

Explore • Educate • Enhance



College of Forestry
Oregon Forest Research Laboratory

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College of Forestry/Forest Research Laboratory

The College of Forestry supports Oregon State University's Land Grant mission through excellence in teaching, research, and outreach. The College offers top-ranked undergraduate and graduate education programs in the conservation, management and use of the world's forest resources and renewable materials. Through eight undergraduate and four graduate programs, we prepare students to become leaders, scientists, managers, and stewards of these sustainable resources in the 21st Century.

Research by College of Forestry faculty, staff, and students is conducted under the auspices of the Forest Research Laboratory, a statewide public

service unit of Oregon administered and directed by the Dean. The "FRL" is a dynamic source of knowledge about the science and management of forests, the connections of people to forests, and the use of renewable materials to benefit businesses, communities, and quality of life in Oregon.

This report highlights our accomplishments and recent activities with a focus on research and students. We refer to the College of Forestry and the Forest Research Laboratory as CoF/FRL throughout this report in recognition of the close coupling of programs and people, except when referring specifically to College of Forestry degree programs.

Our facts at a glance

Established:	College of Forestry (CoF), 1906 Forest Research Laboratory (FRL), 1941
Employees:	215
Students:	953
Academic Departments:	Forest Ecosystems & Society (FES) Forest Engineering, Resources & Management (FERM) Wood Science & Engineering (WSE)

Undergraduate Degree Programs:

Renewable Materials
Natural Resources
Forest Management
Forest Engineering
Forest Operations Management
Recreation Resources Management
Tourism and Outdoor Leadership
Forest Engineering/Civil Engineering

Graduate Degree Programs:

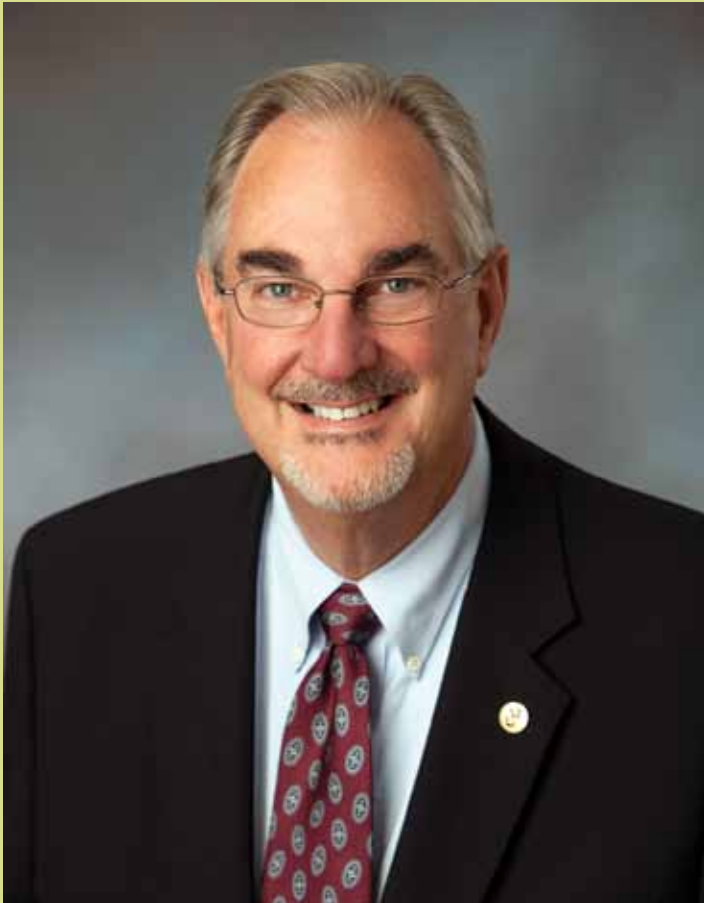
Forest Ecosystems and Society
Sustainable Forest Management
Wood Science

Our products

- ◆ Graduates: Well-educated, workforce ready people who reflect the diverse communities they will serve. Adaptable, global, lifelong learners who will help solve the complex problems and multiple demands of forest ecosystems and the forest sector.
- ◆ Research & Development: Science-based knowledge, technologies, and tools to solve emerging problems and shape Oregon's economic, environmental and social future.
- ◆ Public Service: Outreach and engagement with those who value forest ecosystems, forest management for multiple objectives, and forest-derived renewable materials.
- ◆ Information: Sound and scientifically based information for research partners, well-informed citizenry, landowners, and for public policy makers.

Our Oregon

- ◆ 48% of Oregon's land area is forest
- ◆ 70,000 people own 10 acres or more of Oregon forestland
- ◆ One third of Oregon's forestland is managed as reserves for environmental, habitat or scenic values
- ◆ Oregon is the U.S. leading state producer of softwood products, providing 20% of domestic supply
- ◆ Oregon's forest sector provides direct and indirect employment of about 120,000 people, generating \$4.7 billion in payroll
- ◆ Oregon's forest sector accounts for 7% of the state's total industrial output



From the Dean & Director

Well positioned for Oregon's recovery. The past biennium will likely be remembered as the worst recession most Oregonians will know. The recession has severely impacted Oregon's forest sector, particularly in rural communities where forest-related employment accounts for major portions of their economies. The CoF/FRL has reduced its numbers of teaching/research faculty and specialized support staff to manage reductions in state and external funding. The past few years have added clarity to the future demands and threats that our forestlands will face. Working forests, global change, energy independence, water quantity and quality, human interactions with forests, "green" living/working, and manufacturing competitiveness in a global economy are among our teaching and research priorities for the future.

We believe that our education and research programs will provide knowledge and people for the integrated management of forest resources for multiple values and products that meet society's needs. We place special attention on social and economic benefits. Some of the reasons for our confidence in the future are outlined below.

Our research. CoF/FRL faculty are providing regional, national, and international leadership in addressing many of society's challenges at scales ranging from molecules to the globe. Last year, CoF/FRL scientists spent \$21.7 million in support of Oregon-based research, thanks largely to their success in competing for external funding. This success results from the ability of our faculty to leverage \$6 of support for every \$1 of state appropriated support for the FRL.

Our commitment to addressing workforce needs. Enrollment has increased 50% in the past 5 years. We have become the Western institution of choice for industry, agency and NGO employers. Our graduate students are tackling new problems as they work to become the next generation of forest related scientists. Curricula and degree programs are being changed to ensure students are ready for the future.

Our organizational structure. We have restructured our departments to reduce administrative overhead and align faculty disciplinary strengths to address natural resource needs and issues. We have also increased our collaboration with other colleges at OSU and other universities to research topics that cross landscapes, regions and borders.

Our future. Forests are one of Oregon's primary, sustainable resources. The water, wildlife habitat, recreation, and renewable materials they provide are important to both rural and urban citizens. We remain confident that we can continue to provide the leadership, people, and information to protect, grow, manage, and utilize forest resources for multiple purposes, and for generations of Oregonians.

Our dynamic planet



South Sister volcano in Oregon, reflected in the waters of Sparks Lake. Photo credit: USGS/Cascades Volcano Observatory.

The volcanic peaks, glacial rivers, and diverse landscapes of Oregon remind us that we live in a place shaped by dynamic natural forces. These natural disturbances—windstorms, floods, and landslides, wildfires, earthquakes, and even tsunamis—continue to affect our region and carry risks for the people who live here. Scientists and engineers at the CoF/FRL are engaged in research that can help us live, work, and play more safely in Oregon and elsewhere on our dynamic planet.

