modern-day hubris—than my friend Bill Hagenstein."

I know of no living American who has done more to help advance the cause of forestry than Jim Petersen.

James D. Petersen is a member of the Society of American Foresters, but he isn't a forester—he holds a degree in journalism from the University of Idaho and has been a working journalist for 57 years. In 1986, he started the Evergreen Foundation, a nonprofit organization dedicated to providing "fact-based information about forestry and forest management." Most people know of the foundation through its *Evergreen Magazine*, which started out printed on paper and continues today online ([evergreenmagazine.com](http://evergreenmagazine.com)). Petersen has published numerous articles on anchor forests, collaboration, and the US Forest Service and its management of western national forests. He has published 11 essays, so far, in his "Felt Necessities: Engines of Forest Policy," which "trace the history of the conservation movement in the United States and its influence on the nation's ever-shifting forest policy."

The US Forest Service's Forest Inventory and Analysis (FIA) Program has been the subject of several of Petersen's

*Evergreen* articles, including a new one that probably will be available on the Evergreen site by the time you read this. FIAs work is "unblemished, unbiased, and backed by decades of field research, which is why we consider them to be forestry's gold standard," he wrote. Petersen interviewed Vicki Christiansen when she was interim chief of the Forest Service; Kurt Pregitzer, dean of the University of Idaho's College of Natural Resources; and Idaho governor C.L. "Butch" Otter in 2016, during his third term in office. There are too many others to mention.

(Jim's wife, Julia, has written a number of *Evergreen* articles in a "Women's Work" series. Most recently, she profiled a mother and daughter who work in a mill, banding and stacking lumber. Jennifer, the daughter, says her mom, Karin, is "the mom of the mill.")

Among numerous awards for his writing, Petersen received SAF's Outstanding Forestry Journalism Award in 2003 for "The New Pioneers," an *Evergreen* special report about "an eclectic mix of entrepreneurs, visionaries, scientists, politicians and true believers" who were working to address the Southwest's forest health crisis.

Petersen has given numerous speeches, including one entitled "The Fire Next Time," to the Intermountain Forestry Association annual meeting in 2009. The text of his remarks is on the *Evergreen* website. He talked about the Great Fires of 1910, saying, "The fire next time will be different from the 1910 fire in two very significant ways. Many more lives will be lost and far more property will be destroyed, simply because there are many thousands more people living in northern Idaho and western Montana than there were in 1910." More than 10 years later, the region re-

mains ripe for another Big Burn, and the fire that devastated Paradise, California, in 2018 may be a harbinger of what is to come.

Wildfire has been a topic of numerous *Evergreen* articles. It is also the subject of a new book by Petersen, *First, Put Out the Fire!* Subtitle: "Rescuing Western National Forests from Nature's Wildfire Pandemic." The book can be purchased via the Evergreen website and eventually from Amazon and other retailers.

Naturally, Petersen starts Chapter 1 with a story:

*On a beastly hot afternoon some 20 years ago, I hailed a cab in the Bronx and asked the driver if he could take me to my hotel in Manhattan. "Sure," he said in one of the thickest Bronx accents I'd ever heard. God only knows how long he'd been driving cabs, but he was Bronx-born, Irish, in his early 60s and he'd never been out of the five boroughs that make up New York City. His name was Danny O'Reilly.*

*Almost immediately, he asked where I was from and what I did. I said I was from Montana and that I ran a forestry education program I'd started in 1986.*

*Silence. He was watching me in his rear-view mirror, but I wasn't prepared for his next question. "Are there any trees left out west?"*

*Before I could answer he said, "We hear all these stories here about how all the trees out there have been chopped down."*

*"I know," I said ruefully. "Let me assure you, we have millions if not billions of trees in our forests. You should come out sometime. I'll show you around."*

Petersen and O'Reilly hit it off, and O'Reilly invited the man from out west to his home for dinner with him and his wife.

Later in Chapter 1, Petersen explains the book in a nutshell:

*First, Put out the Fire! is the summation of what I have learned about wildfire and forest management over the last 33 years. It traces the path that I took to give myself an out, to escape the echo chamber where I lived before I began to think more deeply about why hundreds of thousands of acres of old growth reserved in no-harvest areas in national forests we all love are burning to the ground in catastrophic wildfires for which there is no ecological precedent in our nation's history. Herein, I chronicle the history of the west's wildfire pandemic, lay out the stark choices we face, and offer safe, reliable, time-tested, science-based solutions for pulling western national forests back from the fiery brink of ecological collapse.*

Petersen never minces words.

I recently talked with him about his book. What follows are brief excerpts from our conversation.

**Who did you write this book for? Who needs to read it?**

Congress is one of the big target audiences. People who work in the policy arena, people who make the rules and regulations by which we must abide. And as you might



A new book by Jim Petersen. See [evergreenmagazine.com](http://evergreenmagazine.com).

surmise, I'm very interested in engaging young people. I want desperately to get them off their cell phones. I want them to stop getting their news by algorithm. I want to introduce them to the Dewey Decimal System—seriously, I want them to go to libraries. But let's be real about this. Most kids won't do that, but we can at least steer them in the right direction, to good science, good data. That's why you see QR codes throughout the book. Hyperlinks are fine for old guys like you and me, but we decided to use QR codes—it was my wife's idea—because that's what these youngsters do. [The 70 square code symbols in the book serve as references. Readers can use a QR code reader app on a cell phone to get to the reference material.]

Nothing would please me more than to have this book become a topic of conversation during a presidential election year. I'm going to send a copy to every candidate. I don't care who talks about [the wildfire problem], as long as they talk about it accurately and are actually willing to step up and do something.

**In the book, you write about harnessing the passion of young people who want to "save the world."**

I love the idea that young people are passionate about our world. That kicks open a big door for us. All we have to do is be smart enough to stroll through it. This is a great opportunity, because we have a great story to tell, a very timely story.

**In the book, you include quotes from Alston Chase, a former philosophy professor who wrote *Playing God in Yellowstone* and other books. You interviewed Chase for the September 1990 edition of *Evergreen*, and he said, "Environmentalism increasingly reflects urban perspectives. As people move to cities, they become infatuated with fantasies of land untouched by humans." So people living in urban areas is another key audience?**

Our industry has a terrible time dealing with urban and metropolitan audiences. We have a great story to tell, but we just hide it in a closet. Do you know Nick Smith, who runs Healthy Forests,



## EVERGREEN MAGAZINE FEATURES



"Felt Necessities: Engines of Forest Policy" is a series of Evergreen articles that "trace the history of the conservation movement in the United States and its influence on the nation's ever-shifting forest policy."

Healthy Communities, the nonprofit? [See [healthyforests.org](http://healthyforests.org).] He's basically doing what we did with Evergreen 30 years ago, but back then, we didn't have the internet, cell phones, and social media. But he's on the right track. He hired us last year to do some "person on the street" interviews, to see what people actually understand about wildfire. So we bought a bunch of video equipment and sound gear, and we went to Portland and Seattle.

In downtown Seattle, we went to Pike Place Market. I figured that if there are people anywhere who hate forestry, they'd be there. We did these interviews unscripted, and we assured people that we wouldn't misrepresent what they said. We just let them talk. One of the things that we wanted to find out was whether there was anybody out there who thought it was a good idea to just let nature take care of the forest health and wildfire problem. Not one did—no one was willing to stand there and with an absolutely straight face say to us, "Yeah, we should just let nature take its course, it's natural." Everyone we talked to sees that there is a problem.

Frankly, what has brought this problem home to places like Portland and Seattle is smoke. That's why I posed the question in the book, "How many cigarettes are in a burning tree?" On its face, it's a ridiculous question, but it did give me the opportunity to cite an enormous amount of research conducted in the public sector about what's in wildfire smoke and what it does to your body.

### Did the people you interviewed understand the difference between smoke from a wildfire and smoke from a prescribed fire?

The line from Paul Hessburg comes immediately to mind. I say in the book that Hessburg, a well-respected landscape ecologist with the US Forest Service, frames it like this: "How do you want your smoke?" Our house near Coeur d'Alene backs up against Canfield Mountain, which is a prominent natural area with hiking and biking trails. This past winter, between snows, they did some prescribed burning

up there. Our neighbors went *crazy* because of the smoke. So, some people don't get it. Once you explain it to them, they understand. But we don't have time to do this one person or one family at a time, so we try other means of getting the word out.

### Such as with this book. Your Chapter 5 is entitled "We have some soul-searching to do." Who needs to do some soul-searching?

The soul-searching needs to be done by everybody who cares about our western federal forest heritage. I lecture periodically to graduate students in the forest policy classes at the University of Idaho. I was down there about a month ago, and I told these students that what they really need to understand is that, if we lose all this [forest], we'll still have lots of lumber, because it comes from lots of places. But we could lose centuries' worth of outdoor recreation possibilities. I make the very real and tangible case that, if our forests go up in smoke, it won't be the timber industry that really suffers, though environmentalists will insist on that. It's tourism, outdoor recreation—those will be the big losers. It's fish and wildlife habitat. It's air and water quality. Something like 80 percent of the people who live in the West get their water from a national forest watershed.

### Maybe Congress also has some soul-searching to do. They don't seem to understand the magnitude of the problem.

I used to say, when I was in a snippy mood, that if we could just figure out how to pipe some of the smoke into the House and Senate chambers, they'd fix it in about an hour.

### Fix it through adequate funding? But also somehow relieving the "analysis paralysis" and "the process predicament" that Forest Service chief Jack Ward Thomas and others have talked and written about?

Jack was a friend of mine. I liked Jack quite a lot, because he and I could speak candidly to each other, which is how we sometimes ended up in shouting matches. I didn't agree with everything he said, but

I liked him. I liked his honesty. I liked his passion. He was a real tough guy, but he couldn't figure out how to get through the bureaucracy in Washington, DC.

### Gifford Pinchot also famously had trouble with Congress. You wrote that Pinchot "pulled no punches in his bare-knuckle assessment of Congress' refusal to adequately fund the Forest Service, a problem that persists to present day." You've also written that we need someone with the passion of a Pinchot to get Congress to deal with Forest Service funding and the complex and conflicting laws the agency must follow.

Where is that passion? I want somebody up there before House and Senate hearings who is willing to kick some ass and take names. I do! That's what we need!

Toward the back of the book, I talk about the letter that Dwight Eisenhower wrote the night before D-Day. He wasn't sure what the outcome of the invasion was going to be, and he wrote a letter in which he accepted full responsibility for defeat. Well, the defeat never came. I want somebody who's willing to go out there and risk making some mistakes. The way we're going now [with our federal forests] is wrong. It doesn't make any sense on either a scientific or a social plane. It just doesn't make sense.

### What Evergreen article or essay are you most proud of?

I'd have to say that it was in 2003, when I received SAF's Outstanding Forestry Journalism Award for a big addition of *Evergreen* on what was happening with forests in the Southwest. It was our first take on what the Forest Service and some entrepreneurs in the region were trying to do to get ahead of the wildfire and forest health problem. There were thinning projects underway, and it was all small-diameter stuff, and I met a lot of entrepreneurs who are trying to do things with it.

A big issue in that part of the world at the time was whether thinning these forests was the right thing to do, whether it might be better to let nature take its course. One woman at a public meeting I attended stood up and said, with an absolutely straight face, "Well, I don't have a problem with loggers thinning out these forests, but we sure don't need to sell this wood to all those greedy lumbermen. Couldn't we just dig holes and bury it?" I thought to myself that we might as well bulldoze all those logs into the Grand Canyon, since there's a big hole there already.

The public perceptions of what should be done in our forests are all over the map, and I was proud of that edition of *Evergreen* for at least trying to help get people onto the same page.

And I guess I'm proud that I'm still here after all these years. Thirty years ago, we made a promise to all the folks in the forest products industry who helped us get started, a promise that we'd stick with them. I'm proud that I'm still doing this, still trying to get something done that makes sense. We'll see what this book does. I hope it will start a new conversation, during a presidential election year, on forest management. **ES**

## RAINS ■ From Page 3

decisionmaking will eventually be the demise of the agency." Former chief Dale Bosworth said something similar.

