BIOFUELS AND NUTRIENT BENEFITS OF SLASH RETENTION

Is There a Place for Woodland Owners in the Biofuels Industry?

Hybrid Poplars for Fuel

From Biomass to Jetfuel

Is Biomass a Future Market in Montana?

Maintaining Site Productivity During a Biomass Harvest

NEXT ISSUE . . .
Owning Forestland: What’s Next?
TABLE OF CONTENTS

FEATURES

IS THERE A PLACE FOR FAMILY FOREST OWNERS IN THE BIOFUELS INDUSTRY?
Get up to speed on the biofuels industry and learn what your state is doing to support biomass utilization.
BY MATT KRAMENAUER

HYBRID POPLARS FOR FUEL
A $40 million project will convert short-rotation hybrid poplars to liquid biofuels such as gasoline, diesel, and jetfuel.
BY KEVIN W. ZOBRI

NARA: RESIDUAL WOODY BIOMASS CONVERSION TO BIOJET FUEL AND OTHER PRODUCTS
Learn about the efforts of the Northwest Advanced Renewables Alliance to explore a viable aviation biofuels industry in the Northwest, as well as the science behind converting woody tissue to other valuable products.
BY CHARLES BURKE

IS BIOMASS A FUTURE MARKET FOR MONTANA?
Western Montana has been chosen as a pilot community for a woody biomass utilization and potential jet-fuel conversion analysis. Find out how this community came together to support the local wood products industry.
BY PETER KOLB

IS A BIOMASS SALE POSSIBLE FOR SMALL WOODLAND OWNERS?
A practical look at a biomass harvest. Will it pencil out?
BY BILL HERMANN AND HARRY BELL

MAINTAINING SITE PRODUCTIVITY DURING BIOFUEL HARVEST OPERATIONS
Demand for biomass for bioenergy products is expected to increase in the years to come. Is there a contradiction between the development of new biofuels markets and the impact of that increased utilization on soil nutrient cycling?
BY DEBORAH PAGE-DUMROESE AND MARK KIMSEY

ALSO IN THIS ISSUE . . .

24 Disconnect Your Roads (from Streams)!

27 Forestry Leadership Academy Slated for January

DEPARTMENTS

3 Presidents’ Messages

6 Down on the Tree Farm

28 TreesMarts

30 TreemAN Tips

ON THE COVER:

Advanced Hardwood Biofuels Northwest is a $40 million project to develop a system to convert hybrid poplar into biofuel.

STAFF:
LORI D. RASOR, Editor
MICHELE DOCY, Assistant
4033 S.W. Canyon Rd.
Portland, OR 97221
503-488-2104
rasor@safnwo.org

MINTEN GRAPHICS, Graphic Design

Northwest Woodlands Advisory Committee Members:
Mike Barsotti
Rick Dunning
Chuck Higgins
Jim James
John Poppino
Lori Rasor
Ed Styskel


Other than general editing, the articles appearing in this publication have not been peer reviewed for technical accuracy. The individual authors are primarily responsible for the content and opinions expressed herein.
Some Benefits of Slash

For this issue I am filling in for our president, Steve Stinson. Steve is experiencing an unexpected fight against Leiomyosarcoma cancer. Our prayers and positive thoughts continue to go out to him and his family, and we all look forward to his return.

Having spent my career as a private-sector forester and active hands-on fourth-generation tree farmer has given me a sound background in most aspects of forest management.

As tree farmers, using forest biomass for renewable energy is nothing new, we just call it firewood. Many of you, like our family, use firewood for heating our homes and may also sell it to supplement tree farm income. We have our favorite firewood species and know which one provides the most BTUs. As we have all said, cutting firewood actually heats us several times. Whether salvaging tops and low-value wood after a harvest from storm damage or from thinning our trees to improve the stand, harvesting our own fuel wood is rewarding hard work that improves our tree farms. We know our lands well and understand that retaining some scattered slash provides nutrient benefits to the soil as it quickly decomposes. Precommercial thinning slash may seem like a waste, but the benefits of letting it decay usually outweigh the cost of removal. Slash may be an “eyesore” to some not understanding its numerous other benefits like providing erosion control and excellent habitat for a variety of living organisms, and offering some protection for new seedlings.

Tree farm owners look for a variety of available markets for the products we grow. Several years ago our area experienced an increased demand for hog fuel. Contractors were actually willing to travel some distance into the woods to remove and grind biomass (landing slash piles). Some landowners were even paid a small amount or at no cost were able to get rid of landing piles without having to burn them. This market was limited sharply after a large, hog-fuel-utilizing pulp mill closed permanently.

Continued reductions of the forestland base available to harvesting have shrunk the timber industry manufacturing infrastructure and the markets for our wood. We’re not holding our breath, but are wishing biofuel and other technology may help revive the needed infrastructure and create a demand for biomass that offers a return for the landowner. A competitive market place is always a better way to have lasting markets, rather than one that has to be supported by another’s taxes. Tree farmers are open to learn about new innovation and market opportunity, but in the mean time can utilize our sustainably grown biofuel to heat our homes and our neighbor’s. We can also learn why retaining some slash may be the best option on smaller acreages for keeping our forests healthy. As my dad would say referring to his trees, “Keep’em growing.”

Buying Douglas Fir and Red Cedar Poles

A professional staff providing the most productive way of bringing your Poles to market.

Services include:
- Pole marking
- Quality control during harvest
- Free estimates

- Facilitate access to certified Pole Loggers and Haulers
- Buying Douglas Fir and Red Cedar Poles

Forestland For Sale
Mark.Willhite@juno.com
World Forest Investment.com

You can also visit us at www.ldm.com
I have had an interest in forest nutrient management, both personally and professionally, for many years and have witnessed various interpretations of its importance among government, industrial, and small private landowners.

Over the years, we have gone from leaving everything in the woods that wouldn’t make a sawlog, including all longbutts, to skidding everything that would make it to the landing, including tops. Along the way some landowners decided that after skidding to the landing they would then drag slash back into the woods after processing it in an effort to return nutrients back to the site.

Everything we do comes at a cost, so landowners must make their own decisions. Cut-to-length/forwarder operations allowed landowners to leave nearly all unmerchantable material in the woods, but logging costs were generally higher than conventional feller buncher/grapple skidder—so again, one has to balance costs.

A recent paper in the 2012 journal *Forest Ecology and Management* titled “Effects of Organic Matter Removal, Soil Compaction and Vegetation Control on 10th Year Biomass and Foliar Nutrition: LTSP Continent Wide Comparisons,” may not be the final word but it is the most current. It is dangerous to summarize a 21-page article in a few sentences, but here are a few highlights that surprised me.

The study looked at over 100 long-term site productivity (LTSP) studies throughout the U.S. and Canada on numerous soil types. Only two sites were located in Idaho (Council and Priest River) with none in Washington or Oregon, so don’t extrapolate the results too far. The study suggests that on most forest sites slash removal had minimal growth impact to 10-year-old planted seedlings. Researchers also evaluated soil compaction and vegetation control, and again, results indicated that vegetation control consistently increased growth while soil compaction impacts were variable, but in my estimation less than what I would have expected.

On our own tree farm I try to leave nearly all slash in the woods during periodic harvest operations. My reasons are that my silvicultural prescription has generally been a single tree selection at fairly low volumes/acre, thus generating a low (< 3 tons/acre) slash load. I feel I can reduce skidding damage by limbing/topping in the woods and would prefer to limb in the woods with a chainsaw rather than on the landing in the dust, mud, and rocks. If I were paying a logger to do it this way, it would be more expensive, but my own labor comes cheap.

Despite research results that may be to the contrary, I still feel leaving slash better protects long-term site productivity, helps reduce soil erosion, and enhances native flora and fauna by limiting noxious weed spread. One must still balance the risk of wildfire with too high of slash loads.

Someday, economic removal of slash for biofuels may become a reality for small private landowners, but I think it is many years away in most locations. I have been involved in a number of in-woods slash grinding operations on other ownerships and the economic go/no-go threshold can change overnight based on the price of natural gas. This makes long-term planning and investment very risky for folks. It takes more time than I have left to build a productive soil structure, so I will continue to do what I can to protect and enhance the organic and nutrient inputs to my soils.
This spring our neighbor hired a logging outfit to harvest about 25 acres of second-growth Douglas-fir. Now complete, there are several large piles of slash on the gentle-sloped unit, slowly curing in the summer heat. The logger says the slash, and even some of the larger cull logs and chunks, are not worth shipping seven miles to the North Plains chip mill. According to Mark at Biomass Harvesting in Banks, the bottom has fallen out on the price for either hog fuel or wood chips. He suspects super-low natural gas prices are to blame. He’s probably right. To compound the problem, a biomass transportation cost-share subsidy has been reduced. A research paper I recently read referred to logging slash as “residual harvest biomass.” It’s interesting how time and markets change the words we use. Over a century ago logging slash was seen as a major threat to Oregon’s forest landowners. In the early 1900s, logging old-growth yellow fir left multiple tons of slash per acre, putting fear into those bold lumbermen of yesterday. Large landowners banded together to form fire protection associations to prevent, or fight, destructive fires. Slash hazards helped mold Oregon’s forest laws, defining negligence when a fire started and crossed property lines and requiring landowners to make reasonable efforts to stop fires.

Markets for slash and non-commercial forest wastes slowly developed since those days of steam donkeys and railroad logging. Wood waste became economical as a fuel to generate steam and electricity for mills, and later the power grid. Someone coined the word biomass. Twenty-five years ago I visited Biomass One, a new 30 megawatt plant in White City, Ore., with my neighbor who was a project electrician. The big issues for that plant were—and still are—fuel availability and cost.