Building homes to withstand earthquakes and floods

Most Americans—some 90%—live in wood-framed houses, and that's a good thing when it comes to earthquakes. Wood is strong but light and flexible, which means that wood-framed structures perform surprisingly well during earthquakes. But there still are gaps in our knowledge, particularly when it comes to structural design.

At the CoF/FRL, Rakesh Gupta, WSE, is working collaboratively with engineers and scientists from OSU and elsewhere to create better test methods that simulate actual earthquake stresses on buildings. Gupta recently was part of a shake-table test of a full-scale six-story wood framed building on the largest shake table in the world in Miki City Japan. The building fared amazingly well during the simulation of an earthquake at 7.5 on the Richter magnitude scale. One of the major conclusions of this research was that it is possible to design a six-story wood-framed building that can survive a major earthquake.

When Hurricane Katrina struck, in many cases it was the water, rather than the high winds, that caused the most damage to wood-framed structures. Near the coast, waves completely removed houses, leaving only the foundations. Gupta's research group tests wooden structures by subjecting them to simulated storm surges and tsunami waves in OSU's O. H. Hinsdale Wave Research Laboratory. This research will yield insights into construction practices that can help homes and buildings better withstand the force of natural disasters such as floods, storm surges, and tsunamis. Because the Oregon Coast is vulnerable to a major earthquake and associated tsunami in the coming years, this research could save untold lives and millions of dollars in property damage.



Shake table test of 6-story building in Miki City, Japan. Photo credit: John van de Lindt.



Integrative water research for a changing world

Forests cover about one-third of the nation's land area and provide natural filtration and storage systems that process nearly two-thirds of the water supply in the U.S. As both urban and agricultural demands for water increase, clean water from forests is even more valuable as an "ecosystem service." Oregon's economic vitality is directly tied to water and water is "virtually" embedded in all Oregon products, from timber and salmon to solar panels and semiconductors. But water supply and demand in the state is changing. There is now less snowpack in mountain regions and the snow is melting earlier in the spring. These changes have implications for irrigation, human consumption, hydropower generation, and ecosystems. Shifting population, land-use patterns, and environmental policies will also influence the future supply and demand for clean water.

One OSU center of water research is the Institute for Water and Watersheds (IWW), led by OSU Distinguished Professor and Richardson Chair in Watershed Science Jeff McDonnell, FERM. IWW is Oregon's federally designated water resources research institute and its role is to catalyze water research by assembling diverse research teams and leading interdisciplinary and transdisciplinary water research projects on complex water issues. The CoF/FRL is home to the IWW Collaboratory, a shared laboratory that offers training and access to water quality and stable isotope analysis facilities for OSU graduate students.

McDonnell and researchers from Portland State University and University of Oregon are teaming up to study the regional water supply in the Willamette River Basin and how it might be impacted by population growth and climate change. The National Science Foundation recently awarded a \$4.3 million grant to the three schools for the five-year study. As McDonnell, who is lead investigator for the research project, points out, "How climate change will conspire with population growth to affect water quality and quantity in basins around the world is the defining issue of this century."

Another center of water research in the CoF/FRL is the Watersheds Research Cooperative (WRC), led by Arne Skaugset, FERM. WRC scientists are in the midst of three long-term, interdisciplinary, paired-watershed studies that are yielding new scientific knowledge about the cumulative environmental effects of contemporary forest management activities on water quantity and quality, fish, and other aquatic biota. These studies are key to informing future forest management regulations that protect watershed resources at the least possible cost.

A third center of water-related research at the CoF/FRL occurs through the National Science Foundation Long Term Ecological Research (NSF-LTER) program based at the H.J. Andrews Experimental Forest. Recent accomplishments include pioneering research on the movement of water in the soil and its availability for tree growth.



Climate change, carbon cycling, and fire

Many CoF/FRL scientists, including John Bailey, Beverly Law, Mark Harmon, Dave Turner, Dave Shaw, Stephen Fitzgerald, and Olga Krankina, are conducting research to improve understanding of various aspects of climate change and its implications for carbon cycling, natural disturbances such as wildfire and insect/disease outbreaks, and the potential implications of different approaches to managing forests. There are indications that a warmer climate will stress at least some forest ecosystems. The current bark beetle outbreak that is killing large areas of lodgepole pine in the interior West is cited as an example of reduced ecosystem resiliency to insects and diseases. These changes may also increase the potential for larger and more frequent forest fires in the Pacific Northwest.

Fire has been a natural part of Oregon ecosystems for millennia—whether frequently, as on eastside ponderosa and lodgepole pine forests and sagebrush-juniper rangelands, or at longer intervals, as in Douglas-fir and western hemlock forests of the west side. John Bailey, FERM, believes that the key to the future is in accepting the inevitability of fire and learning to manage it as a natural part of the ecosystem. Bailey and others are also exploring opportunities to actively manage stands to increase their resilience and reduce fire risks. Indeed, much recent research has explored ways in which fire and some other restoration treatments help maintain the health of surviving trees and leaves them better able to resist disease and insect attack, reduces competition for moisture and nutrients, develops complex forest structure, and sometimes sets the stage for forest renewal.

CoF/FRL scientists are also contributing to the science base about carbon emissions from wildfires, as well as about opportunities for carbon storage in larger trees provided by longer rotations. In addition to carbon stored in living trees, researchers are examining how to best account for the long-term storage of carbon in wood products used in the construction of buildings and other wood structures.



Photo credits: (left) Amy Simmons maintains hydrologic sensors in the Trask Paired Watershed Study area near Tillamook, Oregon, after a storm (Trask Paired Watershed Study); cutthroat trout (Dave Leer); Pacific tree frog in charred log (Garrett Meigs, FES); Cassie Hebel (MS FS, '07) in Sol Duc Valley, Olympic National Park, WA (Garrett Meigs); fire in the trees, U.S. Bureau of Land Management/Prineville Office.

Our working forests



Humans depend on and value forests for food, shelter, water, fuel, recreation, inspiration, and many other benefits. We seek to understand the diversity of benefits derived from forests and expand our knowledge of how forests function to provide those benefits. Our goals include the discovery and dissemination of knowledge related to the interactions among forests, people, and other organisms—especially in the face of climate change, land use pressures, and economic uncertainties. We provide the expertise needed by scientists, managers, and the general public as they jointly decide how these important values can be sustained on forest lands in Oregon and around the globe now and into the foreseeable future.



Changing climate, adapting management

The forests of the Pacific Northwest are amazingly productive, but will this change in the future?

Most scientists agree that global climate change has already affected where and how trees grow, and long-term changes in temperature and precipitation will present new challenges to forest managers in working forest landscapes. The key is that forest species are genetically adapted to their local climates—and forest health and productivity are expected to change with changes in the local environment. Adaptability of forest trees—their ability to tolerate stresses such as drought, temperature extremes, insects, diseases, and fire—will be crucial in the future. Adaptability has both genetic and environmental components that can be altered via forest management, but we currently lack sufficient site-specific knowledge to apply these measures broadly or with confidence.

The Taskforce on Adapting Forests to Climate Change (TAFCC), under the leadership of Glenn Howe, FES, in the CoF/FRL, is a group of scientists and land managers from universities and state and federal agencies working to

understand the potential effects of climate change on natural and planted forests in the western United States. They are developing new genetic and silvicultural approaches that foresters can use to help increase forest health and productivity in the face of climate change.