While there seems to be an acknowledgment in the 2021 budget proposal that forest management is critical to address the fire situation, this cannot be done by decreasing land management accounts, including science, and elevating fire expenditures to 60 percent of the total budget. The fact is, as funds have shifted away from forest management work, fires have become larger and much more destructive because forests are not being maintained. The loss of funds for forest management over the last decades has not been restored to the Forest Service through the appropriation process. This gap now equates to a minimum of about \$2.2 billion, annually. Continuing to cannibalize other accounts, like R&D, is certainly not the answer.

As I read through the proposed budget, it's hard to not become discouraged. Not at the notion of trimming a budget, but at the notion that there seems to be no rhyme or reason for the "pushes and pulls." It seems to be just a conglomeration of disconnected accounts, with little appreciation for both the direct and indirect roles of land stewardship the Forest Service is responsible for.

The good news is that one branch of government proposes the budget and another disposes. **ES**

*Michael T. Rains became a private consultant after retiring in 2016 after a 48-year career in public service with the US Forest Service, where he served as deputy chief and director of major field units in science and technology transfer, including director of the Northern Research Station and Forest Products Laboratory.*

## WV Bobwhites

West Virginia governor Jim Justice recently announced that the state's Division of Natural Resources (DNR) is beginning a five-year project to restore northern bobwhite quail. The bird once thrived across West Virginia, but harsh winters in 1977, 1978, and 1979 devastated the population. In addition, large areas of quail habitat have been lost or degraded.

"There's no question we've lost favorable habitat to quail over the last several decades; however, there is still a significant amount of habitat for quail to flourish by starting this reintroduction program," Gov. Justice said.

The DNR is working to restore habitat at the Tomblin Wildlife Management Area (WMA). In March, 48 bobwhite quail captured in Texas were released at the WMA. Transmitters were placed on some of the quail to monitor survival and habitat use.

"We are already providing habitat management resources in the area for our elk restoration efforts that will benefit these birds as well," said DNR director Stephen McDaniel. "In the future, wouldn't it be great if you were able to see both elk and quail on a visit to southern West Virginia?" **ES**



their work—the US Department of Fish and Wildlife (FWS) removed the Kirtland's warbler from the endangered species list.

The bird is considered a member of the class of '67, since it was one of the original species listed under the Endangered Species Preservation Act in 1966. Even earlier, in 1958, the state of Michigan created the first Kirtland's warbler management areas, said Keith Kintigh, a forest conservation and certification specialist with the Michigan Department of Natural Resources (DNR).

The warbler's life cycle is split between nesting in upper Michigan and wintering in the Bahamas, which meant that restoring jack pine ecosystems was crucial to the species' recovery. The birds require early-seral forest conditions that arise five to seven years after a wildfire. After the listing under the 1973 Endangered Species Act, what followed was subsequent silviculture experiments to re-create the historical wildfire regime on these droughty jack-pine landscapes in upper Michigan in order to create suitable Kirtland's warbler habitat.

Bocetti and other wildlife biologists identified the key elements the habitat needed. "There's a certain density of jack pine that attracts the birds, and it needs to be patchily distributed," she explained. Within the open spaces between patches, shrubs such as bearberry and blueberry are the preferred ground cover, and sedge is used as nest material.

The resulting planting configuration that creates the desirable habitat conditions is called the warbler's wave. "If you can imagine 10 rows of waves facing one way and 10 waves facing the other, where those waves separate, an opening is left, creating a pattern of 75 percent jack pine thicket and 25 percent open areas," explained Kintigh.

Included amongst the thickets and open spaces are snags and strips of mature trees dubbed "stringers" that take the place of the trees left behind after a wildfire.

"The program has been a great example of how to do conservation work," said



**Historically, the Kirtland's warbler nested in jack pine early-seral habitat created following wildfire. The exclusion of wildfire from the landscape was a contributing factor to the population decline. Habitat is now created through clearcuts and a planting design that mimics natural regeneration following a wildfire. Photograph courtesy of the Huron-Manistee National Forests.**

Bocetti. "The research-management interaction and the adaptive effort that goes on in the forestry program was critical to our success."

The landowners managing for Kirtland's warbler habitat include the US Forest Service on the Huron-Manistee and Hiawatha National Forests, the DNR, and the FWS. The DNR's portion is about 90,000 acres, which presents about half of the total acres. To manage across all the ownerships, "it's a highly collaborative, coordinated effort," Kintigh said. "The partners have made commitments to each other about how much habitat we manage."

Annually, the DNR manages a total of 1,500 acres in blocks from 300 to 1,000 acres in size across 13 different management areas. "For eastern forestry, that's a pretty big disturbance," he said. The need for managing at this scale was identified in Bocetti's research and in Forest Service research by John Probst and Deahn Donner-Wright.

"We all found that the Kirtland's warbler preferred larger stands of jack pine,"

she explained. "The agencies used to do 200-acre blocks, and now they're doing 500- to 1,000-acre blocks based on that data."

With new habitat, the species responded. "What's absolutely amazing about this species is that, if you look at the graph of habitat as it was created and the graph of the population increase, they are right on top of each other," explained Bocetti. "It was the 'If you build it, they will come' phenomenon to the nth degree."

The removal from the national endangered species list begins the next chapter of Kirtland's warbler management.

"Now we have to concentrate on sustainability," explained Bocetti. "Nothing in terms of the amount of habitat management is going to change; we have to set back succession and create habitat, but we have to be creative about how we do it... We want to develop a program that is both economically viable and ecologically meaningful to not just Kirtland's warbler, but all kinds of jack pine associates."

Of the pine species grown in Michigan, jack pine is perhaps one of the least commercially valuable; it's usually sold for pulp-related products. The jack pine in Kirtland's warblers' blocks are even more undesirable, because they grow in the lowest productivity soils in Michigan, resulting in stunted growth and poor form. "They're so nutrient poor, species diversity is low," said Bocetti.

In addition, dense spacing is needed to create the desired thickets, which further suppress tree growth.

"We recognize that these dense plantations aren't great monetarily, and we've had some instances where we've had challenges marketing the sales," Kintigh said. "We are experimenting with precommercial thinning now."

"We have to figure out how to create habitat and still allow the local communities to make money," added Bocetti. "And I have full faith we're going to figure out ways to do that."

One research study launching soon

will study stocking density.

"We've had these narrow stocking-density goals in the past and, with the assistance of the forestry department at MSU [Michigan State University], we're going to create replicates of various stocking densities and look at bird response," he said. "It's a pretty grand project, and it's going to take a long time, because of the five- to seven-year delayed bird response after planting."

David Rothstein, an MSU professor in forest ecology, will lead the study, which will have three replicates of three stocking densities: 1,452 trees per acre, which is the traditional planting density, 1,200 trees per acre, and 900 trees per acre planted over three years on more than 5,000 acres. Planting will begin in 2021, followed by more in 2022 and 2023; the earliest bird response will be in 2026. "It's a long-term project," explained Kintigh. "Our understanding of these systems unravels very slowly."

Some additional good news: The Kirtland's warbler has since expanded into Wisconsin and Ontario, which used to be within the species' historical nesting range. These areas also have a jack pine ecosystem, and the land managers are looking at what's worked in Michigan; however, Kintigh said that what works in upper Michigan won't necessarily work elsewhere. **FS**



**Kirtland's warblers nest only on the ground in large stands of young jack pines that are five to 20 feet tall and six to 22 years old. Photograph courtesy of the Huron-Manistee National Forests.**

### Seeking Sci-Tech Articles

*The Forestry Source* welcomes contributions for the Science & Technology section, which focuses on recent research, technologies, and techniques for forestry and natural-resources management. These articles are not peer reviewed; they may include references and links to resources. Length: 700 to 1,500 words; photos, charts, and graphics welcome. Information: Steve Wilent, Editor, 503-622-3033, wilents@safnet.org.



# Millennials at Work: The Leadership Vacuum

By John Greene

Generational differences are not new in human history. Significant societal changes—political, economic, or otherwise—often bring generational preferences



Forest2Market's John Greene

into tension, which are now amplified by the mass and social media outlets scrambling for a few seconds of your time. If you feel like you are a target of incitement, rather than a consumer of news these days, you are not alone.

The reality is that generational differences are often exaggerated, especially in the tech-fueled modern information age. The demands of life have generally followed the same pattern for thousands of years, and they are unlikely to change with a single generation: We learn, grow, work, and provide for our families throughout the many seasons of life, and yes, there are tweaks along the way. Isn't it generally the same in our industry? Take a sawmill, for instance. New technologies have made sawing logs a much safer, efficient, and profitable business, but a sawmill still performs the same essential function—still follows the same trajectory—that it has for hundreds of years: converting round trees into square boards.

This is how I tend to view the overhyped “generational divide.” In the end, we all are following a similar path and working toward the same basic goals. I am not a millennial myself, but I believe this cohort gets a particularly bad rap in both the marketplace and the workplace. We often hear that they are “lazy,” “self-absorbed,” “uncompromising,” “entitled,” etc. While this has not been my own experience, can you really blame them? In general, millennials have had to find creative ways to follow the patterns of life since:

- Only 41 percent of them work full-time;
- 50 percent have less than \$5,000 in savings;
- Average student loan debt for a college graduate is nearly \$40,000; and
- When adjusting for inflation, they earn 20 percent less than their parents did.

Millennials are the first digitally native generation, but that distinction has not markedly improved their quality of life. Technology has made certain aspects of modern life more accessible and convenient, but I would hardly say that millennials (or any younger gen-

eration) “have it easier” than I do. To be honest, I wouldn't trade places with them ... even on a good day.

## The Leadership Vacuum

I recently came across related data that brought some high-level generational inclinations more clearly into focus, and which also forced me to think more pointedly about the future of labor trends and the forest products industry. We all hear about the same challenges, if anecdotally, repeated across the forest supply chain: Loggers and harvesting crews on the front lines struggle to find young, eager, and dependable workers; mill facilities can't hold on to young workers; forestry is “outdated,” “boring,” or a career choice of a bygone era; wood products are not “environmentally sensitive,” etc.

More concisely, there has been a tremendous generational shift in the way millennials prioritize leadership traits in the workplace, which suggests that many industries, including the forest industry, are simply not reacting to changing employment dynamics.

Brittney Majka and Steve Coats completed some eye-opening research for The Leadership Challenge that really illustrates this knowledge gap (see [tinyurl.com/up8e5df](http://tinyurl.com/up8e5df)). Using the Characteristics of Admired Leaders (CAL) research categories (e.g., ambitious, honest, competent, inspiring, forward-looking, supportive) developed by Leadership Challenge authors Jim Kouzes and Barry Posner, Majka and Coats sought to determine if millennials looked for similar characteristics in leaders they admire, compared to the overall historical findings Kouzes and Posner have been collecting for more than three decades.

While a good bit of overlap in preferred leadership qualities exists between the two datasets, one stark difference best exemplifies the shift in generational priorities. In the longitudinal data, “forward looking” is the second most important quality in a leader; in the millennial data, this trait is missing altogether (see Figure 1).

What conclusion can we draw from such a frank difference in priorities? Millennials value leaders focused on the near-term and the here and now, because “forward-looking” suggests a preoccupation with the future and with commitment. In other words, millennials want to know what you can do for them right now, and if it is unsatisfactory, they will simply move on. While this may seem shortsighted to older generations, it is the reality of the modern workplace, and it has a significant impact on the business environment and the broader economy.

Majka offers a less pessimistic view



Figure 1. Characteristics of Admired Leaders (CAL) research categories developed by Jim Kouzes and Barry Posner (see [tinyurl.com/up8e5df](http://tinyurl.com/up8e5df)).

rooted in semantics: “Why is ambition so important to millennials? Has ‘ambitious’ simply replaced ‘forward looking’ as the preferred language to describe an aspirational or future state? My personal opinion is that millennials equate ambition to ‘grit,’ as popularly coined by author and scholar Angela Duckworth in her book by the same name. With an economic recession already under our belts, we know what it's like to have to fight for what you want—and we want a leader that's willing to dream big and go to bat for us. Ambition implies action. And that's the kind of intrinsic motivation we want surrounding us.”