Today a biofuel market is evolving. I had to look up “biofuel from biomass” on the Internet, which led me to NARA—the Northwest Advanced Renewables Alliance. NARA researchers are figuring out how to turn forest biomass into fuel—jet fuel. The technology is not exactly like fermenting mash into beer in your kitchen, but there are some common steps: take cellulose, introduce chemical catalysts and enzymes, then brew up isobutanol. Then you make jet fuel. Complicated, yes, but it can be done.

This nascent biofuel industry faces very difficult engineering, logistical, and cost challenges. Woodland owners can only hope this new market matures and offers a good price for biomass. Until that happens, folks like my neighbor will just go ahead and burn their slash piles.

---

Slash, Biomass, Biofuel: An Evolution
TIPS & TRICKS OF THE DAY: If you have an endangered species listed under the Endangered Species Act, you are obligated to protect it.

WHAT TO DO IN . . .

NOVEMBER

SLASH TREATMENT AFTER LOGGING: To Pile or not to Pile?

❑ Reasons to Pile:
  • Heavy slash is difficult to plant through and will cost you more for planting and you may not get the planting job you were hoping for.
  • Ips beetles like pine slash, so if you have pine slash you may need to pile and burn to avoid a beetle outbreak and possible damage to your green trees. You may create an Ips outbreak on your place if you generate pine slash early in the summer and the beetles complete a life cycle in your slash and emerge in late summer.
  • You want a clean site around your dwelling for cosmetics or for a fire break.
  • You may want to create fire barriers (breaks) along public access routes through your forest and around your buildings.
  • You like straight rows of seedlings and/or have a management plan for managing rows of trees.

❑ Reasons not to Pile:
  • Piling can be expensive.
  • Slash breaks down over time and improves your forest soil.
  • Deer and elk are opportunistic feeders and tend to browse that which is easiest to reach. Slash may help hide your seedlings and make your unit less desirable for deer and elk.

❑ Other Options and Considerations:
  • Pile just enough slash to make planting successful and leave the rest.
  • Chip the slash in your firebreak areas and broadcast your chips.
  • Don't pile next to snags that can become torches when piles are burned.
  • Pile when soils are dry to minimize compaction and make them dirt free for a clean burn. An excavator with a brush grapple works best and a dozer with a brush blade next best. A good operator improves the quality of the work done with any tool.
  • Or you can hand pile.

❑ To Burn or not to Burn:
  • Wildlife like piles.
  • Wildlife that dine on seedlings also like to hide in your slash piles. So you may need to protect your seedlings next to piles you leave for wildlife.
  • Piles take up planting space. Make small piles if you plan to leave them.
  • Landing areas tend to accumulate slash that may be marketable as biofuel or hog fuel.
  • Leave limbs in the woods if your landing clean up plan is to pile and burn.
  • Need a permit to burn.

❑ When to Burn:
  • Burn only when rains arrive. Make sure you are really wet so the fire doesn't spread from your piles. Fall is normally the best time to burn as the fall and winter rains extinguish your fire. In spring you need to make sure your fire is out.
  • Cover your piles if you think they will be tough to light after you wait for the surrounding area to be fire safe. You do not need to cover the whole pile, just an area large enough to get hot when lit. Good portions of your pile to cover would be the downhill side, the side into the prevailing wind and where you have suitable fuel to light your pile.

❑ Know the regulations regarding burning. Visit your state's fire regulation webpage to learn more:
  • Idaho: www.idl.idaho.gov/bureau/firemgmt.htm#laws
  • Washington: www.dnr.wa.gov/RecreationEducation/Topics/FireBurningRegulations/Pages/rp_burn_silvicultural_burning.aspx
  • Montana: http://dnrc.mt.gov/Default.asp#

Inspect Roads

❑ Roads are the largest source of stream sediments from managed forest properties, and according to a recent court decision, a source of water pollution.

❑ Clean your water bars and culverts, and walk your roads on a rainy day with a shovel to make sure your drainage system is working.
‘Tis The Season to:

☐ Check out your tree farm while family members are home for the holidays. This is a good way to burn up some calories. Make it a rain-or-shine-event. Pull invasive weeds while you walk along your roads and bring a shovel so you can drain puddles and touch up your drainage structures. Plant or transplant a few seedlings and check out the seedlings you planted in previous years.

☐ Harvest a holiday tree off your place. Maybe one you planted for this purpose or maybe one that is growing in the wrong place, or maybe one with poor timber genetics whose beauty will be discovered as you decorate it (your version of a Charlie Brown Christmas tree).

☐ Do some short- and long-range financial planning. When will you need cash in the tree farm account, how much and what do you have to sell to generate this revenue? Who will be responsible for managing this task?

☐ Walk the perimeter of your property and see what Mother Nature has been up to or what your neighbor has been doing.

New Year’s Resolutions

☐ Renew your membership in your local woodlands association.

☐ Attend your woodland association’s annual meeting with your family.

☐ Invite a member of your woodlands association to attend a woodland activity and offer to pick them up. This could be your newest member or a mostly inactive member.

☐ Get to know your forest neighbors.

☐ Make time for your children and grandchildren.

Planting Season: January and February are the best months for planting bare root stock forest seedlings on the westside of the Cascades.

Occupy Seattle, Occupy Portland, Occupy Your Tree Farm: Weeds occupy your tree farm. Have you ever eradicated one weed like Himalayan blackberry only to find another one has taken its place? Or applied a soil active herbicide such as Oust and later thought you had also planted Canadian thistle? Do you remember the Fall 2010 issue Northwest Woodlands piece on "Will I Get Weeds If I Log?" You will, and a recent study counted 6,000 weed seeds per square meter deposited annually. So it should be no surprise when an undesirable species occupies your bare ground. Now would be a good time to come up with a seeding mix so you decide who occupies your tree farm. You may wish to come up with more than one seeding mix, possibly one for your roads and one for your forested ground. A good place to start is your USDA Service Center which should include the Natural Resources Conservation Service Office, NRCS, and your Soil and Water Conservation District Office. Another good place to start would be your local extension forester. Have your soils information available when you call.

Favorite Forestry Websites

☐ www.fridayoffcuts.com. This is a weekly forestry newsletter out of New Zealand.


☐ Send me your favorite forestry related website and I will share the link here.
Is There a Place for Family Forest Owners in the Biofuels Industry?

By MATT KRUMENAUER

Biofuel, bioenergy, and other biomass related opportunities are getting increased attention from landowners, entrepreneurs, policy makers, and others. Developing bioenergy and biofuel projects can provide not only a local, renewable energy source, but can help improve the health and vitality of our forests and create jobs and economic opportunities in our rural communities. Local opportunities as well as large international export projects are being pursued in our region and should be of interest to family forest owners. But first, let’s examine what the terms biomass, bioenergy and biofuels mean and what their differences are.

Some definitions

The term biofuel has traditionally been used to refer to the conversion of wood fiber to liquid fuels like ethanol or biodiesel. Biofuel can also describe wood pellets or other engineered wood fuels like torrefied wood fuels in addition to advanced or cellulosic biofuel.

Bioenergy or biopower refers to the generation of electricity or heat from biomass, much like natural gas or coal would be used.

Biomass is a broad term that is used to describe biologic material, often in the context of biofuels or bioenergy-related projects. It is sometimes referred to as feedstock and is the raw material for the energy or biofuel production. Increasingly, biomass is also thought of as an opportunity to help revitalize our rural communities and improve the health of our forests. Much of the effort and focus on biomass utilization is tied to the goal of improving the health of our forests, especially fire-prone dry forests; however, there is also increased utilization of slash from industrial timberlands, as well as emerging markets for smaller landowners and land managers.

The main market for biomass has been hog fuel that is used at a mill to produce steam for dry kilns and to generate electricity in a combined heat and power or cogeneration plant. Advances in collection technologies and practices have helped to increase the amount of forest-based materials that are used to produce power in this way. Electricity that is produced from biomass at one of these facilities is often eligible for

Combined heat and power or co-generation is an efficient way of utilizing biomass to produce both renewable electricity that can be sold over the grid and thermal energy that can be used to power dry kilns, and provide space heat and other process energy needs.
state Renewable Portfolio Standards or RPS. An RPS is a requirement that electric utility companies provide a set percentage of renewable electricity to its customers.

Biofuel production is also an important opportunity for our region. Additional higher value markets for biomass materials can help support forest restoration treatments, add more value, and provide new options for landowners. Biofuel opportunities are also a way to help revitalize rural communities and reduce our dependence on imported fuel sources.

**Two major Northwest projects underway**

The Northwest was fortunate to be the recipient of two large research and development projects geared toward advancing the development of advanced biofuels in the region. The Northwest Advanced Renewables Alliance is a broad group of private industry and educational institutions working to build a sustainable supply chain for aviation biofuel. The group is working on increasing the efficiency of the entire chain from forestry operations to the conversion processes. Led by Washington State University, the alliance has five main teams that are working on education, conversion, feedstocks, sustainability, and outreach.

The Advanced Hardwood Biofuels Northwest project is a consortium led by the University of Washington focused on the creation of gasoline, diesel, and jet fuel from hybrid poplar. The goals are to have a biofuel product that is completely compatible with our existing vehicle fleets and fueling infrastructure and provide the opportunity for landowners to grow poplars on marginal lands. Both of these projects will provide valuable outcomes and help increase economic opportunities in our rural regions. See accompanying articles for more information on these two projects.