Howe, a forest geneticist, is studying the adaptive potential of forest trees and developing new seed zones, breeding zones, and tree improvement methods that foresters can use to ensure well-adapted and productive plantations in the future. Howe is also planning for the future by developing genomic approaches to better understand forest adaptation and improve the efficiency and effectiveness of tree breeding programs.

Howe's research on climate change and forest genomics is being supported by the members of the Pacific Northwest Tree Improvement Research Cooperative, as well as by TAFCC. Financial support is also being provided by the National Science Foundation to the Center for Advanced Forestry Systems and by the USDA Agriculture and Food Research Initiative to the Conifer Translational Genomics Network.





Swainson's thrush. Photo credit: Matt Betts

Bird's eye view

Intensively managed plantation forests are one way to meet the high global demand for wood. How do these managed forests look to birds and other native wildlife species? CoF/FRL ecologists are engaged in collaborative research with industry partners to learn more about the potential impacts of intensive forest practices on native wildlife as well as ways to mitigate such impacts.

To the untrained eye, the tall, lush stands of Douglas-fir in a plantation forest may look ideal for wildlife, especially birds. But these production forests, which are efficient for growing conifer trees in the temperate Pacific Northwest, often lack the complex structure and diverse types of habitat that are important for many different kinds of animals. Intensive management often means the removal of competing broadleaf trees and shrubs so that conifers can thrive. This understory vegetation forms critical habitat for wildlife, however. Birds such as the Swainson's thrush feed on insects and berries from a variety of hardwood trees and shrubs.

Ecologists worldwide have documented the decline in populations of birds and other species, as well as a decline in the amount of forest that is dominated by early-successional broadleaf trees and shrubs. Although there are concerns about the possible connection between the two trends, there is a lack of information. Matt Betts, FES, and his research team at the CoF/FRL are developing new ways to analyze trends in forest biodiversity. Betts studies the ways that landscape composition and pattern influence



animal behavior, species distributions and ecosystem function and services.

Betts's research in forests of the Pacific Northwest has found that there is a link between declining populations of certain species and the loss of broadleaf trees and shrubs in intensively managed forests. However, forest management treatments that maintain or restore even small amounts of broadleaf vegetation could mitigate further declines.

With funding from the USDA and National Council for Air and Stream Improvement (NCASI) as well as partnerships with landowners including Oregon Department of Forestry, Weyerhaeuser, Forest Capital Partners, Plum Creek and Hancock Timber Resources have initiated a large-scale forest management experiment to determine how to better manage forestlands to maintain biodiversity. This includes examining the effects of herbicides and associated vegetation changes on bird populations and insect and plant diversity, as well as the ecosystem services provided by birds in controlling insect populations.

Valuing outdoor recreation

As Oregonians, we are fortunate in having easy access to outdoor recreation no matter where we live. Tourism and related outdoor recreation activities are also significant contributors to local economies. The CoF/FRL offers educational opportunities for students interested in recreation resource management through the Natural Resources degree program in Corvallis and through the Tourism and Outdoor Leadership degree at the OSU Cascades campus in Bend. Faculty have collaborated with state and federal agencies in program development, assisted communities with economic development, and

provided research-based information about topics that include valuing services, willingness to pay, and visitor safety and crime awareness.

We recognize the importance of our forests, mountains, rivers, parks, campgrounds, trails, lakes, and beaches for our health and well being—and we are using them in ever increasing numbers. One challenge for the foreseeable future in Oregon and elsewhere is to find a way to accommodate greater numbers of outdoor recreationists while remaining within restricted budgets, or to develop new sources of financial support to maintain levels of service.



As one example, Mark Needham and Randy Rosenberger, FES, have been researching public support, demand, and valuation of recreation on the College's McDonald-Dunn Forest near Corvallis, Oregon. "Mac Forest" is popular for recreation activities such as trail running, hiking, mountain biking, and horseback riding. The OSU College of Forestry manages this forest and has traditionally provided public access free of charge. Budget constraints, however, are making it difficult to accommodate increasing levels of use without resulting decreases in visitor experiences and resource conditions. Would visitors be willing to pay for continued access and to maintain some desired level of experience?

A study was initiated to survey visitors and examine their willingness to pay for access to the forest and their support for alternative funding sources

that could be used for generating revenue and recovering costs. Insights from research like this may be useful for other communities and states that are facing similar issues and are struggling to find a balance.

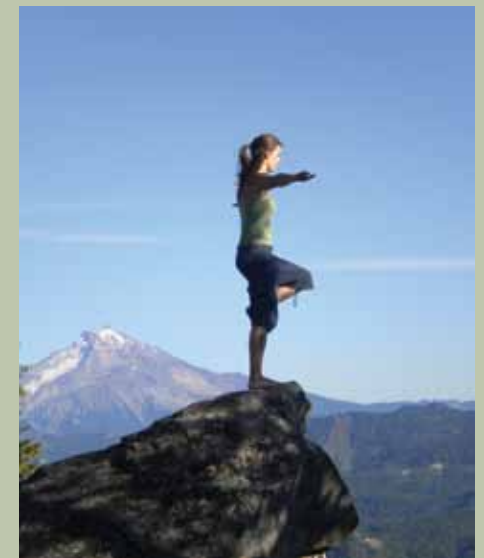


Photo credits: (left) hiking in MacDonald-Dunn forest (OSU College Forests); (top) whitewater rafting (OSU-Cascades Campus); near Gold Butte Lookout, Detroit, Oregon (Rebecca Burson, FM).



From problem to profit

The hardy *Juniperus occidentalis* or western juniper—which is endemic to the dry, rocky grasslands east of the Cascades—has heartwood that is both beautiful and enduring, fragrance that is coveted for soaps and lotions, and berry-like cones that give gin its characteristic taste. Yet despite its potential market value, this high-desert native is viewed mainly as a worrisome invader across much of Oregon's rangeland. Its dense roots suck up gallons of water, stealing scarce moisture from sagebrush, grasses and streams. Habitat for wildlife and forage for livestock are becoming lost or degraded. Ranchers are fighting back, downing the trees with chainsaws and tractors. Much of the wood remains where it falls, unused.

An estimated 6.5 million acres of private and government lands in Oregon are classified as juniper savanna or juniper forest. That's up from just 1.5 million in the 1930s. Suppression of wildfires on rangelands has allowed young seedlings to survive and flourish in recent decades. Yet despite the abundance—and landowners' eagerness to be rid of it—juniper occupies a very small place in Oregon's wood-products industry. Transforming juniper from problem to profitability is the vision of OSU forestry student Steve Ashley. Cultivating new markets for juniper products could benefit not just Oregon's ranchers but also its mills, builders, landscapers, furniture makers, garden centers, retailers and enterprises in specialty niches such as essential oils, craft distilleries and animal bedding, he says.

And then there's the growing demand for sustainable energy. Juniper is a sizeable source of biomass just waiting to be tapped, Ashley asserts. So what's getting in the way? That's the question Ashley explored for his senior thesis in the Wood Science and Technology program with guidance from his adviser, Scott Leavengood, WSE, Director of OSU's Wood Innovation Center (OWIC). In his study, Ashley makes recommendations for expediting the western juniper market, including using alternative harvesting methods such as mule or horse logging and creating a "value added" product such as wood chips right on the harvesting site.