While her assessment may help to explain the glaring difference in the data, Gallup Workplace research ([tinyurl.com/wwefmvs](http://tinyurl.com/wwefmvs)) uncovered some additional statistics that suggest a fundamental shift in the way millennials view the employee/employer relationship. It notes:

*A recent Gallup report on the millennial generation reveals that 21% of millennials say they've changed jobs within the past year, which is more than three times the number of non-millennials who report the same. Gallup estimates that millennial turnover costs the U.S. economy \$30.5 billion annually.*

*Millennials also show less willingness to stay in their current jobs. Half of millennials—compared with 60% of non-millennials—strongly agree that they plan to be working at their company one year from now. For businesses, this suggests that half of their millennial workforce doesn't see a future with them....*

*Millennials are also the most willing to act on better opportunities: 36% report that they will look for a job with a different organization in the next 12 months if the job market improves, compared with 21% of non-millennials who say the same.*

## What Jobs Do Millennials Want?

Millennials are the most highly educated demographic (for now), which helps explain the aversion to the monotony

associated with lower-skilled jobs. If a job feels like a dead end, millennials are quick to use their digital skills to formulate an exit plan and make job hopping simpler, or they are equally comfortable participating in the “gig” economy and working multiple freelance, part-time, or temporary jobs: One in four millennials is now a part of the gig economy. However, the impact of this trend is costly for employers.

The costs associated with replacing an employee vary by wage bracket, but they are significant, per a Center for American Progress study ([tinyurl.com/gv7o9y3](http://tinyurl.com/gv7o9y3)) cited by PeopleKeep, a health benefits automation software provider, which notes that:

- 16 percent of annual salary for high-turnover, low-paying jobs (earning under \$30,000 a year). For example, the cost to replace a \$10/hour retail employee would be \$3,328.
- 20 percent of annual salary for midrange positions (earning \$30,000 to \$50,000 a year). For example, the cost to replace a \$40k employee would be \$8,000.
- Up to 213 percent of annual salary for highly educated executive positions. For example, the cost to replace a \$100k executive is \$213,000.

Unlike older generations, earning potential doesn't appear to be a primary driver for millennials in certain job categories. Other telling trends uncovered by financial technology company *daily pay* ([tinyurl.com/y5x5lews](http://tinyurl.com/y5x5lews)) that carry implications for the forest products industry include:

- 64 percent of millennials said they wouldn't work in construction even if they earned \$100,000 or more.
- According to a study conducted by



ket Committee (FOMC), the branch of the US Federal Reserve that oversees the money supply and interest rates (monetary policy), decided to reduce its target range for the federal funds rate by half of a percentage point (50 basis points).

To me, the FOMC press release, which opened with “the fundamentals of the US economy remain strong,” read like the dreaded “feedback sandwich” in a poorly conducted performance review. “Hey Percy, let me start by saying you showed up to camp in great shape. But we’re sending you back to the minors. Keep up the good work!”

Markets responded similarly. The S&P 500 ended the day 3 percent lower, and US 30-year Treasury yields closed March 3 at 1.64 percent, down 29.6 percent since the start of 2020. The rate change by the Federal Reserve, which occurred between scheduled FOMC meetings for the first time since 2008, signals worry about recession risks. Okay, message received.

For those of us who prefer work over worry, how should we think about this productively? How can we frame potential economic disruptions specific to the coronavirus?

In 2018, we shared our framework for thinking through potential disruptions generally and applied this to the forest products and timber industries. We use versions of this framework for studying markets and evaluating business strategies. When thinking through the means and mechanisms by which disruptions affect timber markets and forest investment cash flows, I start with two simple questions rooted in economic fundamentals:

- **Big or small?** In other words, how impactful, whether positive or negative, would we expect this disruption or change to be on forest supplies or wood demand?
- **Long or short?** What is the likely duration, whether positive or negative, of this disruption or change on supplies or demand (in the market or industry)?

Then we address a third issue, as big changes can affect us locally, globally, or both. For strategy and planning, we want to specify the context—which gives us a box to work in—of the disruption to best understand its absolute and relative risks, whether positive or negative. We have little, if any, control over systematic (global) risk, while unsystematic (local) risk can be mitigated and managed through diversification, insurance, and operational competence.

In Part II, I apply this framework and introduce scenarios.

#### Part II: Frameworks and Scenarios

According to Greg Ip, writing in the *Wall Street Journal* on March 3, 2020, “Epidemics historically haven’t been disruptive enough to affect gross domestic product much.... That probably won’t be true this time,” with respect to the coronavirus. A primary reason: the growing impact on demand from closing schools and large-scale

events, which reduces the use of services related to travel, hotels, restaurants, and entertainment.

Picture a movie theater that continues to show films even as no one arrives to buy tickets. The days pass and the films show, but no popcorn gets sold or seats filled. Now, and more broadly, we’re flying fewer planes and canceling conferences, in addition to skipping theaters. This lost economic activity, perishable and unrecoverable, gets subtracted from our original expectations for 2020. How long until people start attending the theater again?

With the coronavirus, analysis of supply-side (supply chain) and demand-side disruptions varies widely. We struggle to quantify the size and duration of the potential economic impacts. So, we turn to frameworks and scenarios.

Part I of this series revisited our framework for evaluating disruptions to businesses and specific industries. Consider the exposure of timberland owners to coronavirus-related disruptions:

- **Big or small?** No forest supply effect; varying local impact on wood demand.
- **Long or short?** Short-term decrease to demand; no long-term impact on value.

Graphically, the framework affirms the expected short-term impact from the coronavirus (in isolation)—see Figure 1. Its current progression mirrors previous pandemics; it will likely be in the rear-view mirror one year from now, and investors will still hold timberlands. However, the magnitude of the short-term disruption is unclear. Will it simply slow wood demand for a quarter, or will it disrupt forest industry cash flows for all of 2020?

The framework also reminds us to beware analysis in isolation. The coronavirus epidemic occurs in a larger context, one in which trade policy impacted the forest industry and global economies began slowing in 2019. For this exercise, we assess potential disruptions from exponential growth in coronavirus infections over the next few months through a set of simple scenarios.

In Part III, I leverage two variables—GDP and housing starts—to connect the dots and scale the implications for the US forest industry.

#### Part III: TP and Housing Starts

We do not have a toilet paper problem. As a forest industry analyst, I say this for three reasons:

1. Many firms in this industry are Forisk clients or customers of clients, and we can confirm that trees continue to grow, wood continues to flow, and mills continue to pulp fiber. For North America, these firms are number one at producing what we need for number two.
2. The coronavirus does not increase the need for toilet paper, whether or not you contract it. Our use of toilet paper remains steady; on average, we each use about 100 rolls per year.

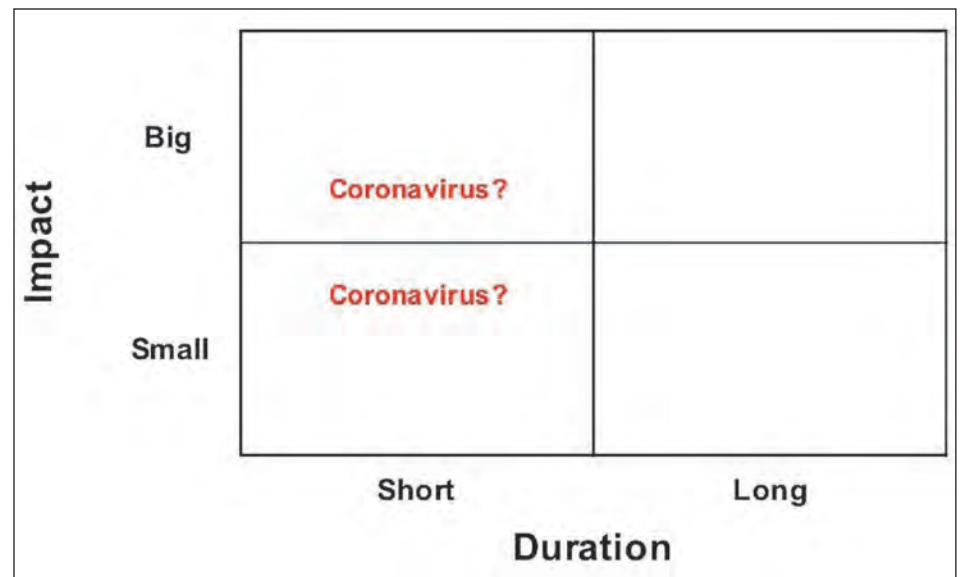


Figure 1. The potential exposure of timberland owners to coronavirus-related disruptions.

Scenario	2020 GDP % growth	2020 U.S. Housing Starts millions	2020 U.S. Softwood Lumber Consumption % change from 2019
Forisk Jan 2020 Base*	2.1%	1.3473	2.7%
Forisk Jan 2020 Slow*	2.1%	1.3186	1.5%
Shock One	1.6%	1.2350	-6.8%
Shock Two	1.1%	1.1228	-13.2%
Shock Three	0.5%	1.0105	-18.7%

\*Forisk Base and Slow Cases as of January 2020 from Q1 2020 Forisk Research Quarterly (FRQ)

Figure 2. 2020 Macro Scenarios for U.S. Softwood Lumber Demand

3. In the US, more than 92 percent of these 100 rolls are manufactured in North America. So, our TP supply chain has little exposure to imports from anywhere, much less China.

Rather, primary concerns for the forest industry are housing and “aggregate demand,” which is the three-dollar term referring to everything we buy at any given time. Prior to the coronavirus, industry capital investment and housing markets looked strong yet constrained, as builders grappled with scarce skilled labor and increasing costs of building materials.

Part II of this series introduced the role of scenarios to test disruptive implications on a given business or sector. The coronavirus consumes economic growth through delayed production and consumption. To the extent that it slows people, it slows the economy and eats time. These scenarios reflect the idea that the coronavirus hit a massive “pause” button on the US economy. The question is, “For how long?”

#### The Scenarios

The *Forisk Research Quarterly (FRQ)* always includes at least three scenarios for timber and log price forecasts, to help clients test and contemplate key assumptions. For this analysis, I include the Base and Slow Case scenarios from the Q1 2020 *FRQ* to provide “pre-coronavirus” baselines and add three scenarios to evaluate three “shock levels” on GDP, housing starts, and demand for softwood lumber in the US (Figure 2):

1. **Shock One** strips the equivalent of GDP growth for one quarter (three months of zero percent, spread out over the rest of the year) and housing starts for one month from the 2020 Forisk Base Case.
2. **Shock Two** bakes in two quarters of zero percent GDP growth and two months of lost housing starts.

3. **Shock Three** pauses GDP growth for three quarters and reduces housing by three months.

It’s hard to make up for lost time. Consumption and production perish; months of inactivity translate to less economic growth and fewer housing starts and falling softwood lumber production. A one-month shock, from a US softwood lumber standpoint, would mirror volumes consumed around 2015. However, we averaged 16.5 percent annual growth in housing starts from 2012 through 2015 to get there, along with the associated sawmill capital investments and employment. In the shock scenarios contemplated here, we slow down and step back to regain our footing.

In Part IV, I share conclusions and recommendations for where to focus our attentions and energies as the coronavirus, and other economic headwinds, work through the system.

#### Part IV: Conclusions and Charting a (Forested) Path Forward

“Without a structured approach to ordering the world, the world will impose its views on us. The fact is some things are more important than others, some things are easily verifiable... Simple processes help us sort the mess and prioritize.” – from a March 26, 2019, blog post, “Risk and Context in the Forest Industry.”

The coronavirus presents two specific risks to most of us. One, we transmit the virus to someone vulnerable (older, ill, immuno-compromised). Two, we or someone we love gets sick or injured in some other way and can’t access the health care system because it’s overwhelmed. These risks highlight the interconnected nature of the situation. Our individual choices affect others.

Given the risks, how do we contemplate a path forward? At work, we normally develop plans based on scenarios that spec-



ify factors to watch and how we're watching them. We do this all the time in forestry. However, it's hard to build scenarios when you don't know where to start.

**We know what we don't know.** This is a numbers game. And the numbers will get worse before they get better. It's simply the math we learned in forestry. Trees planted years ago give us the forests we have today. Volumes can strike in massive waves. We call this "a wall of wood," or "the pig in the python."

With the coronavirus, the spreading that occurred silently weeks ago gives us the infections we have today. We don't know the infection rate, which makes it difficult to know the pervasiveness, speed, and, ultimately, decline of the coronavirus. What tells us we can return to normal? When we have smog alerts or forest fires or car crashes or hurricanes or food poisoning, we have metrics and indicators that signal "All clear!" Why? Because we have data.

The bed bugs are there. We know this. Now we're lifting the sheets to find them and count them so we can nuke 'em.