One example of a regional project that will use biomass to produce advanced fuels is ZeaChem, which is building a biorefinery in Boardman, Ore., that will produce gasoline, jet fuel, and chemicals. Hybrid poplar will initially be used, but other types of biomass may be utilized as well. The project is under construction and the company has plans for further expansion once the initial plant is constructed.

In addition to electricity and biofuel production, one of the fastest growing opportunities for biomass is as a replacement for fuel oil or propane as a heating source for schools, hospitals, prisons, and other buildings. Biomass can be a much less expensive fuel source and can save municipalities and building owners hundreds of thousands of dollars, plus the money they do spend on fuels will be going back into the local economy instead of sent out of the region or out of the country.

Other existing markets for biomass include post and pole manufacturing, animal bedding, firewood production, pellets, and landscaping materials. New markets are emerging and have the promise to produce multiple benefits. More buildings are being converted to biomass heating.
and pellet manufacturers in the Northwest are beginning to export product to Asia. There are also a number of entrepreneurs developing projects that produce biochar, torrefied solid biofuel, and other advanced biomass products.

**What are states doing to support biomass and bioenergy?**

Biomass has always been an important part of the Northwest’s energy and industry mix. States have initiated a number of programs to support biomass utilization. The Idaho Bioenergy Program provides technical assistance and resources to help develop bioenergy projects. The program has helped to develop demonstration projects like the biomass boiler at the University of Idaho and new pellet mill and energy production equipment at lumber mills.

Montana has a strong Wood Biomass Utilization Program and the Montana Biomass Working Group has developed a strategy for the state. The strategy recommends enhancing markets and supporting biomass project development, ensuring a sustainable, reliable supply of biomass, and advancing science, engineering, and technology. In addition the state provides planning grants, feasibility assessments, and other assistance.

Oregon’s Forest Biomass Working Group recently developed a new biomass strategy that is focused on developing new and expanded markets for woody biomass. The state provides incentives to support biomass collection and harvesting and provides grants, loans, and tax credits for biomass projects. The state Department of Forestry has a dedicated biomass specialist on staff that provides technical assistance to landowners and others seeking to utilize biomass from their lands.

Washington has recently completed a robust assessment of the amount of biomass that is available and is implementing a Forest Biomass Initiative that is supporting innovative and emerging biomass harvesting and processing technologies through pilot projects. The state also has a strong biomass policy and talented staff coordinating the various biomass initiatives, including a forest biomass to aviation fuel demonstration project.

**Haven’t we heard biofuels are only five years away?**

Biomass projects are not always a slam dunk, in fact they are often far from it. Biomass is a bulky material that has low energy density. It is often located far from any markets and is expensive to collect, process, and transport. With rising diesel prices and falling cost for natural gas and slow growth in the electric markets, it can be tough to make a biomass project pencil out.

New advances in harvesting and processing technologies are helping to reduce the cost of grinding and trucking biomass out of the woods. Planning for biomass utilization when evaluating a treatment or harvest can help build efficiencies and improve the margins for a project. Contractors and their employees are becoming more experienced with handling biomass and are introducing innovations and gaining knowledge to help reduce costs.

While we have heard that we...
would be able to create advanced biofuels from wood biomass in just another five years for a while now, there are some real advances occurring and new technologies and products hitting the streets. Projects in the region seek to manufacture an energy-dense coal substitute and efforts are underway to open up markets for biochar in water treatment, remediation, and carbon sequestration.

These advances and opportunities may not open up right away, but we will certainly learn a lot as we pursue them. They are real however, and they do have the potential to provide a huge benefit to our region.

**What does this mean for the family forest owner?**

Utilizing biomass can be an important opportunity to help reduce the cost of treatments and support sustainable forest management. It can also be an economic opportunity that benefits the landowner and the forest products industry. However, biomass utilization must be done in an ecologically and economically sustainable manner.

Making an investment to pursue an emerging opportunity can be a risky venture. Any potential project should be thoroughly evaluated. There are a number of resources to help, including your fellow landowners. These opportunities should also be thought of in the context of overall plans and objectives for your land.

Increased biomass utilization should also consider the contribution these practices can make to overall forest health and the potential impact on areas such as soil nutrient cycling. While biomass harvesting is regulated under forest practices acts, new biomass harvesting guidelines are being developed to help managers use the best available science to address questions related to sustainability. In general these guidelines are not far from practices used during a sawtimber harvest and provide guidance for leaving some material on the ground to protect soil quality and prevent erosion, support and retain wildlife and diversity, and protect resources like riparian areas or protected habitats.

Developing a robust biomass industry will require a commitment to a high quality, reliable, and sustainable supply of woody biomass. While there will be supply available from restoration treatments on federal lands, this supply can be unpredictable and is subject to a variety of management considerations and restrictions. Small woodland owners can play an important role in the biomass industry and help support the development of new industries.

**Matt Krumenauer** is a senior policy analyst, Oregon Forest Biomass Strategy, Department of Energy in Salem. He can be reached at 503-378-6043 or matt.krumenauer@state.or.us.
Hybrid Poplars for Fuel

By KEVIN W. ZOBRIST

Advanced Hardwood Biofuels Northwest is a project to develop biofuels from woody feedstock to support more sustainable air and ground transportation, create jobs, and support rural economies in the Pacific Northwest region. The project is funded by a $40 million AFRI CAP (coordinated agricultural project) grant from the USDA. The project is led by the University of Washington and includes a broad consortium of universities and industry partners who will be working together to develop a system to convert hybrid poplar into biofuel.

The goal of the hybrid poplar biofuel project is to generate liquid biofuels, including gasoline, diesel, and jet fuel, that are fully compatible with existing infrastructure. These fuels will be direct replacements for existing fossil fuels and will be certified to run in existing car, truck, air-
craft, and other types of engines. The target is to produce 400 million gallons of biofuel per year from 400,000 acres of hybrid poplar plantations around the Pacific Northwest. The Pacific Northwest is an ideal location to develop this system because of the availability of suitable land for growing poplar and the existing collaborations between universities and industry partners in the region. The region is also isolated from other U.S. fuel pipelines, making it imperative to develop a regional source of renewable energy. The biofuel production from this project will meet 75 percent of the region's target for the 2022 renewable fuel standard (RSF2).

Hybrid poplar is an excellent crop for biofuel production. It is fast growing and highly adaptable to a wide range of sites. Marginal lands, currently unproductive or underproductive for other types of crops, will present good opportunities for hybrid poplar production.

The cultivars being developed are not genetically engineered. Rather, they are bred through traditional cross-pollination methods that have been used for thousands of years. The poplar cropping system being developed is also very different from the other types of hybrid poplar systems that have been in use for pulp and paper production over the past several decades. Those systems were grown on 12- to 15-year rotations and were harvested using conventional logging equipment and methods. Residual stumps, because of their size, made it challenging to convert the land back to other crop uses. In contrast, the poplars being developed for biofuel production will be grown on very short (two-year) rotations, using a coppicing method that promotes multiple shoots of re-growth at the stump for subsequent harvest. Harvesting is done with a combine-like machine that cuts and grinds the saplings as it moves down the crop rows, feeding the chips into a truck that moves alongside. Residual stumps are small; after several rotations of poplar, the land can be tilled for other agricultural crops without requiring expensive stump removal.

This project is organized into five teams:

1. **Conversion and Distribution.** This team is led by Colorado-based ZeaChem Inc. ZeaChem is developing the chemical conversion process and is adding process modules to its existing 250,000 gallons per year integrated biorefinery in Boardman, Ore., for this project. Supporting research will develop new sensors for biorefinery processes.

2. **Feedstock.** This team is led by GreenWood Resources, which manages 25,000 acres of Forest Stewardship Council (FSC) certified poplar in Boardman that supplies logs to its Boardman sawmill along with the supply of biomass to ZeaChem’s biorefinery. GreenWood is developing the breeding, growing, and harvesting technology. Regional demonstration plantations will be used to quantify biomass yields and economics along with an assessment of the impacts of growing poplar on wildlife, water quality and availability, land produc-

---

**SUPPORT RESPONSIBLE FORESTRY.**

When you consider that only 10% of the world’s forests are certified, we have a long way to go. The good news is that there are a number of credible forest certification programs. And each one, including SFI, encourages responsible forestry. For more on forest certification and what you can do, visit www.sfiprogram.org.
tivity, and other environmental factors to ensure the process is environmentally sustainable. Research projects at the University of Washington, University of Idaho, Washington State University, and University of California-Davis are supporting development of superior feedstock systems.

3. **Sustainability.** This team, co-led by the University of Washington and University of California-Davis, will be doing a comprehensive life cycle assessment (LCA) of the entire process of growing, harvesting, conversion, and distribution. This effort also includes extensive modeling and analysis of alternative development scenarios and system optimization. Economic assessments will evaluate economic viability for landowners and determine other potential socio-economic impacts. A comprehensive social impact evaluation using surveys, focus groups, and interviews will complete the sustainability assessment.

4. **Education.** This team is co-led by Oregon State University and the Agriculture Center of Excellence (Washington network of agriculture-based community college programs serving the Pacific Northwest from Walla Walla Community College). The team will develop high school, community college, four-year college, and master’s level curricula and programs to ensure that a skilled workforce is available to meet the bioenergy needs of the region well into the future.

5. **Extension.** This team, led by WSU Extension, will develop education and outreach materials and build capacity within the region’s land grant universities to ensure that farmers and forest owners have access to necessary technical assistance for growing hybrid poplar feedstock. This Extension capacity is essential to the success of growers, who are the supply link needed for successful biorefineries. The Extension component will be carried out by a dedicated team of agriculture and natural resource faculty that will provide support to Extension programs throughout the Pacific Northwest region.