His vision for juniper in Oregon centers on its "green" assets. "The ecological effects of removing western juniper have yielded great results in increasing stream flows and native grasses," Ashley says. The ranchers he interviewed have seen "drastic ecological changes" after cutting juniper on their land. Besides reviving ecosystems, harvested juniper can be used in all sorts of green products, from long-lived fence posts and landscape timbers that don't need to be treated with chemicals to pellets for woodstoves to biofuels for energy generation.

Excerpted from an article in *Terra*, by Lee Sherman, Steve Ashley (WST, '10).
Photo credit: Donna Barnes

Toward energy security

Woody biomass will play a part in our nation's drive toward energy security—and collaborative work by more than a dozen FRL faculty and students across departments will help us get there. Research is underway at the CoF/FRL on many aspects of this renewable material, from efficiencies in collection and transportation to the environmental impacts of processing and use, and from technological improvements in conversion to heat and energy to updated regulations to ensure consumer health and safety.

Leading the CoF/FRL research efforts is David Smith, WSE, who sees the use of woody biomass as a tool to stimulate rural economic development in Oregon communities. Smith's proposal to reopen closed sawmills by converting them into biomass processing centers that convert logging slash and small wood reclaimed from stewardship projects into higher value products and engineered fuels has been well received by diverse groups, including the Clatsop Forestry & Wood Products Economic Development Committee, Sustainable Northwest, Oregon Forest Industries Council, Rebuild Vernonia, the Oregon House Business and Labor Committee, private forest landowners, and biomass processing companies. Smith, who teaches upper division courses in bioenergy and environmental impact for the College of Forestry's new Renewable Materials program, is a part of statewide planning efforts aimed at defining Oregon's niche in bioenergy. He is also helping to design a wood-fired heating system to be installed in the newly rebuilt Vernonia School system, with support from the U.S. Department of Energy and Federal Emergency Management Agency.

Among other CoF/FRL researchers involved in woody biomass projects are Claire Montgomery, Loren Kellogg, John Sessions, Glen Murphy, Joshua Clark, Fred Kamke, Jesse Paris, Adam Scouse, and Josef Weissenstein. Their projects include examining the impacts of forest restoration and fuel reduction treatments on communities that may receive woody biomass for processing, increasing the efficiency of biomass collection and transportation, finding cleaner and more efficient methods for converting biomass to steam and energy, and investigating the use of western juniper, an abundant and "green" potential source of woody biomass, for sustainable energy production.

This BRUKS Mobile Chipper is producing uniformly sized fuel chips from logging slash. It is one of several new technology options for the economical reclamation of biomass fuels from steep slopes. Photo credit: David Smith, WSE.



Saving resources

The art of wood preservation plays an unheralded but absolutely critical role in helping to maintain our forests for their many benefits, while simultaneously meeting the world's growing demand for wood and fiber. Without preservation, many wood products in our homes, decks, bridges, power poles, railroad systems, shipyards, and industries would fail within a few years because of weathering, fungi and decay, insects, marine organisms, and even birds. Without preservation, the financial and environmental costs of replacing these products regularly would be staggering.

The CoF/FRL's Wood Biodeterioration Lab under the leadership of OSU Distinguished Professor Jeff Morrell, WSE, is responsible for the longevity of many common wood products. This world-renowned research program works in conjunction with companies and government programs to ensure that wood preservatives provide durability without adversely affecting the environment. "Keeping wood in service also lessens the demand for new wood to be cut," notes Camille Freitag, a plant pathologist and mycologist who supervises the lab's research team.



Photo credits: (left) Connie Love, WSE, applying a granular fumigant to a Douglas-fir pole stub at Peavy Arboretum (Randy Gross); (top) Camille Freitag, WSE, with student worker Sean Hayes (ME) preparing samples for the x-ray fluorescence analyzer in the Wood Biodeterioration Lab, Richardson Hall (Bryan Bernart, FCG).



One of the biggest impacts of the program has been the development of remedial treatments for wood poles and other large timber structures. Nearly all of the internal remedial treatments in use in the U.S. were developed through OSU research. These preventative treatments extend wood pole life, reducing the need to harvest trees and literally save consumers billions of dollars in electricity costs each year. The lab works closely with the Utility Pole Research Cooperative, which currently has 19 members from utility companies throughout North America. In 2010, the lab added the Environmental Performance of Treated Wood Research Cooperative, which is focused on wood used in marine applications.

Although the primary aim of improving wood durability has not changed over the past century, the Wood Biodeterioration Lab has recently added new research techniques such as DNA sequencing to identify organisms within wood, particularly fungi. The lab also has expanded research to include work toward improving the durability, and therefore value, of second-growth timbers, such as cedar and redwood by using organic chemicals that do not alter the natural beauty of the wood.

Sometimes research isn't all that is needed to address an issue; just providing information can be a powerful tool to help solve a problem. An example is sapstain—the dark blue, moldy-looking discoloration of logs, lumber, and other wood products.

Fungal stain has been a problem for decades and the CoF/FRL has long been involved in research to help control it.

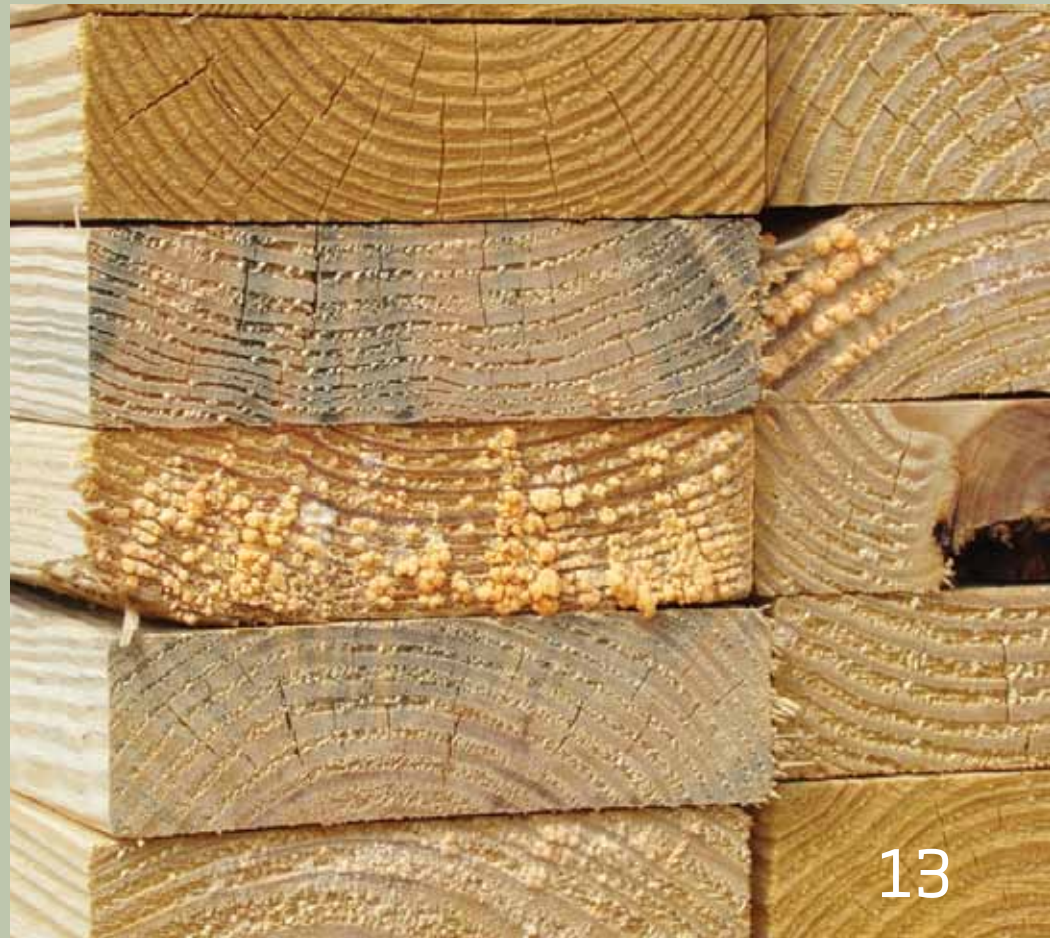
Recently, however, the problem has become especially important. The burst of the housing bubble virtually froze home construction, leaving millions of board feet of logs and lumber across the supply chain with nowhere to go. The longer this material remained wet, the higher the risk of fungal attack. At the same time, concerns about the presence of mold and, to lesser extent, fungal stain, led retailers to be increasingly sensitive to the presence of any growth on their wood. The problem added stress to an already shaken production system.