**We don't know what's knowable.** It does not matter if this situation is better or worse than people think, thought, or said; it just is. And currently, we don't know what "is" is. We can't yet touch the bottom of the pool because we don't know how deep the water is. We need data, and data require testing. Each and every failure to deliver, offer, conduct, collect, and communicate the results of a test reflects a small crime and failing in this battle.

Anything short of complete, ruthless transparency obscures our ability to know what is knowable, develop plans, and support each other. From here, we can chart a path for our teams and help people make decisions for their local situations.

**We know what to do.** In forestry, we have a systematic approach that applies generally to situations requiring clarity for making decisions. We focus attention and energy on three areas:

- **Understand the local situation.** Situations vary by region and city, so focus effort appropriately. Ultimately, the most important thing is that we do our best to help each other (and everyone we interact with) stay healthy, sane, and resilient.
- **Question the data.** As in forestry, everything here is a sample. Trustworthy sources include: Johns Hopkins Coronavirus Resource Center ([coronavirus.jhu.edu](https://coronavirus.jhu.edu)) and the COVID Tracking Project ([covidtracking.com/](https://covidtracking.com/)).
- **Know what's knowable.** Check in with neighbors, read the local paper, and follow the simple practices that we know work well.

With a clear sense of where we are and how things work, it's easier to organize our teams and get moving. Then each day or week, we can check our scorecard—like we do each Monday at Forisk—and confirm that we're making progress on the right things. This gives purpose to our work and confidence in the process, with an eye toward the future. **FS**

## PRODUCTS LAB ■ From Page 10

I think there's a lot of room for improvement. Increasing our ability to predict the performance of these materials would open up the door for a whole lot of other applications for wood products."

Ross said that artificial intelligence, supercomputing, and new scanning technologies would likely aid in this type of research. He suggests that nondestructive wood assessments/analyses will become routine in the future.

"We've got to look at some of the scanning systems in the biomedical field. Obviously, we have some constraints on costs, speed, and ruggedness that they don't have to deal with, but these technologies—sensitivity, resolution—could lead us in some really interesting directions." He said. "In order for us to continue our work in engineered wood structures, in engineered timber structures, we're going to have to have better-defined performance characteristics. And the only way we're going to do that is through the use of these kinds of technologies. We're only just getting started with this. There are some challenges ahead of us, but I think this is an exciting time."

After more than 30 years at the lab, Ross continues to be fascinated by his work.

"I definitely still think it's fun. What's most rewarding to me is to see our research being used," he said. "I like doing the research and writing papers, but when you see it in practice, and you see practicing field foresters, arborists, and industry folks taking those concepts and using them to [not only] better their bottom lines, but also to provide better, higher uses for our natural resources—that's a real kick for me. It's very fulfilling.

"One of the most beautiful things about the Forest Products Lab is that we get a chance to influence materials usage patterns. And that's how we contribute to the conservation movement. One of the neatest parts of that is to be able to do this not only for North America, but [also] for the world. In my own areas of work, seeing some of the grading and scanning technologies we've developed at the lab being used by researchers around the world, and moving [them] forward in their part of the world, is very fulfilling. That's one of the beauties of the lab. Not only can we influence the conservation movement in North America, we can do it worldwide. That is a very cool thing." **FS**

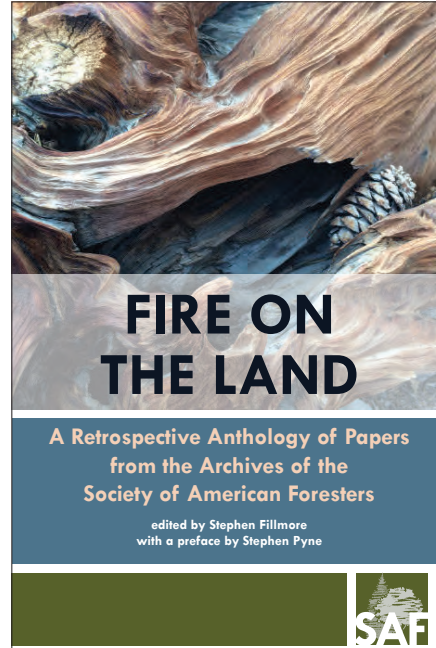
## Put Foresters' Fund Dollars to Work

Do you have an SAF project that promotes forestry education and enhances public understanding of forest management? Do you need funding for the project? Then consider applying for a Foresters' Fund grant. Upcoming deadlines are June 15 (including for special and leadership-development grants) and September 15. For more information and to apply, see [tinyurl.com/keymgt](https://tinyurl.com/keymgt).

# Fire on the Land

Featuring a preface by Dr. Stephen Pyne

*Fire on the Land* brings together the best research and thinking on fire ecology, policy, and application to examine fire's place in forest management. A collection of peer-reviewed scientific articles from the SAF archives, this anthology provides a comprehensive examination of how fire has shaped America's forested landscape and the people who care for it. Each new section is led by a science synthesis introduction that bridges the history of these pivotal papers and the current practices and work that lies ahead regarding fire science in forestry.



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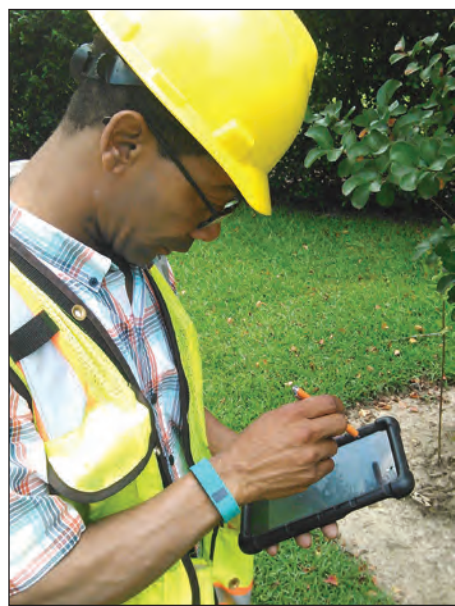


## Darrell Street: Finding Solutions through Representation

**E**ditor's note: Continuing with profiles of up-and-coming SAF members who will continue managing our nation's natural resources in the coming decades, this month we feature Darrell Street. Street brings experience as a landowner, small business owner, and park ranger to the field of urban forestry. He earned an undergraduate degree in political science and a master's degree in public administration at Grambling State University, and is a PhD candidate in Southern University A&M College's Urban Forestry and Natural Resources Department. Street joined SAF in 2016 and is a member of the SU-SAF and Louisiana SAF chapters.

In his own words, Street shares the role of mentors who guided him to urban forestry and the value of representation in the forestry profession.

By Darrell Street



Darrell Street credits Dr. Alexander Appeaning, his mentor at Grambling State University, for encouraging him to apply for a position with the National Park Service. Working as a park ranger set Street on a path to studying urban forestry at Southern University A&M College. Photograph courtesy of Darrell Street.

### Life after high school

After graduating high school, there were limited options for me as a young African American male. My classmates joined the military, but I entered the workforce and matriculated at a local community college to gain additional knowledge and skills. I was inducted into an honor society; however, at that time, college was not a top priority. For the next 10 years, I worked at one of the local factories in Osceola, Arkansas, purchased a home, started a business, and enjoyed the fast life of Memphis, Tennessee, and Mississippi County, Arkansas. Yet it wasn't satisfying, and I realized that a change was needed to enhance my life.

### Discovering my appreciation for the outdoors

In November 1997, I departed my community, friends, and family in Osceola, Arkansas, for Lincoln Parish, Louisiana, to pursue a degree in political science at Grambling State University (GSU). I enrolled in the fall semester of 1999, and in

spring 2003, I earned a bachelor's degree in political science, graduating cum laude. That following summer, I entered the Master's of Public Administration program at GSU. In this program, I met a lifelong academic mentor, Dr. Alexander Appeaning, a professor in the Public Administration Department and associate vice president of academic affairs. Dr. Appeaning encouraged me to apply for a position with the National Park Service because he noticed my love of the outdoors.

I was hired and stationed in Everglades National Park, which is located in South Florida. The rare opportunity to work, live, and play in one of the world's most diverse wetlands was a mind-changing experience. My hidden childhood passion and appreciation of the great outdoors were fully exposed.

Having firsthand knowledge of the River of Grass (Everglades) ecosystem that is home to alligators, crocodiles, migratory birds, humans, and countless other species that depend on this slow-moving river for survival influenced my awareness of environmental issues and the threats of climate change and its accompanying variabilities as a result of anthropogenic stressors.

Serving in the Everglades National Park's Interpretation Division allowed me to be the first point of contact for countless visitors, which enhanced my communication skills and ability to communicate environmental issues to diverse groups of citizens, and it was a privilege to serve in the position. Since completing the Master's of Public Administration program in 2006, I have accumulated more than 14 years of service within Louisiana education, local government, and private industry.

### Opportunities found in urban forestry

I am a PhD candidate in Southern University A&M College's Urban Forestry and Natural Resources Department, a landowner, founder and CEO of the Louisiana Minority Landowner Association, and owner of Tiguar Urban Forestry Consulting LLC. My journey in urban forestry and natural resources has required a tremendous amount of perseverance and dedication toward becoming a better citizen. Along the way, I have gained a wide range of personal and professional experiences, and knowledge about urban and community forest ecosystem assessment and environmental issues. I have had the honor of meeting policymakers, foresters, anthropologists, and environmentalists working toward a better understanding of natural forest ecosystems and the environmental issues impacting them. Networking with international and national forestry and natural resources scientists, academic leaders, and the Society of American Foresters (SAF) has allowed me to enhance my communication skills and research and education knowledge.

Through SAF, I've learned from and networked with many scientists and professionals. My adviser, Dr. Kamran Abdollahi, an SAF Fellow, connected me with

opportunities to become a professional in forestry. These include opportunities to study in China and attend and present scholarly work at national, regional, and state conferences, as well as engage in community tree planting projects with students; construct pocket parks in underserved areas; inventory trees throughout Louisiana; develop publications; and collaborate with community leaders, universities, and other stakeholders. These are just a few of the ways I have worked to connect people to the natural world.

### What I'm studying

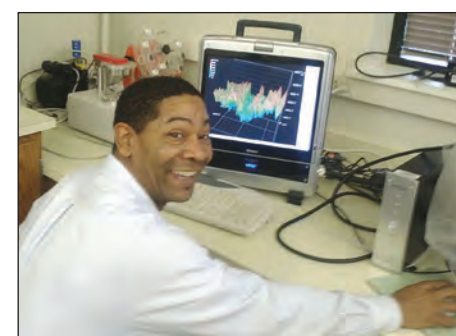
Understanding an urban forest's structure, functions, and value can promote management decisions that will improve human health and environmental quality. My research involves characterizing urban forest ecosystems to quantify their functions and value using state-of-the-art peer-reviewed methodologies and technology, such as the iTree Eco Model. The modeling application quantifies the structure and composition of an urban forest and the ecological and economic benefits of urban trees, including air quality improvements, annual carbon sequestration, carbon storage, and annual avoided stormwater runoff. The results provide baseline data of urban forest ecosystems that can be used to justify the need to invest in planting, growing, and caring for them.

Through a partnership with the Louisiana Minority Landowner Association, my small, minority-owned company is collaborating with Dr. Yaw A. Twumasi of Southern University A&M College to use geospatial technology to enhance and increase the economic benefits of resource-limited farmers, veterans, beginning farmers, and ranchers who reside in Louisiana Congressional District 5.

In addition, I am working in collaboration with partners on a bio-char urban forest restoration project. This project involves applying bio-char, which is generated from pyrolysis of wood waste, to newly planted spruce pine saplings in an urban area located in Baton Rouge, Louisiana. The findings show positive impacts of bio-char application on the growth, physiology, and soil respiration of spruce pine saplings, and I will present the research at the 94th Annual Louisiana Academy of Science Conference.

### My role in urban forestry

I want to engage my peers, underserved populations, and community leaders in integrating urban forestry research and recommendations into their management of urban forests. The state of Louisiana is prone to natural disasters, such as Hurricane Katrina; flooding, such as the 100-year flood of 2016; and frequent tornados in the northern region. Therefore, it is important that there are adequate resources, representation, and services available for underserved farmers, landowners, and families who may one day lose their homes land, or both because of these increasing



Darrell Street is a PhD candidate at Southern University A&M College. His research focus is on characterizing urban forest ecosystems to quantify their functions and value using state-of-the-art peer-reviewed methodologies and technology, such as iTree Eco Model. Photograph courtesy of Darrell Street.

natural disasters.