The project is scheduled to last for five years. Currently, there are no opportunities for local landowners to begin growing hybrid poplar for biofuel production, as this is the beginning of the research and development process. The goal is to be ready for commercialization at the end of the five-year process, at which point there will be opportunities for landowners around the region. More information will become available as this project progresses.

**KEVIN W. ZOBRI ST** is a WSU regional Extension specialist, Forest Stewardship, based in Everett, Wash. He can be reached at 425-357-6017 or kevin.zobrist@wsu.edu.

---

**NORTHWEST HARDWOODS**

Purchasing alder, maple and ash saw logs, pulp logs, and timber. Also hemlock saw logs and timber.

- **Centralia, WA** (360) 736-2811
- **Longview, WA** (360) 577-6678
- **Eugene, OR** (541) 689-2581
- **Coos Bay, OR** (541) 267-0419
- **Garibaldi, OR** (503) 322-3367

---

**PHOTO COURTESY OF GREENWOOD RESOURCES**

*The Case New Holland Bioharvester is working in 1.5 year-old bioenergy plantings at the Boardman Tree Farm.*
In 2010, Sustainable Aviation Fuels Northwest (SAFN), a Pacific Northwest stakeholders group, was formed to explore the development of a safe, sustainable, and economically viable aviation biofuels industry in the Pacific Northwest. Forest residuals were one of four promising feedstocks identified for this purpose.

Under this context, NARA (Northwest Advanced Renewables Alliance) was formed. NARA is an alliance of researchers, educators, and economists from universities, businesses, and non-governmental and governmental institutions dedicated to help create a sustainable residual woody biomass to biojet fuel and value-added co-products industry in the Pacific Northwest. Created in fall 2011, the alliance is led by Washington State University and primarily funded by a $40 million five-year Agriculture and Food Research Initiative Competitive Grant from the USDA National Institute of Food and Agriculture.

A holistic approach

The NARA project is designed to impact all facets of an emerging industry and will provide the following output values:

• A sustainable woody residual to biojet industry;
• Valuable lignin co-products;
• Established supply chain coalitions in the NARA region;
• Rural economic development; and
• Bioenergy literacy.

To accomplish these values, NARA researchers, educators, and economists are working within the following five teams. As of July 2012, there were 169 NARA personnel throughout the United States working on this project.

Feedstocks. This team is divided into two areas of focus—logistics and development. The logistics team identifies preferred methods to process and transport woody biomass from the harvest site. The development team determines the factors that contribute to harvest site productivity and identifies softwood trees that provide optimal chemical characteristics for biojet fuel and value-added co-products production. The reason why softwood residuals are of focus is because they are an abundant source of feedstock currently underutilized in the Pacific Northwest.

Conversion. This team focuses on technologies used to convert woody tissue into biojet fuel and valuable co-products. More will be discussed about these efforts further in the article.

Sustainability measurements. This diverse group evaluates the environmental, economic, and social implications of using harvest residuals as an energy source and will make sure that harvest residuals are captured and processed in a sustainable manner. They also will determine the availability and utilization of residual woody biomass in Idaho, Washington, Oregon, and Montana.

Education. This team is dedicated to raising public bioenergy literacy and provides educational opportunities for K-12 and university students preparing them for the biofuels industry workforce.

Outreach. This group introduces the information prepared by NARA to the general public, policy makers, and industry so that regional communities can support and participate as supply-chain coalitions.

A market for fuel and co-products derived from wood residuals could provide a positive financial impact to
small woodland owners by offsetting some of the costs relating to thinning and stewardship. Here is a run down on how residual wood becomes a valued product.

Wood to biojet fuel

On a molecular level, wood carbohydrates (sugars) are the primary feedstock for biojet fuel. The predominant carbohydrate sources in woody tissue are the polysaccharides, cellulose, and hemicellulose. These complex molecules bind to lignin and form a composite matrix called lignocellulose. Lignocellulose does not give up sugars easily. It is naturally resistant to enzymatic and microbial deconstruction. This resistance or “lignocellulosic recalcitrance” poses a technical hurdle to those that wish to remove the individual carbohydrates.

Pretreatment alleviates lignocellulosic recalcitrance

After the woody residuals have been converted into woodchips, they undergo pretreatment. Pretreatment is a chemical process that breaks up the lignocellulose so that lignin is partially removed and cellulose and hemicellulose are exposed. Once these polysaccharides are exposed, enzymes can be introduced to “hydrolyze” or liberate the individual sugars so that they can be converted to molecules used for fuel.

NARA researchers are investigating three pretreatment strategies: SPORL (sulfite pretreatment to overcome recalcitrance of lignocellulose), dilute acid, and wet oxidation.

Choosing the most effective pretreatment strategy involves a number of considerations including:
• Energy inputs;
• Sugar output;
• Negative structural alterations to the sugars and lignin—the lignin will be later processed into valuable products;
• Environmental concerns;
• Post pretreatment environment for fermenting microorganisms;
• Scalability for industrial bioprocessing;
• Versatility to various upstream feedstocks (hardwoods, softwoods, bark content); and
• Economics.

The SPORL process involves two fundamental steps. The first step mixes woodchips with an acidic aqueous sulfite solution. The mixture is then heated. This process separates most of the hemicelluloses from the lignocellulose and partially separates lignin. The second step employs a mill to grind the pretreated solid cellulose/lignin-rich material into fibers or fiber bundles. The remaining solids are then enzymatically digested to glucose. The separated lignin fraction can be purified and incorporated into valuable co-products.

The dilute acid process is similar to the SPORL process except sulfite is not used. NARA researchers will use this technology to rapidly compare and evaluate various woody species and cultivars to determine their susceptibility to pretreatment.

With wet oxidation, no external chemicals are added except water and moderate concentrations of oxygen. Under high pressure and heat, oxygen reacts with lignin altering its structure and forcing it to detach from the hemicellulose and cellulose. The high pressure, coupled with a quick pressure release, helps break the crystalline cellulose structure making it accessible to enzymatic hydrolysis. The wet oxidation process employs no harsh chemicals thus limiting environmental costs. Another advantage to this process is that no mechanical milling is required and the resulting lignin is chemically pure (non-sulfonated).

Sugar into fuel building blocks

Once the sugars have been liberated by enzymatic hydrolysis, they are

—Continued on next page—
ready for chemical conversion into molecules that can be used to make biojet fuel. NARA is investigating two promising conversion technologies. One technology is pioneered by NARA affiliate Gevo Inc. Using a yeast biocatalyst, Gevo has developed a fermentation technology that converts biomass sugars to isobutanol. The other technology investigated is the BioChemCat process. At Washington State University-Tri Cities, the Bioproducts, Science and Engineering Laboratory (WSU BSEL) is adapting this technology for biojet fuel production. The BioChemCat process uses mixed bacterial cultures to ferment sugars into platform molecules. Both isobutanol and/or the platform molecules can be chemically processed to generate biojet fuels. They are less corrosive and contain a higher energy density than ethanol. NARA’s ultimate target is to develop a biojet fuel that is compatible with existing distribution systems, infrastructure, and airline engines. A top estimate of 750 million gallons per year of biojet fuel could be generated from 15-20 million bone-dry-tons of biomass available in Idaho, Oregon, Washington, and Montana annually.

Why biojet fuel?

Developing a sustainable woody residual to biojet industry will take time and a large amount of financial and human capital. Economic success requires that the drop-in biofuel (fuel similar to aviation fuel requiring no engine or fuel infrastructure alterations) produced will have a long-term sustained market. Ground and water transport can use a variety of fuel types such as liquid, electric, gas, fuel cells, and nuclear. Commercial and military air transport, however, is limited to liquid fuels for some time yet. Therefore, a focus on biojet fuel should ensure that the product will have a market and that the initial investments made today will be recovered. Commitments are already taking form; for instance, Gevo, a NARA-affiliated company, has contracted with the U.S. Air Force to supply jetfuel from isobutanol.

Lignin as a precursor to value-added co-products

An old phrase in the wood products industry goes something like this: “You can make a lot of things from lignin except money.” NARA researchers are focused on retiring that phrase with developing novel lignin-derived products, some substituting for current petroleum-based products that provide for near and longer-term markets and keep pace with biojet development. Creating profitable lignin-based materials is linked and essential to ensuring that the woody residual to biojet industry is profitable and able to compete economically with the petrochemical industry. Besides lignin, there are additional components of the byproduct stream such as residual fibers, alternative sugars, and yeast bodies. Finding value-added products derived from these units will also receive research attention.

NARA: first year

NARA just concluded its first year annual meeting on September 12-14 in Missoula, Montana. The project reached important milestones and anticipates further success. If you would like to get involved and receive project information, then sign up at www.nararenewables.org/or. For more information, visit www.nararenewables.org.

Charles Burke is NARA Communications and Publicity director. He can be reached at 509-335-3018 or ccburke@nararenewables.org. NARA is supported by an Agriculture and Food Research Initiative Competitive Grant # 2011-68005-30416 from the USDA National Institute of Food and Agriculture.

From slash to jetfuel?
Like knowing how you take your coffee and the opening day of hunting season, Oregon® is part of your routine. This comes as no surprise, because Oregon® has been trusted by chain saw manufacturers, loggers, arborists, firefighters and other professionals like you for more than 60 years.

Trust your saw to get started.
Trust Oregon® to do the tough work.
Get more information about the complete Oregon® line-up online at oregonchain.com.

Saws shown without side covers for photo purposes only. It is extremely dangerous to operate saws without the covers attached.