There are many solutions to the sapstain problem—if one knows where to look. The role of the CoF/FRL has been to work with lumber producers in Oregon to help them identify the proper solutions for their problems. A highlight of the effort was a one day workshop sponsored by the Oregon Wood Innovation Center. The program began with presentation by Lee Miller (Miller Timber Services) on how long logs remained in the woods before they reached the mill, followed by a discussion of how landowners perceive their role in the problem by Jerry Anderson (Forest Capital Partners). It culminated with presentations by David Stallcop (Vanport International) and Steve Harms (Weyerhaeuser).

The goal of the workshop was to help producers identify how they could move materials through the system most efficiently to reduce the risk of stain, and, when that is not possible, how to control the problem. Eighty-five attendees representing 22 producers participated in the program, which should help make Oregon's sawmills more competitive in the marketplace.



The OSU aquatic co-op is studying the impact of treated wood such as this heavily colonized piling in Sooke Basin, BC (Dr. Kenneth M. Brooks); mold on stored wood (top right, Paul Merrick); and sapstain in freshly cut lumber (right, Jeff Morrell).



Our green future



The “green building” industry is expected to grow rapidly over the next decade and promises to be an important new market for Oregon producers of wood building materials. Green building is not only the use of sustainable materials in construction, but design that calls for efficient use of resources over the life cycle of a structure. A more sustainable society requires that we use more renewable materials to make the products we need rather than continue to depend on oil and other non renewable materials. Renewable materials, such as wood, bamboo, straw and other plant based goods, are used in the manufacture of building products, textiles, paper and countless other items that are a part of our everyday lives.

The CoF/FRL's new Renewable Materials degree program is designed to fill a growing demand for professionals in the manufacture, marketing and utilization of materials derived from sustainable natural resources. CoF/FRL faculty not only are educating and training the next generation of sustainability professionals, but are leaders and innovators in the use of green, renewable materials and products to enhance local, regional, and global sustainability.

Cleaner air, lower costs

CoF/FRL research and outreach is decreasing emissions from lumber drying and maintaining Oregon manufacturing competitiveness. The plumes of steam coming from kiln drying of green lumber at sawmills contain lots of water and some volatile organic compounds (VOCs). VOCs such as methanol and formaldehyde are listed by the EPA as hazardous air pollutants subject to control under the 1990 Clean Air Act Amendments. Lumber manufacturers must demonstrate to regulators and the public that their operations meet standards for protecting air quality, while minimizing costs so they can stay competitive with foreign producers. Research conducted by Michael Milota, WSE, of the CoF/FRL provided the scientific basis for new emission regulations that ensure environmental safety at minimal cost. The research is credited with saving smaller Oregon lumber manufacturers \$15 to \$20 million in unnecessary regulatory expenses. Milota annually teaches a short course to Oregon dry kiln operators about his research and how to reduce emissions and maximize quality and profitability. The economy benefits from a competitive wood products industry, especially in rural communities, and all Oregonians benefit from improved air quality.

CoF/FRL partners with NSF and Oregon BEST in new \$2.2 million center for wood-based materials

Oregonians are global leaders in green building practices and technology that foster sustainability. Innovation is essential for Oregon companies to remain successful in the intensely competitive international green building products sector. A new OSU Green Building Materials Research Center and a companion NSF-industry/university research cooperative based at the CoF/FRL and at Virginia Tech will help create improved forms of advanced engineered composite materials. Center research will focus on science and technology leading to new, green wood composites and adhesives. Research is expected to bring advances in reduced costs, improved performance, new products, material recycling, and more environmental sensitivity. Fred Kamke, Jeld-Wen Chair of Wood-based Composites Science, WSE, a leader in wood-based composite materials research, is the site director for the Green Building Materials center and laboratory. The new laboratory benefitted from startup funds provided by Oregon Built Environment and Sustainable Technologies Center (Oregon BEST) and the National Science Foundation.



Fred Kamke. Photo credit: OSU News & Communications.



Greener homes, greener highways, greener economy

A revolutionary adhesive developed at the CoF/FRL creates jobs and reduces hazardous emissions as well as the use of toxic chemicals in plywood manufacturing. The environmentally friendly, cost-competitive adhesive inspired by the way mussels cling tightly to rocks on the Oregon coast has generated a wave of new businesses and green products that have reduced formaldehyde emissions by over 90% in mills and homes. Using mussel adhesive protein as a model, Kaichang Li, WSE, worked collaboratively with private industry to develop a unique curing agent that is able to convert inexpensive, abundant soybean flour into a superior adhesive for bonding wood composite panels such as plywood and particleboard.

The non-toxic adhesive, which won the Presidential Green Chemistry Award from the EPA, has been used to produce more than 30 million hardwood plywood panels for the green building industry in the last four years. New products made from the adhesive have allowed manufacturers to maintain 1,700 jobs in four states, including Oregon, during the economic downturn.

Travelers along Oregon's scenic highways may gaze out their car windows and see lush forests, clear rivers, and rich farmlands. Lech Muszyński, WSE, sees all that and more, such as new jobs based on renewable materials and a market for the woody biomass produced from forest thinning for fire prevention.

At the CoF/FRL, Muszyński is researching the use of wood-plastics composites in many common products, including those found along Oregon's roads and highways. Snow fences, traffic signs, mile posts, guardrails, sound barriers, dividers, and even bright orange traffic cones are currently made from non-renewable resources. Wood-plastic composites containing up to 70 percent biomass instead of petroleum-based plastics may eventually be used to manufacture many of these products.

This CoF/FRL research project has attracted interest not only from Oregon Department of Transportation's Sustainability Coordinator, but from rural community leaders because it may open the window to new employment and economic opportunities in the sustainable wood composites industry.

Photo credits: (left) Kaichang Li (OSU News & Communications); Lech Muszyński (Danniell White, WST). (facing page) 9Wood representatives Nathan Pfeifer and Jonathan Gates (WST, '10) present a check to Scott Leavengood and Tom McLain (WSE).



Innovation, partnerships key to sustainable business development

In the midst of the recession, Jonathan Gates (WST, '10) went right to work after graduation as a research and development assistant for 9Wood Inc., an innovative wood-products company in Springfield, Oregon. Founded in 2004, 9Wood continues to grow, now employing 60-70 employees and producing nine product lines. The company, which recently won an award for its efforts toward encouraging sustainability, is working on new research involving certified Pacific Albus.