I hope to use my platform for promoting the works of educators, scientists, and professionals who came before me to inspire a younger generation to embark upon careers in forestry and natural resources. Through serious community engagement, I want to increase involvement of underrepresented groups to assist with creating new initiatives, developing new methodologies, and implementing new policies to ensure that our urban forest ecosystems are sustainable into the future.

### The future of the profession

The future growth of forestry and natural resources is not only dependent upon new methodologies, technologies, and innovations, but also inclusion and equity. As a minority forester, I have witnessed the importance of being a member of SAF. SAF has provided many opportunities for me, other minority students, and professionals to participate in local, state, and national conferences. As a result, I have learned and received awards for my research and outreach efforts. In 2015, I earned the Chinese Culture and Agricultural Certificate from the China Northwest A&F University. I also was a 2016 National Science Foundation International Research Experiences for Students Global Scholar; recognized as a 2019 Southern University Blue and Gold Student in recognition for maintaining a 3.4–4.0 GPA, and was awarded at the 93rd Annual Meeting of the Louisiana Academy of Science for the best graduate presentation in the Agricultural/Forestry/Environmental Science/Wildlife Division.

My skies are blue, because I see so many underrepresented males who look like me contributing to a field of study in which, traditionally, we have been absent. The collaborative efforts of universities, the United State Department of Agriculture, SAF, and other organizations to address the diversity gaps in our field is noteworthy. I have witnessed faculty, such as Dr. Zhu Ning of Southern University, encourage and support nontraditional students, like myself, and help develop our skill sets through hands-on training, scientific research, and professional meetings. **FS**

Darrell Street can be reached at [uforstreet@yahoo.com](mailto:uforstreet@yahoo.com).



## Anil Raj Kizha: Forestry Is about Interactions

**E**ditor's note: This month we feature Anil Raj Kizhakkepurakkal (Kizha), an assistant professor of forest operations at the University of Maine and an adjunct professor at Humboldt State University. He was a member of SAF from 2007 to 2012, and rejoined in February 2020. He is a member of the University of Maine and Northeast SAF chapters.

In his own words, Kizha writes about the benefits of talking with foresters from other countries and the value of applied research.

By Anil Raj Kizha



**Anil Raj Kizhakkepurakkal (Kizha) is an assistant professor of forest operations at the University of Maine and an adjunct professor at Humboldt State University. Photograph courtesy of Anil Raj Kizha.**

In India, where I earned my undergraduate degree, the government places you in a college based upon a common entrance rank; this is an exam similar to the SAT. I was assigned to Kerala Agriculture University, which is located in Vellanikkara, Trichur, to study forestry. Most of us who joined did not have an idea what forestry was, but that first week was very exciting because we got the chance to walk in the woods. In 2004, I received my undergraduate degree in forestry, and for the next one and a half years, I worked with the Kerala Forest Department and did research.

In 2006, I got an opportunity to earn a master's degree in forestry at Louisiana State University; my research there focused on quantifying the volume of wood biomass available from the forest production industry. I remained there for my PhD, which involved the supply chain logistics of biomass, and I also earned another master's degree in environmental sciences.

After graduating in 2012, I went to Humboldt College in northern California and was a GIS (geographic information systems) lecturer. After one year, I moved into research in forest operations and worked there for the next two years as a post doc. In 2015, an assistant professor position opened up at the University of Maine. I applied for the position and have worked here since.

### The value of applied research

I have worked on several projects funded by the Cooperative Forest Research Unit

(CFRU), which brings all the people to a single platform to answer forest operations research questions. Applied research is where we should be going, because at the end of the day, science is not just forest operations—it's involving a whole lot of different disciplines.

The first advantage of applied research is that it boils down to the research question itself. By working with the stakeholders, such as loggers, landowners, and foresters, I can get what they want at this point in time: What are the challenges they are facing? I have been getting more into using smaller-diameter trees, because that is a challenge we are facing in New England. I usually talk with the foresters to know what their problem is and design our research based on their problem. I also work with loggers to understand their challenges. This makes the research more applicable, and it's not something we did just for the sake of science, but rather we're trying to help or answer a question. And at the end of the day, we are using taxpayers' dollars.

Another advantage is working with other researchers. On a day-to-day basis, I work with silviculturists, forest economists, market specialists, wood scientists, and wildlife biologists. By working with these people, I get the opportunity to learn techniques they use in their field. It's always good to advance science by learning from others and applying that to our research.

For example, I was talking with an economist friend of mine a couple months back about a research question, and he said, "Here's how we do it. Why don't you do it this way?" That was a big "Ah ha!" moment. Now we are working on an article looking at productivity challenges from an economist angle. We presented our research at a meeting for forest engineers, and it was not well received, but that's science.

### Why learn about forestry in other countries

Forestry has never been a regional science. Yes, it's done on a regional basis, but it's always had an international perspective. If we have a problem here, such as with invasive pest species, we're not the only ones who have this problem. Right now, developing a market for smaller-diameter timber is a big thing for us in Maine. We have a lot of small-diameter trees, and when you harvest, the financial return is not too good. I was at a conference in Europe and talking to a scientist, and it came down to how we define small-diameter trees. Over here, it's six inches or less DBH; for them, it was six centimeters or less. All of a sudden, I felt a little bit better, but it still boiled down to what they are doing over there and how can that be implemented in Maine.

Adopting a practice from another country is not a silver bullet, but certain practices can be adapted. If a practice cannot be adapted, look into why it cannot be adapted and what changes are needed to bring those technologies that have been successful in other parts of the world to



**As project scientist with the Cooperative Forest Research Unit, Kizha partners with loggers, foresters, and landowners to answer management questions such as how to develop markets for small-diameter trees. Photograph courtesy of Anil Raj Kizha.**

your part of the country.

Bringing forestry practices from other parts of the world to the classroom has its own advantages, especially in forest operation. We are equipping our future foresters by putting more tools in their toolkit. If they come across situations in which they can adopt such a tool, that would be a great future.

At the end of the day, we are using practices that have been adopted by our predecessors, but the situations in which they applied these practices might have changed because of markets, policies, or regulations. It's always dynamic, so just adopting what was there seven years back might not be the best option. We need to look outside the box and see what's being done in other parts of the world.

### How students can make the most of their academic experience

The first thing is for a forester to be out in the woods. That's something we might think is common sense, but I've seen it over the years that sometimes students do not like being in the woods; they like classroom situations. To quote one of my professors, "The forest is your teacher, and all we do is guide you through the learning process." The forest is the teacher, and students should try to be out in the woods for the purpose of learning.

Next, try to learn from other foresters and their experiences. What are their challenges, and what are they doing on a day-to-day basis? This will equip students to better to understand working conditions.

Forestry is all about interactions—a forest manager interacts with a lot of people, including landowners, loggers, other foresters, and government officials. Communication skills should be at the top of their skills list. To improve your communication skills is to practice over and over.

Attending workshops is also useful. At many universities, especially the University of Maine, we have conferences or workshops that are offered to professional foresters, and undergraduate students usually don't attend. Students should attend such workshops, because they can learn cutting-edge technology and talk with other people.

Lastly, subscribing to newsletters and participating in organizations, such as SAF. Students should be more engaged in professional organizations, because that's

where they learn where the industry is going, and that's going to be very helpful at some point. In one of my undergraduate classes, there was a portion called international forestry. We heard about SAF, and I wanted to be a member, but the cost was too high since it was in US dollars. One of the first things I did when I came here to this country was to join SAF.

### Why more awareness of forestry is needed to recruit the next generation

In India, forestry is a very respected profession, but few people have an awareness of forestry; it just goes unnoticed. Of the 3,000–4,000 professional college admissions, forestry is just 50. But it is respected in the sense that people who have graduated with degrees in forestry are doing a tremendous job. The problem here in the US is also a lack of awareness, and that brings me to another point. For the first time we are seeing throughout the globe, more women are getting engaged in forestry. It used to be a male-dominated field, but more women and minorities are getting in, which is a good sign.

Today, we are facing a serious shortage of labor, at least in Maine. We need to adapt our situation to attract more people into the industry. One way to do this is to get rid of the stigma about logging always being in harsh conditions. I have gotten into the cab of a cut-to-length system, machines that have been adopted in this part of the US and in the Pacific Northwest. These machines are very advanced; the operators know everything from the diameter of the tree they cut down to how many logs they have cut in a day. It's fully automated, and that's one way we can attract the next generation into this profession. I do agree that logging is a dangerous job, but it has changed a lot from where it used to be.

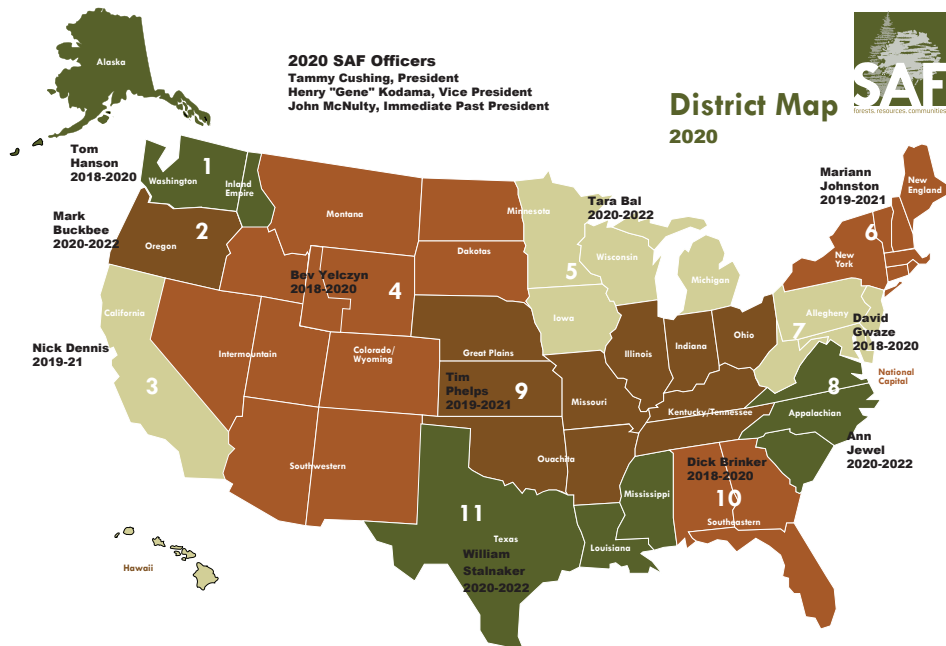
Also, there's obviously a stigma for being a timber harvesting specialist—people think, "This guy is for cutting down trees." But I follow the rule that a healthy forest is a managed forest. The resources that we get from a forest cannot be possible without managing the forest. **ES**

Anil Raj Kizha can be reached at [anil.kizha@maine.edu](mailto:anil.kizha@maine.edu).

Do you have lessons learned that you would like to share with fellow SAF members in a future issue? Please e-mail [Andrea Watts](mailto:Andrea.Watts@safnet.org), [wattsa@safnet.org](mailto:wattsa@safnet.org).



## SAF Seeks Leaders Like You to Join Our Board



SAF is seeking leaders to serve on its Board of Directors. The Board provides leadership and direction to SAF to achieve its mission.

The president, vice-president, immediate past-president, and 11 elected directors (one from each voting district) serve on the Board, along with several representative national leaders, such as the chair of the House of Society Delegates and the chair of the Student Executive Committee. Board members are elected by SAF members, with elections taking place in October and terms beginning January 1.

Candidates are sought for vice-president and four districts:

- **Vice-President:** The position serves for three years in succession: one year as vice-president, one year as president, and one year as immediate past-president.
- **Directors to represent Districts 1, 4, 7, and 10.** Members are elected to three-year terms.

**Deadline:** Members interested in serving SAF in these capacities should submit their candidate packets to Lori Rasor (rasorl@safnet.org) by June 1, 2020. Forms and additional information are available at [tinyurl.com/y9bv4osc](http://tinyurl.com/y9bv4osc).