OREGON® | Blount Inc.

oregonchain.com
Montana is a little different than the rest of the United States when it comes to forests and forestry. Although we are often included as part of the Northwest, only a quarter of our forests are part of the Columbia River basin and we lack a shipping port to the west coast. For us, the Rocky Mountains sometimes impose the same barrier that Lewis and Clark encountered 200 years ago, which is both a boon and a bane.

Those mountains keep a lot of moisture to the westside, which benefits tree growth across north Idaho and eastern Oregon, but not west and central Montana where summer drought is the average, wildfires have burned close to 4.5 million acres of timber over the past 10 years, and bark beetles have eaten their way across another 5 million. Similarly, transporting anything west across the spine of the Rockies imposes an extra cost for economic growth and development. This might be why the fourth largest state has a population that hovers at barely a million.

Around 29,000 private landowners manage only 3.5 million acres out of our cumulative 25 million forested acres whereas the Forest Service and Bureau of Land Management collectively manage 17 million.

In spite of all the fire and beetle mortality, timber harvesting has shrunk from an average annual yield of 1 billion board feet to a 40-year low of 348 million in 2011. The closure of the state’s only pulp buyer in January 2011 hit many loggers and landowners hard, as Montana has an abundance of small, slow-growing conifers, and pulp has been one of the traditional markets for this material. Many loggers, including multiple generation businesses, finally tired of the challenges facing the industry and found good-paying jobs in the Bakken oil fields of eastern Montana.

The sawmills that remain, with the exception of the largest private forest landowner Plum Creek, are predominantly family owned, sticking with the business out of sheer determination, creative financing, and a can-do attitude. Towns like Missoula, home to the University of Montana and longtime beneficiary of the tax wealth that liner-board manufacturer Smurfit-Stone had brought with it, suddenly felt the profound hunger pangs that happen when a wealth-creating industry leaves. Landowners that used to be able to thin out overstocked forests of smaller and less desirable trees for at-cost pulp harvests were left relying on federal cost share dollars and the headache of treating vast piles of woody debris—alternatively known as “biomass.” Out of such circumstance western Montana may become an example of the saying, “Adversity builds some of the best friendships and innovation.”

The Montana wood products-based industry has long maintained a tremendous effort to try and work with everyone and every interest group. This has resulted in nationally recognized partnerships such as the Blackfoot challenge and an attempt to allow partnerships to influence national forest policy through a state-specific National Forest bill called the Forest and Jobs Restoration Act. During the past year, the Montana Forest Business Network, University of Montana Bureau of Business and Economic Research, Montana State Extension Forestry, and numerous community-based economic development groups teamed up to present the Northwest Advanced Renewables Alliance (NARA) with a proposal to consider western Montana as a pilot community for a woody biomass utilization and potential jetfuel conversion analysis, which was accepted.

Key components of this proposal were that: 1) Montana has a vast quantity of woody biomass available that currently has only a limited market, mostly to buyers in other states; 2) local governments such as Missoula have come to the sudden realization that money does not grow on trees but rather is gained by processing them and they are very interested in attracting new business; 3) there are
several former wood processing sites that retain the power lines, real estate, and water and air permits that would allow for a new wood processing facility to be built; 4) dealing with years of anti-forest harvesting politics, the remaining forest products industry is cohesive and quick to move when new partnerships that offer solutions rather than obstructions present themselves; and 5) there is a sense of urgency that has developed not only among landowners and forest products representatives, but also the general population that our forests can use some help as they continue to be ravaged by wildfires and beetles.

Biomass processing is not a new concept to Montana. Many biomass options have been looked at over the past decade, in part because Montana has a typical high summer wildfire risk and therefore any logging or timber stand improvement activity requires by law that the resulting woody debris be treated so as not to present a wildfire hazard under “standard bad fire weather conditions.” This state law represents a significant demand to loggers and landowners that are harvesting timber or treating stands, and with the loss of a paper pulp market and associated hog-fuel power plant that offset some of these costs it has become an even greater expense as the alternatives are mulching, masticating, or burning during a very limited burn window in the fall. A market for this material, even if it only covers the cost of treating it, would be welcome to the industry and many landowners.

Based upon experience and models from the United States and Europe, burning woody biomass for electricity production doesn’t usually make economic sense. Even in a best-case scenario, a wood-to-electricity plant produces electric power at a rate that is two to four times more expensive than existing fossil fuel plants. This makes sense when one considers that woody biomass has less energy per pound, is more widely scattered across the landscape and thus requires more transportation, and needs more secondary processing (chipping and drying) than coal, fuel oil, or natural gas.

Those facilities that do burn woody biomass tend to gain most of their economic advantage as cogeneration plants of both heat and power.

Numerous wood energy plants across

—Continued on next page—
Europe heat entire communities with steam pipes, as do U.S. universities that have biomass-based systems such as the University of Idaho or Fuels for Schools projects across Montana. Electricity production is a byproduct that adds to the efficiency of the system but cannot pay for itself as a stand-alone product. This is why universities that heat their campuses with steam and wood products processing plants that need heat for their lumber dry kilns or paper production are the logical outlets for woody biomass energy facilities. However, even when both heat and electric power can be captured, such facilities are at best break-even. The recently proposed University of Montana biomass project that would have employed the most modern energy conversion technology available ultimately was canceled because estimated heat and electricity production with woody biomass would have cost almost double what natural gas would.

For another example, family-owned Stoltze Land and Lumber Co. will be building a small wood biomass energy system over the next several years because they have the wood biomass already on site and available, they can offset the cost of construction in part with needed upgrade costs they would have anyway, and North Western Energy finally agreed to buy electricity at a fixed “green energy” rate—though only in a very limited quantity that allows for a relatively small biomass cogeneration facility. This project was the result of about 10 years of intense research and negotiating by Stoltze personnel and they readily admit they would have liked to build a facility 10 times as large as the final product, but power companies could not or would not buy the electricity at the cost needed to make a larger facility work.

All told—burning biomass as an alternative energy source does not currently offer an economically viable stand-alone proposition for most scenarios—except of course as simple firewood for residential heating. Enter the Northwest Advanced Renewables Alliance.

The NARA project is focused on the biochemical breakdown of woody tissue for multiple high-value end products ranging from the potential of food flavorings, soap, and cosmetics to jetfuel. It involves multiple research partners taking a pilot project involving noted wood chemistry professor Norman Lewis’ research and new companies’ conversion processes such as Gevo Inc.’s proprietary yeast biocatalyst through a regional analysis of sustainable woody debris supply, harvesting and transportation costs, processing costs, and rural community support and acceptance. A major targeted end product of this research process is isobutanol, a four-carbon alcohol that can be converted into an easily transported, noncorrosive “drop-in ready” jetfuel. Although the NARA project primarily targets jet fuels, there are multiple other interests that can potentially use woody biomass for other conversion processes.

For example, the local Missoula based start-up company Blue Marble Biomaterials uses an acid, gas, and ammonia targeted extraction technique on a common organic food industry byproduct to produce high-value food flavorings and cosmetics. At the international level, England-based Green Biologics Ltd. uses Clostridia bacteria strains (the same non-oxygen-loving bacteria that produces botulism toxin, tetanus, and gangrene) to break down biomass for similar end products and already has pilot plants in Ohio and offices in Brazil, India, and China.

Biochemical breakdown techniques look at the essential components of wood, which are cellulose, hemi-cellulose, and lignin. The major building block of wood cellulose is the glucose molecule, which chemically bonds together to form long molecular chains and is one of the primary components of cell walls in the form of microfibrils. In the paper-making process wood is disintegrated into these microfibrils and then recompressed into paper sheets. In the biochemical refining process, one of several techniques using acids, caustic compounds, enzymes, yeasts, or bacteria are used to break microfibrils into component sugar molecules, which are then reassembled using fermentation or other processes to produce high-value alcohols, esters, thiols, and terpenes. Although the processes are complicated, many of these end products

--Continued on page 31--
Profitable timber harvest, where revenue exceeds costs, typically depends on delivering the right logs to the best price destinations. Saw logs go to a sawmill and pulp logs go to a pulp mill. The remaining tree tops, branches, and cull logs—but not the duff layer of the forest floor—are what we consider “biomass” for this article.

Without a substantial increase in the value of delivered biomass it is unlikely that a harvest operation will be exclusively for biomass production. (One exception might be where decades of selective [high grading] partial timber harvest has resulted in low-grade residual trees that have little alternative value.) In western Washington, at current prices and costs, a 5-10 acre clearcut timber harvest is an approximate break-even threshold for a commercial biomass harvest. This does not consider the alternative cost and risk of burning piled slash or lost future revenues for land under piles not removed.

Typically, slash piles along roads and landings that result from the timber harvest and processing are necessary for a profitable commercial biomass harvest. Since approximately 70 percent of any slash pile is air, onsite processing (grinding) is necessary to reduce hauling costs. Semi-sized chip vans will need a road system that allows either a drive through or a turn-around route. At current costs, grinding allows an economic haul distance up to about 50 miles.

Biomass facilities typically need a continuous supply even through rainy seasons. Delivered prices are likely to be higher during wet weather especially if the material has cured during a previous dry season. Roads need to have adequate surfacing if wet weather hauling is planned. However, currently the value of delivered biomass does not support road construction or surfacing just for biomass production. If the roads do not already exist then a profitable biomass harvest is unlikely.

Regarding site productivity, recent USDA Forest Service research has shown no change in 11-year Douglas-fir seedling height growth after biomass removal in western Washington. Another article in this issue will further address soil nutrition issues.