Gates credits his education at the College of Forestry for helping him succeed in what he considers an ideal job at a forward-looking company. "Everything about the program does an awesome job of preparing students to be involved in an amazing industry," he says, "not only what you learn but how it's taught. I can't speak more highly about that."

Gates made a trip back to Corvallis recently, along with 9Wood representative Nathan Pfeifer, to present the CoF/FRL's Oregon Wood Innovation Center (OWIC) with a donation from 9Wood. The donation is a contribution toward the development of future graduates and will help increase their practical experience before graduation. For OWIC Director Scott Leavengood and Assistant Director Chris Knowles, both of WSE, the check was a welcome reminder that the industry appreciates their knowledge and efforts to encourage and promote innovation. Innovation is crucial in the industry, Pfeifer points out. By giving back to OSU,

9Wood hopes to encourage improvement not only in their company but also in their competition, thereby strengthening the industry. "Everybody wins when knowledge is gained and movement is made," Pfeifer says.

Pfeifer and Gates both support the recent change in the College of Forestry's degree program from Wood Science & Technology to Renewable Materials. "Change is necessary as you push forward," Gates says, "and the change toward renewable materials makes sense. The curriculum has to be structured so that students are prepared for the future and the College of Forestry is doing just that." It's essential to make changes to stay current in industry, Pfeifer agrees. "You have to think about what owners and architects will want. They want green, they want certified. Ten years ago we would hardly see a project that is specified as certified and now it seems like every other one is. That's just one indication of how the industry is moving when it comes to sustainability," Pfeifer says. "It's about trying to find how to be profitable and still be sustainable, which is part of our core values."

All of these changes add up to opportunities for undergraduates in Renewable Materials. "We're no different than other companies out there. We need people who are knowledgeable in the wood products industry," Pfeifer says. "This program is pretty unique in its focus on that—and gearing that program towards the sustainability side of things, that's really important, too. As for students such as Jonathan, I could use three more of him!"

Our students



For many students, a successful career after graduation means personal satisfaction and financial security. For College of Forestry students, however, it also can mean making a tangible contribution to the well being and future of people around the world. As the world population grows, already complex natural resource issues will multiply and so will the need for well-educated professionals who not only understand these critical issues, but can help with solutions.

It takes a large measure of confidence as well as a good education to enable graduates of any program to succeed. What provides this winning combination for our students? It's the teaching, guidance, support and encouragement they receive from the world-renowned faculty of the CoF/FRL — and the confidence they gain through active participation in research and learning experiences beyond the classroom. Whether conducting research in CoF/FRL laboratories or Oregon's forests, interning in industry or government, presenting research to congressional aides or at professional conferences, taking a semester abroad, or serving as volunteers, our students are engaged and involved, in Oregon and around the world.

Against all odds

Is it possible to create a management plan for Oregon forests that includes more logging and significantly more funds for timber-dependent counties, while protecting old growth, curtailing clear cutting, providing for ecological services such as carbon storage, diverse habitat for songbirds, butterflies, deer and elk?

Yes, according to forestry students under the guidance of OSU Distinguished Professor K. Norman Johnson, FES. The students' proposal has potential to help break years of political gridlock over the management of public lands in western Oregon, while serving some important ecological and economic goals. The innovative proposal, which has been presented to the staffs of several Oregon political leaders, provides a possible way forward that would produce a sustainable and predictable level of income for counties.

Photo credits: (left) bark beetle research crew, Pringle Falls Experimental Forest, Oregon (Garrett Meigs, FES); (top right) students David Linton (WSE/CE) and Bill Kirkham (WSE/CE) building residential roof truss assembly before testing (Rakesh Gupta); (right) forestry students Elizabeth Bly, FM, and James Crawford, FE (OSU News & Communications).





Ramona Arechiga and friends during an Oromo holiday in Addis Alem, Ethiopia.
Photo credit: Tracy Hruska.

Oregon and beyond

A remote community in Bale Mountains National Park in Ethiopia is the place Ramona Arechiga will call home for the next two years. Arechiga, a graduate student in Forest Resources under the guidance of John Bailey, FERM, is the first OSU student to join the Peace Corps Master's International (PCMI) program offered through the College of Forestry. The PCMI program was established at OSU in 2009 and is available for all College of Forestry graduate students interested in gaining hands-on experience and conducting research in conjunction with serving in the Peace Corps.

Arechiga, along with her husband, Tracy Hruska, has just begun an assignment in Rira, in southern Ethiopia, where the major ecological issues stem from the clearing of local forests. In addition to assisting with several natural resource management issues, she also will undertake related research on silviculture and sustainability as part of her master's program. "Rira is largely dependent on subsistence farming, livestock grazing, and unsustainable resource extraction from the Park," Arechiga says. "We would like to support Rira in finding non-timber forest products to provide alternative livelihoods for the community."

Arechiga originally planned to study how to develop a set of indices that will help evaluate the sustainability/adaptability of managed forests. However, she is now leaning more towards researching how to determine a sustainable harvest of fuelwood for communities dependent on the park's forests. This is a "sticky wicket," however, because Rira itself is an illegal settlement—and one that is exploiting the resources of the park at an alarming and expanding rate every year.

One goal is to try to help find a way for community members to meet their resource needs without compromising BMNP policies. "Ideally we would like to start a community forest for the town to meet its fuelwood needs, but we may not be able to find support for that project, especially since the most popular tree species (i.e., the fastest growing) are all non native," she says. "We are thinking of trying to start a small native tree nursery in part of our compound and hope to find some support for that."

Other possible projects include local honey production and marketing for Rira as a community, and the development of community bread or injera ovens, which would limit some of the need for large quantities of fuelwood and also provide a direct benefit for having a community forest, Arechiga notes. Although she has been in Ethiopia just a few months, she has already witnessed the struggles of those trying to provide for their families against current forest policies, as well as the impacts of unsustainable practices on the forest resource. When she returns in two years, she intends to work on public forest policy in the United States after completing her MS degree.

Natural Resources online

Graduate education in natural resources management has gone global with the addition of the new Master of Natural Resources degree offered through the College of Forestry and OSU ECampus. The interdisciplinary program went online in fall of 2010 alongside the existing undergraduate degree program. Director Badege Bishaw notes that the timely new program “facilitates learning by natural resource professionals who work in settings that require integrating multiple disciplines to find solutions to complex natural resources problems.”

This collaborative effort, for which 5 other colleges and 12 departments also provide support, enables students to explore multiple areas of natural resource management, including ecological, social, economic, and ethical issues; sustainable natural resources, fisheries management; water conflict management; and geographic information science. “Growth in human population and affluence of well-educated people over coming decades will place ever more pressure on the world’s natural resources—water, wood, flora, fauna, food, air, and open spaces,”

“The twin challenges of this century will be to sustain Earth’s life support systems and improve social justice at all scales in meeting human needs under these increasing pressures, says Hal Salwasser, dean of the College of Forestry. “This degree will prepare its graduates to tackle those challenges.”

Dream job

Stephanie Root joined the College of Forestry as a distance natural resources student in fall 2007, after attending several other colleges. With her husband serving as a captain in the Marine Corps, Root has lived in Virginia, Florida, Hawaii, and California. “The distance education program in natural resources seemed like a great fit for me because of all that moving around—and I’ve always felt that Oregon State is a superior university and it is well known for its excellent forestry programs.”