For more information on these positions and process, contact Clark W. Seely, National Nominations Committee chair, at [cseely2@cfl.rr.com](mailto:cseely2@cfl.rr.com). **FS**

## Colonna, Loewe Join SAF Staff

Angela Colonna joined the SAF national office team in March 2020 as a communications and marketing manager. Colonna is a University of Florida graduate and, with three degrees, is a “triple Gator.” She holds a master’s degree in forest resources and conservation and bachelor’s degrees in public relations and sustainability studies. A native of Minnesota, Colonna enjoys traveling, reading books, hiking, and being outdoors. Most important, she likes to talk about how trees, plants, animals, water, and soil all create healthy ecosystems to support natural resource industries.



Angela Colonna.

certification, and standards to serve the SAF community. She has worked extensively with state and veterans’ educational certification stakeholders and processes, and enjoys helping others learn and advance their careers. Loewe is originally from Spokane, Washington, and now lives in Derwood, Maryland with her husband, two cats, and a border collie-Brittany spaniel mix named Norm.



Melisa Loewe.

Welcome to SAF, Angela and Melisa! **FS**

### Letters to the Editor

The Forestry Source welcomes letters to the editor. Send letters to Steve Wilent at [wilents@safnet.org](mailto:wilents@safnet.org) or to 10100 Laureate Way, Bethesda, MD 20814.

## Edisto Chapter Foresters’ Fund Grant Helps with Bee City Display

By Liz Bourgeois



The new permanent forestry exhibit at the Bee City Zoo in Cottageville, South Carolina, includes colorful dioramas and panels describing different aspects of forestry.

Among the gum trees along the Edisto River, the Nature Center at the Bee City Zoo in Cottageville, South Carolina, now includes a permanent forestry exhibit. Members of the SAF Edisto Chapter and dedicated Nature Center staff have been working on an expansion project for the Nature Center for nearly four years as part of a Foresters’ Fund Grant. The project includes a display with colorful dioramas and panels describing different aspects of forestry. There’s even a mannequin dressed as a firefighter who is “lighting” a prescribed fire. The exhibit provides a thorough introduction to the importance of forests and forest products. The dioramas highlight forest management, forest products, forest protection, and environmental services that the forest provides.

The Biering family started the Bee City Zoo more than 30 years ago to demonstrate their love of honeybees and passion for educating people. The facility has evolved into a one-of-a-kind interactive and educational bee farm and zoo. It is still family-owned and -operated. The exposure potential is great: Bee City hosts more than 45,000 school-age children and their chaperones every year, along with more than 25,000 other visitors.

The South Carolina Forestry Commission, Edisto Chapter of the SAF, WestRock, the American Tree Farm System, the Sustainable Forestry Initiative Implementation Committee, and the South Carolina Timber Producers Association contributed to the funding of this project. **FS**

Liz Bourgeois is a member of the Edisto Chapter. The photos accompanying this article were taken by chapter member Eric Smith.



A display at the forestry exhibit at the Bee City Zoo explains that forest products are South Carolina’s number 1 export, and forest products have a \$21-billion impact on the state’s economy.



## SAF Budget Testimony, R&D Letter

SAF recently submitted written testimony about fiscal year (FY) 2021 appropriations to the House Committee on Appropriations' Subcommittee on Interior, Environment, and Related Agencies. SAF recommended funding for four priority areas:

1. Increase funding for USFS Forest and Rangeland Research to no less than \$315 million, with no less than \$83 million for the Forest Inventory and Analysis program.
2. Continue to support increased cross-boundary work and collaboration across land ownerships and stakeholders to improve forest health and reduce wildfire risks.
3. Maintain funding support for USFS State and Private Forestry Programs at or above FY 2020 funding levels.
4. Support BLM Public Domain Forestry and Oregon & California Railroad Grant Lands funding levels at no less than \$10.24 million and \$112 million, respectively.

"SAF's yearly appropriations requests highlight important federal programs and the power of partnerships and coalitions. Behind the scenes, funding levels are discussed and negotiated with forestry and natural resources partner organizations—giving our requests additional credibility and relevancy," said Danielle Watson, SAF's policy and public affairs director. "Although we will probably see a continuing resolution this year, which will maintain current funding levels until after the election, it's still important to continuously remind Congress about the importance of these programs to public and private lands and forestry professionals."

Watson encourages SAF members to use these letters in their outreach to members of Congress.

### R&D Letter

SAF also submitted a letter to the subcommittee regarding funding for the US Forest Service Research and Development (R&D) program. The letter was co-signed by the American Fisheries Society and The Wildlife Society.

"Offering vital benefits to forests, wildlife, and fish, the undersigned organizations and professional societies urge you to increase funding for all Forest Service R&D to a minimum of \$315 million in FY 2021 including all necessary increase for the Forest Inventory and Analysis program and at least \$232 million for the remaining Forest and Rangeland Research program areas," the letter states. "We thank you for supporting a funding increase in FY 2020, but we are deeply concerned by the administration's

proposal to cut R&D by 25%, eliminate the wildlife and fish research program, close two research facilities, and reduce other important research activities. We urge you to reject these proposals and include report language underscoring the value of Forest Service R&D in providing foundational information and innovative solutions to improve the health of the nation's forests, grasslands, and aquatic systems."

The budget testimony and R&D letter are available to members via SAF's web site at [bit.ly/SAFpolicy](http://bit.ly/SAFpolicy). **FS**

## ApSAF 2020 Student Awards

The Appalachian Society of American Foresters (ApSAF) honored two students at its annual conference in Norfolk, Virginia, January 30–31, for excellence in oral and poster presentations.

Kipling Klimas received an award for his oral presentation, "Immediate Effects of Prescribed Fire on Limiting Macronutrients in a Managed Loblolly Pine Forest." He received \$250, thanks to a personal donation from an ApSAF member. Klimas is a graduate student at Clemson University in Patrick Hiesl's forest operations lab. He earned his bachelor's degree in ecology from Sewanee: The University of the South. His research is focused on prescribed fire impacts on forest health and water quality in the southern Blue Ridge Mountains.



Kipling Klimas

Keith Phelps received an award for his poster presentation, "Optimization of the Restoration of Fire-Dependent Habitats on the Blue Ridge Escarpment." He received \$150, thanks to a personal donation from an ApSAF member. Phelps is working toward a master's degree in forest resources at Clemson University (his advisers are Don Hagan and Patrick Hiesl). His research focuses on forest restoration on the Blue Ridge Escarpment in South Carolina.



Keith Phelps

In addition to these two young professionals, ApSAF congratulates all the student poster and oral presenters at this year's conference: Daniel Amparo (North Carolina State University (NCSU)), Sarah Bailey (NCSU), George Hahn (Virginia Tech), Alison Plumley (NCSU), Princess Mutasa (NCSU). The contributions from these students enriched the conference in numerous ways. **FS**

—submitted by Adam Downing ApSAF Science & Technology chair

## IN MEMORIAM

**Alexander Murray Anderson**, 91, of Debert, Nova Scotia, died on December 4, 2019. Anderson loved the woods of Nova Scotia, where as a youth he tallied pulp to be loaded on to ships near the mouth of the St Mary's River. He earned a bachelor's degree in forestry from the University of New Brunswick and a master's degree in forestry from State University of New York in Syracuse. He worked in several forestry positions, including as a wood procurement forester, until his retirement in 1992. Anderson was a member of the Canadian Institute of Forestry, the Canadian Pulp and Paper Association, and Nova Scotia Forest Fiber Producers. He was a Golden SAF member—62 years. For more information, see [tinyurl.com/s4n8lbv](http://tinyurl.com/s4n8lbv).



**Clarence E. Blackstock**, 93, of Laurel, Maryland, died on January 29, 2020. Blackstock earned a bachelor's degree in forestry from North Carolina State University in 1948, served in the US Marine Corp from 1951 to 1953, and earned a master's degree in forestry from Duke University in 1959. Over his career, he worked at the Maryland Department of Forests and Parks, the US Forest Service, the US Tariff Commission, and the Federal Energy Regulatory Commission; he retired in 1989. Blackstock was a Golden SAF member—71 years. For more information, see [tinyurl.com/scbqlsw](http://tinyurl.com/scbqlsw).



**Dave McNair Campbell**, 66, of Montana, died on March 25, 2019. Campbell was 12 when he met a wilderness ranger on a family camping trip and knew immediately this was the career for him. He began working seasonally for the Forest Service while still in college at Colorado State University. Forty years later, he retired from what he always said was the best job in the Forest Service: district ranger on the sprawling West Fork District. Campbell joined SAF in 1982. For more information, see [tinyurl.com/ue2uqh7](http://tinyurl.com/ue2uqh7).



**Thomas Alexander Greene**, 61, of Springerville, Arizona, died on November 2, 2019. A conservationist professionally and avocationally, Greene loved the quiet green spaces of our national forests and wilderness areas. His undergraduate and graduate studies at Texas A&M University



and Louisiana State University prepared him for his lifetime's research and work in tree improvement, fire management, and conservation planning. Greene joined SAF in 1987. For more information, see [tomgreenememorial.com](http://tomgreenememorial.com).

**Edwin Earl Rodger**, 97, of Bridgewater, Virginia, died on December 9, 2019. Rodger served as an officer in the Army Air Force during World War II. He earned a degree in forestry from Pennsylvania State University and worked for the Virginia Department of Forestry, retiring in 1984 after 38 years. Rodger received the Virginia Forestry Association's Man of the Year award, several awards from the Virginia Wildlife Federation, and special recognition from the FFA (formerly the Future Farmers of America). He received the bronze, silver, and gold Smokey Bear awards for his activity in state and national wildfire prevention programs. Rodger was named an SAF Fellow in 1986. He was a Golden SAF member—70 years. For more information, see [tinyurl.com/rpdlhda](http://tinyurl.com/rpdlhda).

**John K. Strickler**, 84, of Manhattan, Kansas, died on February 23, 2020. Strickler was a professor emeritus working with the Kansas State Forest Service at Kansas State University. He served as assistant state forester in 1965 and associate state Extension forester in 1966. He took a leave of absence from 1987 to 1989 to serve as a special assistant for environmental affairs to Kansas governor Mike Hayden. Strickler became state forestry Extension program leader in 1990. He took a short leave of absence in 1995 to serve as acting secretary of the Kansas Department of Wildlife, Parks, and Tourism. He retired later in 1995. He was a Golden SAF member—62 years. For more information, see [tinyurl.com/wvd4gak](http://tinyurl.com/wvd4gak).



**Walter J. Wagner Jr.**, 83, of Bristol, Indiana, died on March 21, 2018. Wagner served in Germany with the US Army. He graduated from Purdue University in 1957 and later served for many years with the US Forest Service. After retiring, he operated a small appraisal company in Marietta, Ohio. He was a Golden SAF member—62 years. For more information, see [tinyurl.com/swzvk49](http://tinyurl.com/swzvk49).



### JoF, Forest Science Archives

Full, Transitional, and Student SAF members can access current digital editions and archives of the *Journal of Forestry* at [academic.oup.com/jof](http://academic.oup.com/jof) and *Forest Science* at [academic.oup.com/forestscience](http://academic.oup.com/forestscience).



property in films used in electronics: The heat generated by electronic circuits must be dissipated before it damages the circuits. This ability to transfer heat is another advantage of CNs over traditional polymer materials.

### CNs in Everyday Products

The properties of CNs make them quite compelling for a variety of common products. For example, when added to hand creams, shampoo, sunscreen, cosmetics, and other personal care products, CNs act as a thickener and stabilizer. In addition, CNs have a whitish to neutral color, a neutral smell and no taste, are not sticky, and provide a nonoily flat, or matte, finish. They also are nontoxic and have few environmental effects.

“The idea is that it spreads on smoothly when you apply it to your skin, and it stays there. CNs also help these products retain moisture,” said Moon. “For the personal care products industry, these characteristics are very important. And because CNs are nontoxic, all natural, and biodegradable, that’s a very compelling story for consumers. Of course, this industry isn’t nearly as big as the paper industry, for example, which deals with tons and tons of material per day, but [personal care products] is going to be one of the many markets that CNs can play a role in.

“I see CNs as one of those magical additives that’s in so many things, and you don’t even know it’s there,” he added. “The nice thing about them is that they can replace a lot of other additives that aren’t biodegradable and are made from nonrenewable resources.”

Are the properties of CNs made from southern yellow pine better than those made from Douglas-fir, ponderosa pine, or quaking aspen? No, Moon said. For most of the CNs from wood produced to date, the source of the parent cellulose isn’t very important.