Local best management practices for habitat diversity need to be considered. For example, in western Washington, a timber harvest permit application needs to show that biomass removal is expected and that several down logs per acre remain for wildlife. State or county policies will vary and should be understood.

The biomass industry is relatively young and developing rapidly. Various subsidies, grants, and tax benefits are being tested. In Washington state, a forest landowner can receive a Business and Occupation (gross revenue tax) tax credit of $4 per bone dry ton of biomass delivered. Forestry extension agents or local farm forestry organizations should be aware of these opportunities.

Given the current values for biomass, infrastructure, and costs, biomass harvest for small woodland owners will likely receive only a token stumpage. Larger benefits will likely come from avoiding the cost and risk of burning, tax breaks, and better stand establishment.

Bill Hermann is president of Hermann Brothers in Port Angeles, Wash. Harry Bell is chief forester of Green Crow Corporation, also in Port Angeles. He can be reached at harry@greencrow.com.
Maintaining Site Productivity during Biofuel Harvest Operations

BY DEBORAH PAGE-DUMROESE AND MARK KIMSEY

Demand for forest biomass for bioenergy production and other uses is expected to increase to four times the current level in the next one to five years. The search for alternative energy sources, including forest bioenergy, increases pressure on the productive capacity of our western forestlands. The questions are: Can forest soils in the western U.S. support more intensive timber harvesting for both traditional uses and emerging bioenergy markets? Are biomass harvesting for bioenergy and sustainable soil productivity compatible? The answers are “yes!”

Biofuel harvest operations are becoming more prevalent in the western U.S. because of the large amount of biomass accumulating in unharvested or overstocked stands. Markets for forest residues such as pulpwood or chips are increasing.

In the past, logging or thinning operations generated a considerable amount of residue that had previously been left on-site, burned in slash piles, or removed as hog fuel. Now we are considering removing forest residues that were once left on-site. Consequently, bioenergy harvesting may impact the soil’s physical, chemical, and biological environment to a greater degree than traditional timber harvesting.

Soil impacts are usually dependent on the amount of organic matter and woody residues on the soil surface, soil texture (e.g., clay, silt, sand), rock content, and soil depth. For example, harvesting often compacts clay and silt soils more than sandy soils. However, the soils that compact the easiest are often less susceptible to reductions in nutrients from biomass harvesting (e.g., finer textured soils typically have higher plant essential nutrients). This suggests that biomass removal mitigation strategies must reflect site conditions to maintain the health and fertility of the soil resource. Nutrients and carbon are removed when tops and leaves are removed, and therefore concerns over “mining” of the soil resource must be addressed. Thus the question: “Some woody residues must be left behind, but how much and what kind?”

Fine woody residues. Fine woody residues are usually defined as that portion of harvest residue that is less than three inches in diameter. Ecologically, it adds soil cover that can reduce soil erosion, moderate soil temperatures, and on some sites may increase soil nutrients. Published data indicate that in general, intensive residue removals do not universally reduce site productivity. However, removal of all fine woody residues following repeated harvests can cause substantial growth declines on coarse textured soils with low soil organic matter. On some Pacific Northwest forest sites, nitrogen (N) is limiting, but often there is an adequate supply of other nutrients so that even repeated intensive removals of fine woody residues will not induce nutrient deficiencies. However, in dry or cold forests where N cycling is slow due to climate, N losses in harvested materials may substantially reduce productivity by lowering decomposition and N mineralization rates. During typical biomass harvesting, a large amount of top breakage occurs, and this material should be sufficient to alleviate concerns about nutrient loss, erosion, or compaction.

Coarse woody residues. Coarse woody residue is defined as wood greater than seven inches in diameter and is usually laying on the soil surface. Coarse wood can be added to a site during logging or when a snag falls. Ecologically, coarse woody residues function as habitat for a variety of organisms, including fungi, mosses, liverworts, insects, amphibians, reptiles, small mammals, and regenerating plants. On any given site, coarse wood is naturally regulated by local climatic regimes, which determine decomposition rates. As woody debris decays, it eventually forms soil wood (covered by mineral soil and forest floor material), where it helps to improve nutrient cycling and increases water-holding capacity. This slow incorporation of woody material into the mineral soil improves soil properties over the long term and influences tree growth over time. Coarse wood also affects ponding, sediment trapping, and aeration in streams. In addition, coarse wood can alter site water balance and water quality, both through storage and release of water, and by reducing runoff and erosion. During harvest operations, coarse wood is often used to protect wet soil areas from compaction and rutting, or used post-harvest to help limit runoff and erosion from skid trails and forest roads.

How much woody residues should I leave? It is relatively easy to determine how much coarse and fine woody residues are present on the soil surface before biomass harvesting by either visual estimates or measurements. One good rule of thumb is to retain the same amount of coarse and fine woody residue that is on-site pre-harvest. More specifically, research suggests that retaining 30 percent of fine woody residues on slopes less than 30 percent and 50 percent retention on steep slopes is a reasonable and conservative estimate of the amount of material needed to maintain biodiversity, prevent erosion and com-
paction, build soil organic matter, and maintain nutrients where possible. One note of caution, if a site has been heavily impacted or is subject to a short fire-return interval, then leaving additional material behind could help improve long-term soil quality.

**Best Management Practices.**
Opportunities for Best Management Practices (BMPs) for biomass harvesting are mostly common sense: limit logging when the soil is wet, match equipment to the site, use winter logging to minimize ground disturbances, leave the stumps in place, and don't create large slash piles for burning. Minimizing the size of slash piles to less than 15 percent of the total land area harvested will also help keep soil impacts confined. Long-term research indicates that the key to sustainable forestry is to keep the surface organic horizons (fresh and decaying organic matter) intact so you can maintain nutrient cycling and moisture retention and prevent erosion. Dry, coarse-textured soils are more susceptible to nutrient losses during bioenergy harvesting than moist, fine-textured soils. To minimize soil productivity losses during biomass harvesting for bioenergy, leave fine woody debris and needles (or leaves) on the soil surface.

On many sites before harvest operations begin, you can develop your own BMPs based on soil nutrient levels, depth of the mineral soil, amount of rocks, and local climatic regimes (rainy, cool, hot, dry, etc.). Ecologically, it is important to leave both coarse and fine woody residues after harvest operations and to leave the surface organic matter intact. Knowing if your soil is limited in N or other nutrients can help you determine how much fine or coarse woody residue will benefit your land. You can also determine if compaction might be an issue, if your soils readily develop ruts, or if you have a drainage problem. Geospatial information on the physical and chemical properties of your soil type(s) is available from the Natural Resource Conservation Service (NRCS) Web Soil Survey (http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm). You can use this information to help develop your own risk rating system that assesses your soil type, topography and climatic regime.

Biomass harvesting that follows site specific BMPs that reduce the risk of compaction, erosion, and nutrient losses can provide valuable forest products while maintaining soil productivity for future forest growth.

**Deborah Page-Dumroese** is a research soil scientist for the Rocky Mountain Research Station in Moscow, Idaho. She can be reached at 208-883-2339 or ddumroese@fs.fed.us. **Mark Kimsey** is a researcher for the Intermountain Forest Tree Nutrition Cooperative at the University of Idaho. He can be reached at 208-885-6740 or mkimsey@uidaho.edu.

---

**You know how to read a 90 year old log... but can you read the 90 year old tax law?**

Timberland owners certainly know their way around the woods, but the forest of taxation and financial decisions can seem impenetrable. That’s where BBJS can be your guide. We’re a full service accounting firm that has been quietly serving the forest industry since 1954. For a free initial consultation please give us a call at:

206.682.4840

Phone us today, before more opportunities get lost in the woods.

We count trees, not beans.
In late June, the U.S. Supreme Court agreed to review an important legal case involving the Clean Water Act and some logging roads in Oregon. A key part of the case focused on the road drainage system (ditches and cross-drains), which apparently delivered road sediment directly to nearby streams during wet weather. The Court is expected to make a decision on the case by next spring, and woodland owners and other rural interests throughout the country are following the case because of the important precedent that may be set by the Court’s decision.

But regardless of the final outcome of this case, it provides an important lesson for woodland owners and operators that build or maintain roads on woodland properties: Keep these roads well-drained and also make sure that runoff with road sediment doesn’t reach a stream. How are these key objectives accomplished? Through “BMPs” (Best Management Practices—see sidebar on page 27) that have proven effective in controlling runoff, erosion, and sedimentation from woodland roads.

This article will highlight some examples that help “disconnect” roads from streams, with a focus on the most common situation—dealing with an existing road system, often very simple and old enough to pre-date many newer standards and BMPs. Keep in mind that expected use is a key consideration—roads used only for access with a pickup or SUV can be built and maintained differently than roads that must handle traffic by log trucks or other heavy vehicles. And for either light- or heavy-duty roads, year-round use almost always requires some rock surfacing and extra attention to road drainage.

Controlling runoff and erosion

Rainwater or snowmelt on or near the road surface weakens its bearing capacity and can have erosive power if runoff volume and flow velocity are allowed to increase. As such, there are two basic concerns for controlling road runoff: 1) getting water off the road surface; and 2) directing that water so that it soon infiltrates stable, undisturbed soil. The first concern is addressed by a road surface shape that sheds water to either (inslope or outslope shape) sides of the road. To ensure good drainage, this design shape requires repeat maintenance with a grader or tractor blade, from occasional to frequent depending on the type, intensity, and season of traffic.