After graduation, Root secured an internship working with wildlife through the Student Conservation Association (SCA) at Joshua Tree National Park, where her primary focus was the threatened desert tortoise. Her other work included surveying and monitoring the nesting activities of raptors such as the red-tailed hawk and golden eagle, surveying mines for bats, conducting point-count surveys for ravens, and assessing human visitor impacts at water sources frequented by bighorn sheep. She also worked on vegetation projects in the park, including species surveys, soil compaction and crust analysis, and plant propagation in the Center for Arid Lands Nursery.

Root then interned as a wildlife specialist with the Guantanamo Bay Naval Station resources department at Guantanamo Bay, Cuba, where she conducted population surveys on hutias, boas, manatees, and iguanas, and recommended revisions to current policies regarding wildlife.

She has now returned to Joshua Tree National Park. “I am really happy I chose natural resources as a major,” Root says, “because the coursework is the perfect blend of science and policy, which has helped me in my career.”



Top: Online at an Internet cafe. Photo credit: Danielle White, WST. Bottom: Stephanie Root, (NR, '09) with “George” a participant in a study on desert tortoise movements in Joshua Tree National Park. Root is preparing to change George’s transmitter. Photo credit: Kristen Lalumiere.



Jeff Wimer oversees members of the OSU Student Logging Training Program on site in McDonald-Dunn Forest. Photo credit: Talia Filipek ('10, NR).

Additional Highlights and Impacts

Research

- ◆ CoF/FRL faculty obtained a total of \$16,286,776 in extramural funding in FY 2010: \$14,568,574 from 135 grants and agreements and \$1,718,202 through the 11 research cooperatives.
- ◆ CoF/FRL maintained distinction as one of 12 national Wood Utilization Research Centers. With a mission to enhance industry competitiveness and renewable product innovation, and educate future scientists, the Center leverages federal funding by 2.5X with other grants and contracts.
- ◆ CoF/FRL scientists are collaborating on a \$5.5 million American Recovery and Reinvestment Act project with OUS Institute for Natural Resources and Forest Service partners to develop landscape-level information and tools that will help land managers in Oregon, Washington, New Mexico and Arizona identify high priority watersheds for cost-effective restoration and rural community economic benefit.
- ◆ Swiss Needle Cast Research Cooperative scientists have synthesized knowledge about the disease and released an integrated pest management strategy aimed at mitigating its ecological and economic impacts.
- ◆ Tree Biosafety and Genomics Research Cooperative research has doubled the rate of growth of poplar trees in the greenhouse. Given potential uses for biofuels, pulp, plywood and environmental services, accelerating its growth will significantly shorten maturity cycles and increase economic returns.
- ◆ CoF/FRL scientists were instrumental in competing for a new Department of Interior climate change research center to be located on the OSU campus.
- ◆ CoF/FRL scientists completed a biomass availability and cost assessment for northwest Oregon, and developed supply curves for cogeneration facilities in six northwestern Oregon locations. This and other studies conducted within the college are helping make biomass energy production a viable economic undertaking.
- ◆ CoF/FRL scientists are collaborating with Portland State and Washington State Universities and multiple agencies in Portland/Vancouver on an NSF planning grant to study how governance and policy impact urban social-ecological systems. Team strengths in urban ecosystem research and in broader regional environmental context enable intensive study within the urban areas as well as regional integration of results with the HJ Andrews LTER and the Wind River Experimental Forest NEON.
- ◆ Dr. Beverly Law led a National Research Council report on methods for verifying greenhouse gas emissions for international agreements. The team provided recommendations for reducing uncertainty in emissions estimates, including emissions from agriculture, forestry, and changing land use.

- ◆ The team of CoF/FRL researchers associated with the National Science Foundation Long Term Ecological Research (NSF-LTER) program at the H.J. Andrews Experimental Forest received the 2010 American Institute of Biological Sciences Distinguished Scientist Award. The Andrews Forest is a living laboratory that provides unparalleled opportunities for the study of forest and stream ecosystems
- ◆ The Northwest Tree Improvement Cooperative led by Keith Jayawickrama, FES, initiated a historic third cycle of breeding and testing coastal Douglas-fir and western hemlock with five new grafted breeding orchards. The first cycle began in 1966.
- ◆ Robin Rose, FERM, constructed and tested an *in situ* freezer to determine the cold hardiness of seedlings in nursery beds, the first time this has been attempted. If it can be made operational, the freezer will enable nursery managers to determine suitability of lifted seedlings for storage from field tests rather than sending seedlings to a testing lab.
- ◆ Claire Montgomery collaborated with Institute of Computational Sustainability scientists at Cornell to apply cutting-edge methods to determine how to optimally place fuel reduction treatments on a forested landscape.
- ◆ Mark Needham studied shore-based whale watchers who participated in the “Whale Watching Spoken Here” program along the Oregon coast and found that participation fosters an environmental ethic that makes people more aware of the

consequences of their own personal actions on animals and ecosystems.

Outreach Education

- ◆ Ties to the Land, an award-winning educational program focused on intergenerational transfer of family forests, expanded its scope nationally. This collaborative public/private effort includes OSU Extension, OSU Austin Family Business Program, the American Forest Foundation, and the Forest Service.
- ◆ The Oregon Natural Resources Education Program engaged 1,158 K-12 educators from 24 counties in Oregon in developing sustainable natural resources and forestry education curricular materials.
- ◆ The Oregon Wood Magic Program and the Wood Magic Traveling Show reached 27,380 students, teachers, and parents at public and private schools throughout Oregon. This science-based educational program about wood includes lesson plans and teaching materials for teachers.
- ◆ The CoF/FRL is a supporter of the emerging ScholarsArchive@OSU to enhance open access of journal publications by faculty and students. OSU’s archive tracking system reported that research articles and reports by Forestry authors were viewed over 49,000 times in 2010 by researchers from 147 different countries.
- ◆ The new Pest Scene Investigator Program expanded educational offerings with a focus on Swiss needle cast and mountain pine beetle epidemics and a new,

OFRI-funded publication “Managing Insects and Diseases of Oregon Conifers.”

- ◆ The Oregon Master Naturalist Program, a collaborative effort between Extension Forestry and Natural Resources, Agricultural Sciences, 4-H, Oregon Sea Grant, and the Oregon Departments of Forestry and Parks and Recreation, completed its first year with a draft statewide online curriculum.

Students

- ◆ CoF/FRL and departments awarded \$354,000 in UG scholarships and \$275,760 in graduate fellowships to students last year.
- ◆ CoF students were national “quiz bowl” champions at the Society of American Foresters Convention in 2009.
- ◆ “SEEDS” (Strengthening Education and Employment for Diverse Students) was initiated to recruit, support, and retain ethnically underrepresented students in forestry and natural resources. SEEDS received a \$30,000 contract from BLM and a \$191,000 2-year grant (ARRA) from the Forest Service.
- ◆ Two NSF-funded Research Experience for Undergraduates (REU) programs provided opportunities for more than 20 undergraduate students at the Andrews Forest.

Commercialization

- ◆ Four CoF/FRL faculty—Kaichang Li, Joe Karchesy, Lech Muszynski, and Mike Milota—and colleagues applied for or were awarded patents in 2010.