“As we’re learning more about how to process these materials, getting better at our skill sets, and understanding better the factors that go into getting higher yields and having a more consistent product, we’re finding that the crystals themselves have a similar morphology and a similar surface chemistry, regardless of the source, and those are two key parameters,” he said. “In studies of materials produced by the same lab from different cellulose source materials, using the same process, for the most part, they are quite similar. Instead of being 300 nanometers in length, they might be 350 nanometers in length. That might make a little bit of a difference in some applications, but nothing too dramatic.”

Other types of materials can perform in similar ways, but nanocellulose has the advantage of being made from a plentiful, renewable resource available in large quantities worldwide and can be harvested on a sustainable basis. What’s more, said Moon, based on all of the testing conducted so far, CNs generally have few negative health, safety, and environmental impacts.

“There’s biomass all over the world,

right? So you can produce these materials almost anywhere,” he said. “And as we scale this technology up, you can produce these materials at a reasonable cost, compared to some of the other nanoparticles, such as carbon nanotubes. If companies can make money from them, [products made with] nanocellulosic materials can be used globally and can impact society in positive ways.

“In a talk on CNs that I gave in August, I mentioned 30 commercial products containing CNs that were developed and were placed on the market in the last three or four years, and there are new products coming online all the time [see [tinyurl.com/s23xv4q](https://tinyurl.com/s23xv4q)]. We’re gaining knowledge about these materials, and companies are becoming more and more comfortable with using them. The more we learn about the [low level of] toxicity of these materials, the more comfortable people are with using them. This is an exciting time.” **FS**

### GREENE ■ From Page 15

Paycheck, manufacturing has one of the lowest percentages of millennial employees (31.8 percent) of all industries.

- Leisure and hospitality have a high percentage of millennial employees (49.9 percent), but also pay the lowest wages (\$15.51/hour).

Overwhelmingly, jobs that are less physically demanding but low paying are more attractive to millennials than high-paying jobs that are labor intensive. This represents a tremendous generational shift, and it creates real challenges for the forest industry moving forward.

Who will harvest and haul timber in the future? Who will cruise and manage timberland, and who will maximize and protect its natural resources? Who will operate, maintain, and repair the complex pieces of mill equipment? Who will manage wood products logistics and exports? These are just a few of the questions that must be addressed in the midst of quickly changing workplace trends that could have far-reaching consequences for the forest industry.

Current industry leaders need to understand this trend to better plan for the future. To do so effectively, they must reassess their roles as leaders, make adjustments to their leadership methods, and be prepared to make organization-level changes. In a follow-up installment to this article, I will look at effective trends driving millennial retention rates in the workplace, and ways in which the forest industry can incorporate fresh ideas to make it more attractive as a career choice for future generations. **FS**

*John Greene is a content marketing manager at Forest2Market ([forest2market.com](https://forest2market.com)). This article was first published on Forest2Market blog; it appears here with the company’s permission. His follow-up article will appear in the May 2020 edition of The Forestry Source.*

## CONTINUING EDUCATION CALENDAR

### April through June 2020

More Events at [tinyurl.com/gnd78jh](https://tinyurl.com/gnd78jh) ([www.eforester.org](http://www.eforester.org))

### Cancelations/Postponements Due to the Coronavirus

Many public events have been cancelled in recent weeks to help slow the spread of the coronavirus (Covid-19). Some events listed here may be affected. Check with program hosts for information about changes to previously scheduled continuing forestry education (CFE) programs, as they may be canceled, postponed, or shifted to an online platform. Check the CFE Event Calendar ([tinyurl.com/gnd78jh](https://tinyurl.com/gnd78jh)) and [www.ForestEd.org](http://www.ForestEd.org) for a variety of online learning opportunities.

In addition to earning continuing forestry education credits (CFEs), SAF recognizes that Covid-19 may affect your efforts to retain or earn your credential, including the examination. With the potential for canceled or rescheduled examinations, we are working with the testing provider to provide you the most accurate information. We want to assure you that Certified Foresters (CFs) and Candidate Certified Foresters (CCFs) will not be penalized if they can’t fulfill their CFE requirements due to trainings cancelled as a result of Covid-19. We will work with current CFs and CCFs whose certifications expire March 2020 through September 2020 to ensure that they are not penalized as a result of these extenuating circumstances. Please visit our certification page for FAQs to answer questions you may have about how Covid-19 will affect certification and state licensure ([tinyurl.com/vrmz4fp](https://tinyurl.com/vrmz4fp)).

CFE Providers: Please visit the Provider CFE Pre-approval page ([tinyurl.com/wgdyuke](https://tinyurl.com/wgdyuke)) for FAQs about CFE pre-approved programs, especially if your pre-approved program is cancelled, postponed, and/or the program details change.

### WEBINARS

- 4/1/2020, 2019–20 FCWG Learning Exchange Series: Tribal Forests and Forest Carbon
- 4/8/2020, Laurel Wilt Biology
- 4/16/2020, Forest Adaptation: Changing Hydrology
- 4/21/2020, Herbicide Use in Forestry
- 5/19/2020, Operationalizing Adaptive Silviculture for Climate Change in Minnesota
- 5/21/2020, Forest Adaptation: Forest Birds
- 6/2/2020, Glades, Quail, and Prescribed Fire Workshop
- 6/16/2020, Restoring Fire-Dependent Woodlands through the Sand Plains Partnership
- 6/25/2020, Forest Adaptation: Regeneration

### ALASKA

- 4/2–4/2020, Alaska Society of American Foresters Annual Meeting, Juneau

### CALIFORNIA

- 4/20–24/2020, FVS Basic Training, Sacramento

### COLORADO

- 4/2/2020, Assessing and Applying Dryland Drought Dynamics to Inform Resource Management, Fort Collins
- 4/14–16/2020, Colorado Wildland Fire Conference, Grand Junction

### FLORIDA

- 4/14–16/2020, Ecosystem Approach to Urban Forest Management, Gainesville

### GEORGIA

- 4/1–3/2020, Georgia Vegetation Management Association 2020 Conference, Athens
- 4/3/2020, Forestry and Wildlife Management Field Day, Eastanollee
- 5/6/2020, Trees, Your City’s Character, and a Sense of Place, College Park
- 6/16–17/2020, Logging Cost Analysis, Dry Branch/Macon
- 6/17/2020, Interpreting Aerial Images of Rural Landscapes, Athens
- 6/18–19/2020, Introduction to ArcGIS, Athens

### IDAHO

- 6/19/2020, Root Disease: The Hidden Menace, Coeur d’Alene

### INDIANA

- 5/8/2020, Advanced Tree Knowledge for Better Tree Care, Indianapolis

### MAINE

- 4/7/2020, Forestry Wildlife Workshop Series: MNAP Day, Ellsworth
- 4/14/2020, Forestry Wildlife Workshop Series: Atlantic Salmon & Turtles, Ellsworth
- 4/16/2020, Maine Driving Dynamics, Old Town
- 4/21/2020, Forestry Wildlife Workshop Series: Invasive Species, Ellsworth

### MASSACHUSETTS

- 4/7/2020, Fruit Tree Pruning Workshop, Boylston

### MICHIGAN

- 4/1/2020, Forest Health Update and Current Issues, Hemlock Woolly Adelgid Surveying, Chatham
- 4/16–17/2020, Michigan SAF Meeting, Grayling
- 6/25/2020, Landscape and Forest Tree and Shrub Insect Workshop, Amherst

### MINNESOTA

- 4/21/2020, Webinar: Herbicide Use in Forestry
- 5/19/2020, Webinar: Operationalizing Adaptive Silviculture for Climate Change in Minnesota
- 6/16/2020, Webinar: Restoring Fire-Dependent Woodlands through the Sand Plains Partnership

### MONTANA

- 5/1/2020, 11th Annual Montana Forest Landowner Conference, Helena
- 5/2/2020, Identifying and Managing Common Forest Insects and Diseases in Montana, Helena

### NEW HAMPSHIRE

- 4/7/2020, Cottrell-Baldwin Lecture Series 2020 - Water Connections, Hillsborough,
- 4/7/2020, Forest Carbon Dynamics and Bringing Carbon to the Market, Concord
- 4/7/2020, Fundamentals of Forestry, Wentworth
- 4/9/2020, Fundamentals of Forestry, Durham
- 4/13/2020, Safe and Efficient Trucking, Bristol



4/14/2020, First Aid & CPR (Basic), Albany  
4/15/2020, First Aid & CPR (Basic), Lancaster  
4/16/2020, NH Timber Harvesting Law, Whitefield  
4/17/2020, First Aid & CPR (Basic), Hillsborough  
4/20/2020, Safe and Productive Felling (Advanced), Loudon  
4/21/2020, Conservation Easements 101, Concord  
4/22/2020, First Aid and CPR (Advanced), Croydon  
4/23/2020, First Aid & CPR (Basic), Concord  
4/24/2020, First aid & CPR (Basic), Campton  
4/28/2020, Selling Timber, Do It Right!, Concord  
5/13/2020, Safe and Productive Felling (Basic),  
5/15/2020, Adapting to a New Climate—New Silvicultural Research at the 2nd College Grant, Second College Grant  
5/15/2020, Forest Health: White Pine & Caliciopsis canker, Concord  
5/20/2020, Caterpillars: Indispensable Insect Herbivores, Concord  
6/12/2020, Forest Health: Emerald Ash Borer, Madbury

## NEW JERSEY

4/23/2020, Pond Design, Management, and Maintenance, Somerset  
6/1–4/2020, Methodology for Delineating Wetlands, Basking Ridge  
6/2/2020, Introduction to Wetland Identification, Somerset

## NORTH CAROLINA

4/14/2020, Carolina Canopy Workshop: Make That Tree an Asset Not a Liability, Goldsboro  
4/16/2020, Woods for Wildlife, Kenansville

## ONTARIO

4/8/2020, Great Lakes Forest Health Showcase, Sault Ste Marie

## OREGON

4/4/2020, Tree School Lane, Pleasant Hill  
4/20/2020, Fundamentals and Best Practices for Forest Inventories, Springfield

## SOUTH CAROLINA

4/2–3/2020, Coyote Trapping and Management Workshop, Garnett  
4/9/2020, Herbicides, Seedlings, and Economic Results, Georgetown  
4/16/2020, An Introduction to Audubon South Carolina's Forest Management Program, Summerville  
4/22–23/2020, SC Timber Operations Professional 2-Day, Columbia  
4/24/2020, Keowee Chapter Meeting—Fish Passage Restoration, Mountain Rest  
4/28/2020, Tree Health Workshop for Professionals, Charleston  
4/29/2020, Growing Our Future Forest, Leesville  
6/4/2020, SC SAF Annual Meeting, Georgetown

## TEXAS

4/1/2020, Urban Riparian and Stream Restoration Program, The Woodlands  
4/7/2020, Mill Creek Watershed Ecosystem Workshop, Bellville  
4/23–24/2020, Outlook for Texas Land Markets, San Antonio  
4/28/2020, Deer Creek Watershed Ecosystem Workshop, Marlin

## UTAH

4/6–10/2020, FVS Basic Training, Ogden

## VERMONT

4/3/2020, Tree Risk Assessment Refresher Training, Barre  
4/6/2020, Business Plans for Forest Businesses, Brattleboro  
4/7/2020, Business Plans for Forest Businesses, Berlin  
4/8/2020, Continuous Improvement in Logging, Randolph Center  
4/29/2020, Managing and Using Forest Ecosystems, Berlin  
5/15/2020, Deer, Invasives, Residual Density and Forest Regeneration, Brattleboro  
5/16/2020, Deer, Invasives, Residual Density and Forest Regeneration. Field Tour, Westminster  
5/26/2020, VT LEAP Spring Workshop: Heavy Cutting Law and Hazardous Material Training, Westminster  
5/27/2020, VT LEAP Spring Workshop: Heavy Cutting Law and Hazardous Material Training, Westminster, Bristol  
5/29/2020, VT LEAP Spring Workshop: Heavy Cutting Law and Hazardous Material Training, Westminster, Island Pond

## VIRGINIA

4/3/2020, Rappahannock Chapter of SAF Meeting, Ashland  
4/28–5/1/2020, 20/20: Seeing the Forests through the Trees. Virginia Forestry Summit, Harrisonburg  
5/12/2020, New Tree Farm Inspector Training, Advanced, Providence Forge  
5/14/2020, 11th Annual Vegetation Management Workshop, Colonial Heights

## WEST VIRGINIA

4/1–2/2020, Changing Markets and Practices in West Virginia Forestry, Saulsville

## WISCONSIN

4/23/2020, 16th Annual Sustainable Forestry Conference: Woods to Market, Florence  
4/23/2020, Income Tax and Timber Sales, Stevens Point  
4/23/2020, Marketing to Increase Sales, Stevens Point  
4/24/2020, Applying a Climate Change Filter—Lake Michigan Coastal Resiliency Project, Manitowoc  
5/12/2020, Using Avenza Pro and Customized Shapefiles to Efficiently Collect Field Data, Stevens Point  
6/7/2020, Timber Marking for Wildlife Habitat: White-Tailed Deer, Amherst Junction

### Letters to the Editor

*The Forestry Source* welcomes letters to the editor. Send letters to Steve Wilent at wilents@safnet.org or to 10100 Laureate Way, Bethesda, MD 20814.