For good drainage of road sections with a cutbank along a hill-slope, a crown or inslope road shape will likely require a ditch and cross-drain (“ditch relief”) system for sections that extend more than about 100 feet. Multiple cross-drains are needed as road grades (steepness) increase or with more erodible soils, with cross-drain spacing varying from about 50 to 500 feet depending on these and other local conditions. Cross-drains can be steel or plastic culverts, or other features such as rolling dips (Figure 1) or drivable water bars built from used conveyor belt material. For the latter, an 8-12” width of rubber belt (3/4” or thicker) is bolted to a pressure-treated board (or sandwiched between two boards), and then secured in a trench across the road with the belt extending 4-6” above the road surface. Culverts and water bars should be angled about 30 degrees down from perpendicular to the road, so that they are self-cleaning and move water efficiently.

Clean, durable rock surfacing is a key feature of roads that are resistant...
CLEAN WATER FOR ALL
A PRODUCT OF OUR FORESTS
AMERICAN TREE FARM SYSTEM

American Tree Farm System:
- A network of more than 95,000 woodland owners sustainably managing 26 million acres of forestland
- A valuable resource giving forest owners the tools they need to keep their forests healthy and productive
- An internationally-recognized Forest Certification program

www.treefarmsystem.org

We grow stewardship from the roots.

OREGON
Oregon Tree Farm System
Jim James
187 High Street Suite 208
Salem, OR 97301
503-362-0242
jimjamesoswa@yahoo.com

WASHINGTON
Washington Tree Farm System
John E. Henrikson
72 Mattson Rd
Oakville, WA 98568
360-273-8892
john@wildlogic.com

IDAHO
Idaho Tree Farm System
Jennifer Childers
Idaho SFI Implementation Committee, Inc.
204 E. Sherman Avenue
Coeur d’Alene, ID 83814
208-667-4641
admin@idahotreefarm.org

MONTANA
Montana Tree Farm System
PO Box 17276
Missoula, MT 59808
www.mttreefarm.org

www.treefarmsystem.org

We grow stewardship from the roots.

CLEAN WATER FOR ALL
A PRODUCT OF OUR FORESTS
AMERICAN TREE FARM SYSTEM

We grow stewardship from the roots.
to runoff and erosion and that allow for traffic during wet weather. To help control costs, rock can be added or increased selectively in key locations such as steeper or wetter road sections and the approaches to stream and floodplain crossings. The inlets and outlets of cross-drains are another location where rock or other durable, energy-absorbing material can help reduce the erosive power of surface runoff during heavy rains or snowmelt.

**Cutting the connections**

Especially on the “wetside” of the Northwest or with older existing roads (which often were purposefully routed along stream channels!), it can be difficult to construct or have a road system that completely avoids a stream or riparian area. But there are some effective ways to keep muddy water from roads from reaching nearby streams. One basic approach is to use cross-drains in strategic locations on road sections with stream crossings, diverting runoff away from rather than toward a crossing (Figure 2). Again, the objective is to direct runoff to areas with relatively undisturbed soil that can absorb the water and filter out sediment.

Stream proximity and higher sediment levels in runoff may require extra measures to control sediment delivery. Faster moving water can carry more sediment so barriers near roads that slow runoff and allow sediment to settle out can be effective; these can be simple materials such as hay bales (Figure 3) or slash windrows made from tree or brush cutting along the road right of way. Constructing a small settling pond is another option, particularly where fine sediment is a problem—fines settle out in quiet water. Constructed barriers or ponds may need cleaning or other maintenance but this should be done carefully—like general ditch cleaning, disturbing otherwise stable soil can be overdone and just add to chronic sediment problems.

**Keeping a watchful eye**

As Yogi Berra said, “You can observe a lot by watching.” That’s especially true for roads during wet weather or heavy snowmelt—there’s no substitute for seeing a road drainage system in action or inaction. Road plans should thus include monitoring during such periods—fence posts or other markers are helpful for quickly checking cross-drain inlets.
and outlets. Road closures or suspension of wet-weather operations may be needed to protect the integrity of some roads or to control stream sedimentation (Oregon’s Forest Practice Rules specifically require this in some situations). Finally, it’s important to recognize that some road drainage problems or other needs are too challenging for landowners to handle alone and to seek professional help for effective plans and solutions.

Paul W. Adams has been a professor and Forest Watershed Extension specialist at Oregon State University since 1980. Paul and fellow OSU Extension Forester Steve Bowers (a.k.a. The Treeman) have been conducting classroom and field workshops for landowners on “Woodland Roads: BMPs That Protect Your Property and Meet the Rules.” These programs are part of the Partnership for Forestry Education and made possible through a grant from the US Forest Service, State & Private Forestry. Steve Bowers also recently updated his popular booklet, “Managing Woodland Roads: A Field Guide,” which should be available through the Extension Service in Oregon, Washington, and Idaho in late 2012.

**BMPs: Did You Know?**

The forest practices programs in Oregon, Washington, and Idaho are how these states comply with federal Clean Water Act requirements for most forestry activities. The requirements allow states to use a Best Management Practices (BMPs) approach for protecting water quality with forestry activities. A BMP is “...a practice or combination of practices considered by a State [or authorized Tribe] to be the most effective means (including technological, economic, and institutional considerations) of preventing or reducing the amount of pollution by nonpoint sources to a level compatible with water quality goals.” The concepts discussed in this article are among the general BMPs required or recommended for woodland roads in the region.

The Partnership for Forestry Education is proud to announce that the 2013 PNW Forestry Leadership Academy will be held on January 18-19 at the Oregon Garden Resort in Silverton, Ore.

The goal of the forestry leadership academy is to equip forest landowners and foresters to take active roles in leading Pacific Northwest forestry organizations. We are especially interested in helping new leaders gain the skills they need to succeed. The Leadership Academy will focus on developing leadership skills that cross organizations.

Project partners include the Oregon Tree Farm System, Oregon Small Woodlands Association, Oregon Society of American Foresters, Oregon Forest Resources Institute, OSU Forestry and Natural Resources Extension, Cispus Institute, Washington State Society of American Foresters, Washington Farm Forestry Association, and Washington Tree Farm Committee.

The academy starts with lunch on Friday, January 18. Following lunch will be an opening general session titled, Working across Generations, which will include a keynote talk covering who the generations are, what some defining characteristics of the different generations are, how to reach them, and why they should join our organizations.

Friday afternoon concurrent sessions will be led by Cispus Institute faculty on the following topics: Managing Effective Meetings; Forming Effective Teams; Working with Volunteers; and Understanding Collaboration.

A group dinner will be held followed by informal social activities.

The Leadership Academy continues on Saturday, January 19 with a group breakfast. A general session talk on Effective Outreach Messages for Diverse Landowner Audiences will be given by Bettina Ring, American Forest Foundation.

Saturday morning concurrent sessions will repeat from Friday afternoon allowing each participant to attend two sessions total.

Following a group lunch on Saturday, the academy will conclude with a wrap-up talk on Effective Outreach Messages Using Diverse Media by Michael Goergen, Society of American Foresters.

The leadership academy is generously supported by grants from the American Forest Foundation, USDA Forest Service-State and Private, and the Oregon Forest Resources Institute.

The American Forest Foundation grant will provide for limited scholarships for OSWA, Oregon Tree Farm System, WFFA, and Washington Tree Farm members on a first come first served basis. Scholarships provide for lodging for one night and a registration fee of $25. The cost to attend the conference without a scholarship is $125 plus lodging. Registration information will be available through your family forest association. Information on the academy will be updated on the following website: www.forestry.org/oregon/saf_members/leadership/2013.

For more information, contact Mike Cloughesy, Oregon Forest Resources Institute, at 971-673-2955 or cloughesy@ofri.org.
TreeSmarts: Forest Research You Can Use

TreeSmarts: Forest Research You Can Use appears in every other issue of Northwest Woodlands. Column editor Ed Styskel reviews research being conducted from a host of sources, sorts through the items of interest to family forest owners, and provides a short summary of the pertinent results in understandable language. If you have a suggestion to share with Ed, please contact him directly at edstyskel@gmail.com.


Inadequate reforestation and poor conifer seedling survival and growth led to a national research and application program on vegetation management in young conifer plantations. Findings from the California part of this program, and more specifically on plantation release, are presented here. Results are from 32 study sites throughout northern and central California over a 25-year timeframe. The study sites represent a wide variety of site qualities, soils, slopes, aspects, and vegetation types. Most of the planted conifer seedlings were ponderosa pine (Pinus ponderosa var. ponderosa) and Douglas-fir (Pseudotsuga menziesii).

This technical report details results from nearly all the direct vegetation management release techniques used in the Western United States. These include herbicides, manual release, mulches, grazing (browsing) animals, and mechanical (large machines). Also included are genetic enhancement of young ponderosa pine seedlings and a new concept termed “indirect treatments.”

Herbicides are effective for release on a wide range of plant communities at a reasonable cost. Manual release generally is effective if the community is mostly forbs and grasses/sedges, or shrubs if very young. The cost of manual release is higher than for herbicides because a second treatment is often necessary. Mulches are effective if they are large and durable, but are severely limited by cost. As presently...
practiced, the use of domestic grazing animals for plantation release showed no significant gain in conifer seedling growth. Mechanical release of older seedlings with large machines is not effective without a follow-up application of herbicides.

Genetic enhancement to boost the growth of conifer seedlings over that of competing species began with promise, but deteriorated to the point that it showed little efficacy as a vegetation management tool. Indirect vegetation management using shade and organic material to reduce the growth and density of competing vegetation has promise, but needs more study. It has the advantage of being low in cost and the disadvantage of taking more time to achieve results.