Research Cooperatives

Center for Intensive Planted-forest Silviculture (CIPS)

Center for Wood-Based Composites

Environmental Performance of Treated Wood Research Cooperative (OSU Aquatic Co-op)

Hardwood Silviculture Cooperative (HSC)

Northwest Tree Improvement Cooperative (NWTIC)

Pacific Northwest Tree Improvement Research Cooperative (PNWTIRC)

Swiss Needle Cast Cooperative (SNCC)

Tree Biosafety and Genomics Research Cooperative (TBGRC)

Utility Pole Research Cooperative

Vegetation Management Research Cooperative

Watersheds Research Cooperative

Selected Research Programs

Center for Wood Utilization Research (WUR) at Oregon State University

Fish and Wildlife Habitat in Managed Forests

Forest Sector Market Modeling

H.J. Andrews Experimental Forest Long-term Ecological Research (HJA LTER)

Institute for Water and Watersheds (IWW)

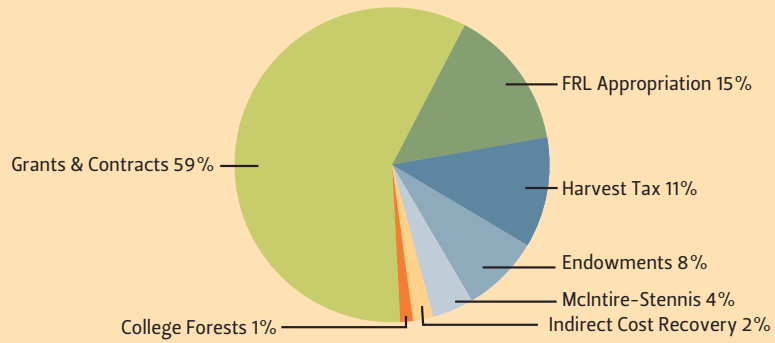
Laboratory for Applications of Remote Sensing in Ecology (LARSE)

Oregon Wood Innovation Center (OWIC)

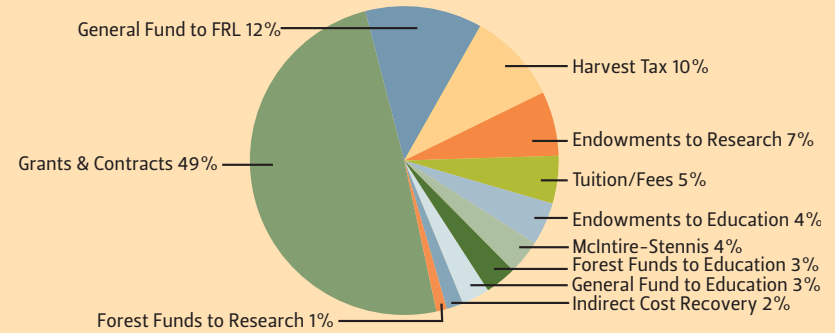
Terrestrial Ecosystem Research and Regional Analysis group (TERRA-PNW)

Trophic Cascades Program

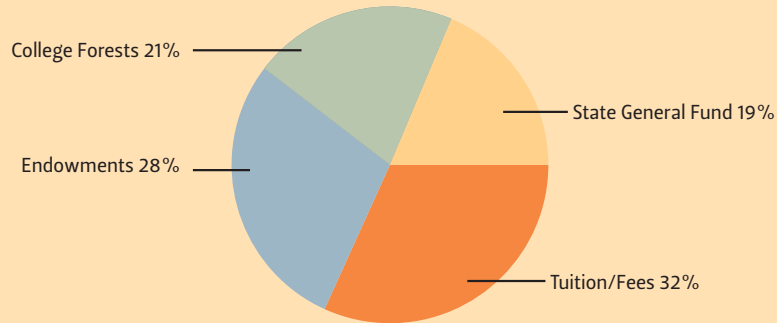
FRL Expenditures, FY 2010 \$21.7 million



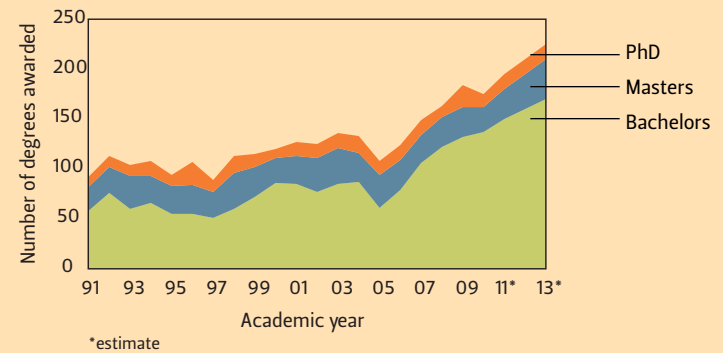
CoF/FRL Expenditures, FY 2010 \$25.7 million



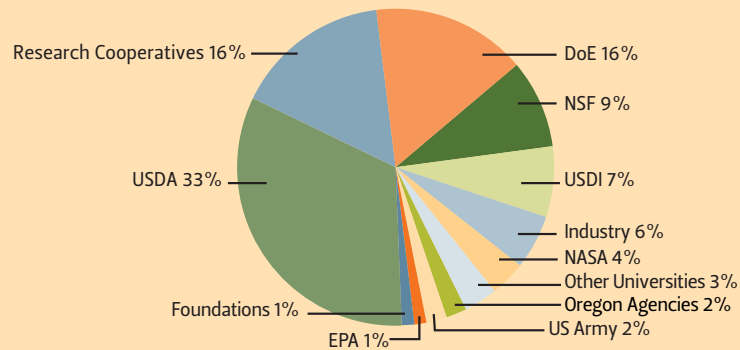
CoF Education Expenditures, FY 2010 \$4 million



CoF Graduates



FRL Grants & Contracts, FY 2010 \$12.7 million



Our Three Keys to National and International Prominence

Recognition as one of the top forestry and natural resources programs in the world is dependent on the efforts of our faculty and staff who serve multiple roles to seamlessly integrate the three mission areas:

College of Forestry

The College of Forestry fulfills the academic mission. Undergraduates are provided professional level education that prepares them for tomorrow's workforce, and as informed citizens. Their classes are taught by the same scientists whose research encompass a broad range of disciplines relating to multiple uses of forested environments and their resources. Graduate students receive additional education and training to become the next generation of scientists, academics and policy leaders. Their instruction centers around the identification and completion of research projects that are supervised by expert faculty.

www.forestry.oregonstate.edu

Forest Research Laboratory

The Forest Research Laboratory is the research component of the organization. The FRL is a dynamic source of knowledge about the science and management of forested landscapes, the connections of people to forests and natural resources and the innovative and efficient use of renewable materials to benefit businesses, communities, and the quality of life in Oregon. The same scientists who teach our students work in labs and forests with cooperators throughout Oregon, the Northwest and the world. It is this role that earns the FRL recognition as one of Oregon's Statewide Public Service Programs. They're solving real problems for real people where they live and work.

www.forestry.oregonstate.edu/frl

Forestry & Natural Resources Extension Program

The Extension Program exists to extend the knowledge of our faculty and scientists to the people of Oregon. The quest for knowledge grows from the ground up, from Extension to research and back again. Here's how it works: OSU Extension faculty work in all Oregon counties with business people, landowners, foresters, individuals, and community leaders. They see first-hand what's needed in Oregon's business sectors and communities. Extension experts collaborate and consult with scientists on the OSU campus where they help focus research on critical issues and timely results. Knowledge developed from that research is brought back to the local community through Extension's outreach and engagement programs and publications.

extensionweb.forestry.oregonstate.edu