### Commentary

*The Forestry Source* welcomes Commentary essays of 500 to 1,200 words on topics of professional interest to SAF members. Because space is limited and publication cannot be guaranteed, writers are encouraged to contact the editor before submitting manuscripts: Steve Wilent, wilents@safnet.org or 503-622-3033.

## CLASSIFIEDS

### From the SAF Career Center

For the complete listing of these and other ads, visit <http://careercenter.eforester.org>

#### FIA Interim Forester

Employer: Tennessee Division of Forestry  
Location: Crossville/Knoxville, Tennessee  
Job ID: 53542051

#### Forester/RPF

Employer: Gualala Redwood Timber  
Location: Gualala, California  
Job ID: 51110681

#### Forester

Employer: Campbell Global  
Location: Ackerman, Mississippi  
Job ID: 53533567

#### Associate Director of Forestry Services

Employer: Colorado State Forest Service  
Location: Fort Collins, Colorado  
Job ID: 53470807

#### Executive Director

Employer: Maine TREE Foundation  
Location: Augusta, Maine  
Job ID: 53460445

#### Forest Invasive Plant Coordinator

Employer: WI DNR  
Location: Rhinelander/Madison, Wisconsin,  
Job ID: 53438199

#### Forester

Employer: Campbell Global  
Location: Lufkin, Texas  
Job ID: 52997699

#### Service Forester—NRCS

Employer: Montana Department of Natural Resources  
Location: Eureka/Helena, Montana  
Job ID: 53392436

#### Urban Forester I

Employer: American Forest Management, Inc.  
Location: Western Washington—Puget Sound Region, Washington  
Job ID: 53392627

#### Project Forester

Employer: Forest Resource Services  
Location: Eastern US  
Job ID: 53391147

#### Monitoring Unit Manager

Employer: Oregon Dept. of Forestry  
Location: Salem, Oregon  
Job ID: 53392410

#### District Forester, West Tennessee

Employer: Tennessee Division of Forestry  
Location: Lexington, Tennessee  
Job ID: 53373296

#### Forest Products Utilization Team Leader

Employer: Nebraska Forest Service  
Location: Lincoln, Nebraska  
Job ID: 53340596

#### Operations Forester

Employer: Wagner Forest Management, Ltd.  
Location: Rangeley, Rangeley Lakes/Sugarloaf Region  
Job ID: 53339546

#### Forester Open Pool

Employer: Colorado State Forest Service  
Location: Several locations in Colorado  
Job ID: 53314588

#### Supervisory Forester

Employer: Colorado State Forest Service  
Location: Northeast Colorado  
Job ID: 53314556

#### Associate Director of Science and Data

Employer: Colorado State Forest Service  
Location: Fort Collins, Colorado  
Job ID: 53303482

#### Professor of Forest Business

Employer: Mississippi State University  
Job ID: 53293288  
Location: Mississippi State, Mississippi

#### Assistant Professor, Ecophysiology

Employer: Washington State University  
Job ID: 51650502  
Location: Pullman, Washington

#### Senior Forester

Employer: Landvest Inc.  
Location: Redding, California  
Job ID: 53503357

#### Forestry Analyst

Employer: TTG Forestry Services LLC  
Location: Atlanta, Georgia  
Job ID: 53471340

#### Lecturers in Forestry (2 positions)

Employer: Northern Arizona University, School of Forestry  
Location: Flagstaff, Arizona  
Job ID: 53460499

#### MS Graduate Research Assistantship in Forest Biometrics

Employer: Mississippi State University  
Location: Mississippi State, Mississippi  
Job ID: 53460379

#### Stumpage/Procurement Forester

Employer: FutureWood Corporation  
Location: Superior, Wisconsin  
Job ID: 53446534

#### Conservation Forester

Employer: The Nature Conservancy  
Location: Cle Elum/Seattle, Washington  
Job ID: 53429047

### How to Post an Ad

The classifieds section in *The Forestry Source* includes only ads that have been posted in the SAF Career Center. To post an ad, go to the Career Center web site, [careercenter.eforester.org](http://careercenter.eforester.org), and click on the Post a Job link at the top right.



## Global Trade Highlights

Highlights from *WRI Market Insights 2020*, a newsletter from Wood Resources International (WRI, woodprices.com):

Global trade of softwood logs in 2019 remained practically unchanged from 2018's total of 93 million cubic meters (m<sup>3</sup>). As much as 45 percent of globally shipped logs were destined for China. Sawlog prices continued their decline on all continents in late 2019. By far the biggest price reductions in 2019 occurred in Europe, particularly in the central region of the continent.

Both of WRI's wood fiber price indices declined for the third consecutive quarter in the 4Q/19. The Softwood Fiber Price Index (SFPI) fell 2 percent quarter-over-quarter, hitting the lowest level in more than two years. The Hardwood Fiber Price Index (HFPI) was 3 percent lower than the previous quarter and the lowest it has been since the 2Q/2017.

Profits for sawmills in the US South reached record highs in 2018 but have since fallen substantially and were below their 10-year average in the 4Q/2019.

In 2019, Russia surpassed Canada as the world's largest exporter of softwood lumber. The shift came as the result of declining exports from Canada, particularly from British Columbia to the US, and a substantial increase in exports from Russia to China.

Shipments of lumber from overseas to the US increased to a record 14 percent of total imports in the 4Q/19. Germany,

Sweden, Chile, Brazil, and Austria were the largest suppliers.

## China Rescinds Hardwood Tariffs

According to the Decorative Hardwoods Association, China recently announced that it has rescinded tariffs for some types of hardwood logs and lumber for one year, beginning February 28. "China prefers to use raw materials from other countries as it rebuilds its own forests, and, as the largest wood product exporter in the world, needs to reduce costs on incoming raw materials," the association reported.

In December, the Chinese government issued a revision of its national forest law, first issued in 1984, that requires forest managers to follow sustainability principles and prohibits importing, transporting, and processing illegally sourced timber. The revised law outlines management practices for public-benefit forests and commercial forests. "Shifting away from a focus on timber production, the revised law seeks to balance forest management to more fully realize the role of forests in providing economic, social, ecological and cultural services," reported *TimberBiz*, an Australian 'zine ([tinyurl.com/shwacz9](http://tinyurl.com/shwacz9)).

## Exports to India

According to *TimberBiz* ([tinyurl.com/v64j4ff](http://tinyurl.com/v64j4ff)), 2019 was a record year for US hardwood exports to India. The value of hardwood lumber and veneer exports totaled \$6.448 million, according to the American Hardwood Export Council (AHEC), reported *TimberBiz*: "A closer

look at the numbers for 2019 reveal that total hardwood lumber shipped from the United States to India increased by 72% in value to US\$2.356 million (up from US\$1.369 million in 2018) and by 140% in volume to 4,082 cubic meters (up from 1,698 cubic meters in 2018). At the same time, direct exports of American hardwood veneers to the market increased by 4% to reach US\$4.092 million."

The top six American hardwood species exported last year were hickory (\$727,000, 1,229 m<sup>3</sup>), red oak (\$466,000, 920 m<sup>3</sup>), walnut (\$329,000, 282 m<sup>3</sup>), white oak (\$262,000, 358 m<sup>3</sup>), ash (\$242,000, 356 m<sup>3</sup>), and maple (\$140,000, 240 m<sup>3</sup>).

## Arkansas Loses Paper Mill

"Chinese company abandons \$1.8B Arkansas paper mill plan" was the headline of a March 16 Associated Press (AP) article. According to the AP, Sun Paper sent a letter to Gov. Asa Hutchinson and state economic development officials, saying that it would not move forward with its plan to build a mill in Arkadelphia, about 60 miles southwest of Little Rock.

"The company cited 'continued polit-

ical friction and economic instability,' and the coronavirus outbreak as reasons for walking away from the project," the article reported. "The announcement comes after Arkadelphia officials announced that the community was marketing the 1,000-acre site planned for the mill to other potential projects. The \$1.8 billion mill was announced in 2016 but has faced uncertainty since then because of trade tensions."

## Boise Cascade Roxboro

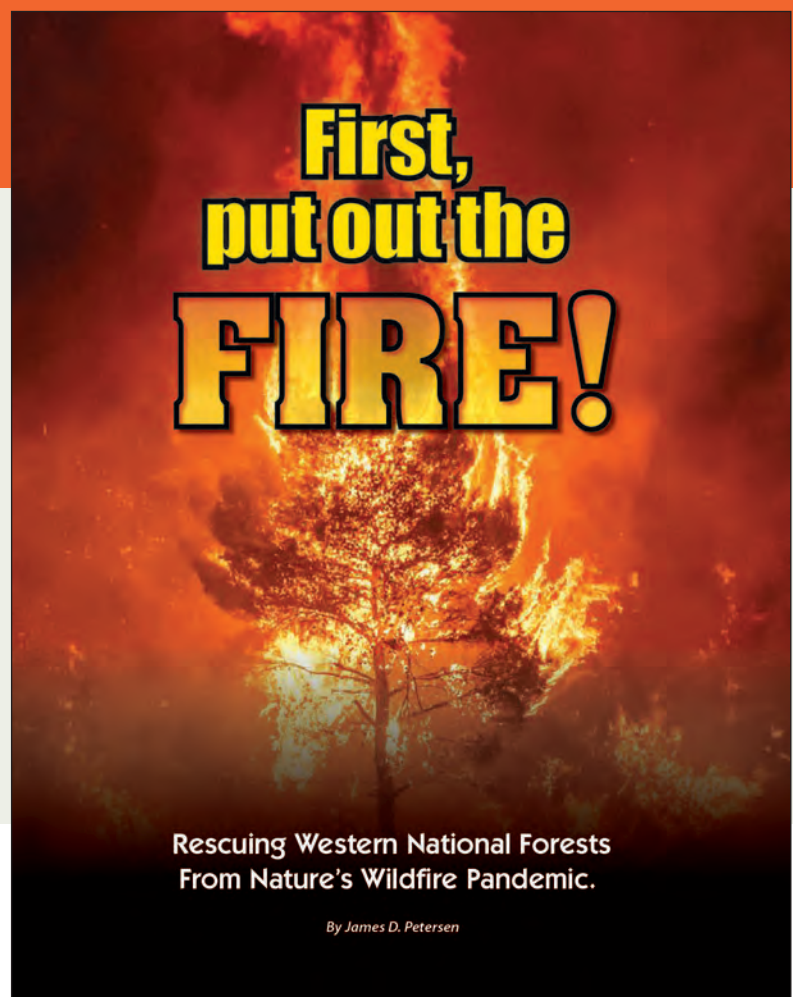
Boise Cascade announced in late February the permanent curtailment of its I-joist production facility in Roxboro, North Carolina. The shutdown will affect approximately 29 employees. The company said production would cease by the end of the first quarter of 2020, but inventory shipment may continue into the third quarter before all operations cease.



Representatives from the Georgia-Pacific containerboard mill in Toledo, Oregon, recently presented the Oregon Coast Science, Technology, Engineering and Math (STEM) Hub with a \$25,000 donation. See [tinyurl.com/qr2ytfq](http://tinyurl.com/qr2ytfq).

“ Jim Peterson is the best writer the forestry world has ever had. *First, Put Out the Fire!* gives voice to ideas and frustrations that I've packed around my entire career.”

—Danny Druator, Executive Vice President, American Loggers Council



Rescuing Western National Forests From Nature's Wildfire Pandemic.

By James D. Petersen