Some important principles to guide vegetation management concern developmental variables for conifer seedlings and competing vegetation. In general, seedling height is a poor descriptor of growth, stem diameter is best, and foliar cover of shrubs best explains the most variation in pine seedling parameters.

The period just after site preparation is probably most critical because it is when the growth environment for conifer seedlings can deteriorate most rapidly.

Grasses and sedges in young conifer plantations on average-to-better sites on west-facing slopes have little effect on the growth of ponderosa pine seedlings, provided that they invade after the pines have become established. However, on the drier east-facing slopes, these plants reduce pine growth for scores of years.

The treated area around conifer seedlings must be large enough (preferably a five-foot radius) to allow root establishment for the first year and usually for the first three years.

Competition is too much when the foliar cover of undesirable plants exceeds 10-20 percent on poor sites and 20-30 percent on good sites.

Evaluating the success of a given treatment relates to time since treatment. Visual observations can be misleading, and occasionally even an early statistical difference can disappear in a year or two. In general, treatment evaluation at age five is adequate, but at age 10 is better.

One of the most important conclusions is that conifer plantations in clearcuts, and herbicides, burning, and grazing are feasible at some place, at some time, and for some purpose.

---

**Other Forestry Publications Online**

Every western state has an Extension Service program within their state university system. Below are sources (and an example) of the numerous forestry publications from programs in Idaho, Montana, Oregon, and Washington.

**University of Idaho Extension**
(www.extension.uidaho.edu/forestry.asp)

**Montana State University Extension**
(www.msuextension.org/forestry/publications.htm)

**Oregon State University Extension**
(http://forest-owner.forestry.oregonstate.edu/)

**Washington State University Extension**
(http://ext.wsu.edu/forestry/publications/index.htm)
Tips From The Treeman

DEAR TREEMAN, How did Oregon State and Oregon get such mascot names as Beavers and Ducks? They sound so hokey. —John

DEAR JOHN, Currently, Benny Beaver is the OSU mascot. He was adopted in 1952 in an effort to boost morale. And a dam good ideal! Prior to Benny, there were numerous attempts at finding a viable candidate. Just after the turn of the century, Jimmie the Coyote was given a chance, but he was too Wile E. to fit the job description, moved to the desert to do battle with roadrunners, and the rest is history. Then there was Athletic Director James Arbuthnot. He owned a bulldog with the school unofficially adopting the “Bulldog” as their mascot, though he was considered unsuccessful and abandoned after four years.

Next up was a human mascot, “Doc Bell.” Dr. John Bell, not to be confused with OSU College of Forestry Professor John F. Bell, author of Log Scaling and Timber Cruising, was a local pastor and stalwart supporter of the football program. His attendance and advising were appreciated to the degree that Doc Bell was adopted as the school mascot.

But alas, his tenure was tenuous, being placed on life support, and the pastor passed into history.

In 1921, along comes the “Bevo,” a live beaver mascot. A number of schools at the time used live mascots.

To our forestry brethren originating from the Washington State University Cougars, “Butch” the live mountain lion served as mascot until that idea was stuff and made into a uniform. Back at OSU, Bevo’s tail was flattened and he escaped back to the wildlands before he became someone’s fashion apparel. But out of the woods came “Billie,” another live beaver, although he too gnawed on people’s patience and was sent downstream.

Next up was, and is, Benny Beaver, though even Benny has endured some turbulent winters. During the “women’s lib” movement of the 1980s, OSU earned the distinction of having the only “uni-sex” mascots, Benny and Bernie. But this too fell flatter than Dee Andros’ favorite seat cushion. In 1999, Benny got a facelift, currently known as “Angry” Beaver or “Psycho” Beaver, but for true fans he remains Benny. Or we could have informed readers OSU adopted the Beaver vis-à-vis “The Beaver State,” Oregon’s state animal. But what fun is that?

How ‘bout the Fighting Ducks of Oregon? Originally known as “The Webfoot State,” Oregon followed suit with their mascot. The Webfoot reference can be traced to a number of Massachusetts fishermen, when in 1776 they assisted in saving General George Washington from eminent defeat at the hands of the British.

When some of the Webfoot progeny joined the western migration to Oregon and the Willamette Valley, the name stuck to their muddy shoes and came with them. Individuals exist of the Beaver persuasion that contend this movement an early invasive species!

L.H. Gregory, sports editor of The Oregonian parsed Webfoots to Ducks and the abbreviated Anatidae was adopted as the official school mascot, beating out the likes of Timberwolves and Lumberjacks. And most would concur a gypo logger sounds more appealing than a lugubrious lumberjack, plus we have coyotes not wolves, though some continue to try.

A second school election defeated uprisings from the Trappers, Pioneers, Yellowjackets, and Spearheads. And, as with many other school’s live mascots, Oregon dabbled with “Puddles,” discovered in the Millrace through its propinquity to campus. But alas, continued complaints from the Humane Society precipitated Puddles’ retirement. Too bad a newly adopted Trapper, Yellowjacket, or Spearhead didn’t skin, sting, or skewer the society.

In 1939, the Oregon men won the inaugural NCAA basketball tournament with Oregon’s “Tall Firs” defeating Ohio State. While some old timers contend Oregon as the Tall Firs, the sobriquet was in reference to the basketball team and not the team mascot. Forward to 1947, a day that will live in mascot infamy, when Walt Disney struck a handshake deal with Athletic Director Leo Harris, allowing Oregon’s mascot the physiognomy of Disney’s Donald Duck. The agreement lasted 20 years until Disney’s death when interested parties realized there was no “official” contract, thus ensuing myriad legal transactions that have allowed the image of Donald to remain albeit within certain limitations. Note the importance of a written contract!

During the same period the Oregon State Beavers adopted their Angry Beaver, Oregon unveiled their own RoboDuck. To be succinct, an abysmal, ignominious marketing faux pau. Public relations thought they could put a “hip, cool” look to the Duck, but to no avail. Robo supersede Donald? Please. It is a Treeman Commandment to “Never say never,” but the likes of Donald, Daffy, Bugs et.al. cannot, nor will not ever be duplicated, much less transcended.

Thus, in consideration of the history and evolution of these mascots, lest not we be too precipitous in our condemnation of Benny and Donald. The institutions they represent have supplied us with many of the professional foresters that manage our nation’s woodlands, along with the lawyers to fight for the right to actively manage, or not manage, them, respectively. Let the reader be the judge as to the value of each. —Treeman

---

BOBCAT
Forestry Services LLC

Brush and Field Mowing
Trail Building • Thinning
Permits • Lot Development

Mark Spogen, Owner
360-520-9430 spog@q.com
“Certified Master Logger”

30 . NORTHWEST WOODLANDS . FALL 2012
After Planting
is a Montana State
1-360-352-6055
www.seadust.biz

Biomass in Future for Montana? continued from page 20
sell for hundreds of dollars per quart and are in significant demand on the international market. Isobutanol, the drop-in jet fuel supplement, might be a targeted byproduct of the process used to make higher-priced products.

So what is the holdup? These processes are complicated and each tree species’ wood attributes have to be matched with the appropriate and efficient breakdown method. Each step of the breakdown and reassembly process may end up being a separate business model requiring different facilities and permits. The bacteria, enzyme, yeast, or other conversion processes are in the development stages in most cases, many involving bioengineered and DNA-altered organisms, each of which is a closely guarded and proprietary secret. There are also different sources of sugar such as corn, sugar beets, and sugar cane that are competing for a market share. An advantage of wood is that depending on the species, it may contain more of the five primary sugars (glucose, mannose, galactose, xylose, and arabinose) than other agricultural crops as well as complex useful secondary compounds. For this technology to move into mass production an attractive site for multiple processing facilities has to be coupled with an available and abundant source of sugar—wood in our case. Site attractiveness will be evaluated based on a combination of social acceptance for this industry and the availability of different tree species, harvesting and transportation costs, and processing potential of their different wood composition (for wood only, or wood with bark and perhaps needles). In the case of the NARA project, the research on social and resource factors along with the chemical extraction processes are scheduled to be completed within five years, with strong hopes that investor(s) will build processing facility(s) in Montana and buy woody biomass close to the end of that time frame.

Most of today’s flavorings and cosmetics high-end products that this industry is targeting are derived from the other most abundant source of hydrocarbons—crude oil and coal. As prices for these non-renewable commodities continue to rise, alternative sources such as wood may become more economically attractive. Also, as awareness of the general public increases they may prefer to eat their breakfast muffins with flavoring made out of tree extracts rather than crude oil.

Western Montana may have the perfect set of circumstances—potential processing plant sites, abundant woody biomass, pipelines and rail systems for product transport, and perhaps most importantly, a population tired of breathing smoke and watching their forests turn red, grey, and black from bark beetles and wildfires. To quote Charles Dickens: “It was the worst of times, it was the best of times, it was the age of wisdom, it was the age of foolishness…” Which is wisdom and which is foolishness will be determined by future outcomes.

Peter Kolb is a Montana State University Extension Forestry specialist and associate professor of Forest Ecology and Management in Missoula, Mont. He can be reached at 406-243-4705 or peter.kolb@fcf.umt.edu.
Through a partnership with Oregon State University, you can address the challenges of transferring timberland in a way that reflects your values and extends your legacy.

OUR EXPERTS CAN ADVISE ON:
• Transferring timberland to heirs
• Donating timberland to OSU’s research forests
• Planning a gift that provides income in retirement
• Creating a scholarship, faculty fund, or program fund in your family name

CALL OR E-MAIL TO LEARN MORE
Zak Hansen • OSU Foundation • College of Forestry • 541-737-4016 • zak.hansen@oregonstate.edu