INTERPRETATION AND APPLICATION OF SCIENCE

Science Supports Forest Managers

Washington’s Adaptive Management

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Climate-Smart Strategies

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Valuable Lessons for Forestland Owners

This magazine is a benefit of membership in your family forestry association. Contact the officers listed on page 5 for membership details.
APPLICATION OF SCIENCE AND ADAPTIVE MANAGEMENT IN SUPPORT OF FOREST CONSERVATION AND USE

Why is science important in forest management decisions? How do large-scale research projects on public land benefit family forestlands? Consider incorporating applicable research findings into your management plan to achieve your objectives.

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MONITORING THE EFFECTIVENESS OF FOREST PRACTICES RULES IN PROTECTING AQUATIC RESOURCES

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WILDLAND FIRE: NATURE’S FUEL TREATMENT

Scientists at the Rocky Mountain Research Station and the Aldo Leopold Wilderness Research Institute are studying how past wildland fires are affecting the spread of subsequent wildfires. Can wildland fire be an effective fuel treatment? How might past wildfires near your forestland affect your risk in the future?

BY U.S. FOREST SERVICE ROCKY MOUNTAIN RESEARCH STATION

INTERPRETING AND APPLYING CLIMATE CHANGE SCIENCE IN NORTHWEST FORESTS

Experienced forest managers often recognize small changes in vegetation over time that could be attributed to climate change. Forest responses to warmer temperatures will vary. Find out from scientists at the Forest Service’s Pacific Northwest Research Station about climate-smart strategies to adapt your management practices for potential future climate conditions.

BY BECKY K. KERNS AND JOHN KIM

COLONEL MUSTARD IN THE LIBRARY WITH A CANDLESTICK? USING SCIENCE TO SOLVE A FISHER MYSTERY

Science is often used to solve mysteries in the forest, from determining why stream temperatures have changed to discovering how trees respond to stressors like drought and compaction. The mystery of the decline of the fisher population in the west is becoming clearer with scientific research by the U.S. Fish and Wildlife Service.

BY SUE LIVINGSTON AND ELIZABETH MATERNA
wo IFOA members provided input on how we interpret and apply forest science.

Paul Buckland tells us, “Forest management is both an art and a science. We use science-based knowledge as a foundation to enhance or elevate the ‘art’ aspect. Landowners use scientific principles to inform our decisions; science doesn’t make the decisions for us, we interpret the findings to apply to our own situation. Cowboy science—this brand of science fits us forestland owners perfectly. It’s not done for academic achievement or credentials, but to figure out a practical solution; it may not be broadly applicable everywhere. But not every scientific finding is a ‘Law of Nature.’ For example, to keep deer from eating cedar seedlings, hang a bar of soap on them, spray them with garlic and pepper, plant a lot more of them or plant bigger ones. Science hasn’t given us a definitive answer, but we all have tried different things that have worked.”

Marrion Banks adds, “Too often everyday citizens listen to the news or read a web post of an interview with a scientist and take it as fact. Reading and learning about the research going on in forestry today is important and cannot be overlooked if we want to be good stewards of the land. But we need to remember that we have a responsibility to turn on our brains and ask questions. Whenever anyone tells you anything, treat it as a hypothesis to be tested. Someone proposes a theory about how the world works. Then they devise experiments or studies to test the hypothesis. When we read scientific articles, what we’re really seeing is the report from the scientist about how well the outcome of the experiment or the study matched the expected outcome of the theory. We need to ask the following questions:

• Does this research really apply to my land and my situation?
• Is there something in my situation that appears to contradict the research and findings of the science?

The most important thing to remember about a scientific theory is that it is just a theory. According to the scientific method, a theory can only be disproven; it can never be proven beyond doubt. When confronted with scientific studies and theories about forest health, a certain amount of healthy skepticism isn’t a bad thing.”

In my experience, forestland owners understand and care very deeply for their forests—much more so than the average citizen understands or cares about their environment. Maintaining a private forest is a labor of love. It is difficult and often expensive work keeping a forest healthy, and frustrating when an outsider forms an opinion based on some false sense of what is really going on. These people have never worked in a forest, have not walked on the same trails daily through many years and all seasons, have never watched things improve over decades of loving care, are not fearful every fire season and don’t have sore backs and callused hands to prove it.”
as forest managers, we are often faced with making decisions in the absence of complete data to form conclusions. As we look at research in the natural resource arena, we quickly realize that our forest ecosystems are complex. There are numerous natural variables interacting with one another and the response in one localized area may have different results in another area. Research shows that impacts to forest ecosystems, either natural or because of management actions, have positive effects on some variables but negative effects on others. As we make management decisions, we strive to select management actions with the most positive, long-term impacts to the ecosystem, and minimize the magnitude and duration of negative impacts.

When policies are developed around natural resources, it is important to consider the complexities of our total forest ecosystem. Looking at one variable while ignoring all the other variables is very short-sighted and will result in less-than-ideal policy decisions. For example, let’s look at the policy resulting in changes to the Oregon Forest Practices Act (OFPA) for small- and medium-sized streams with salmon, steelhead or bull trout. The process was initiated due to a research project indicating when harvest occurred to the maximum extent allowed by the OFPA on private lands, the policy of a 0.3-degree Celsius temperature increase threshold established by Oregon’s Environmental Quality Commission to meet the Clean Water Act was violated about 40 percent of the time. The streams that exceeded the threshold increased by 0.7 degrees Celsius on average. This forced a policy decision-making process where one metric, water temperature, was used to develop a riparian rule policy. By looking at this one metric, all other variables impacted by this policy decision were ignored.

We have three major Paired Watershed Research studies in western Oregon that analyzed many variables and the responses to harvesting, which was done in compliance with OFPA at the time of the study. The results from these studies were consistent with other studies showing water temperatures did increase in some but not all cases. They also indicated that in many cases fish benefited by harvest to the levels allowed by the Forest Practices Act. These results highlighted the need for light in our forest ecosystems. Fish numbers and/or biomass increased in many of the study reaches where additional light caused water temperature to increase slightly. It should be no surprise that some light is not only good, but essential, for our forest ecosystems. With light comes food, some of which the fish eat.

As we move forward in the policy arena, it is critical we look at impacts to the whole ecosystem when making decisions, and not focus on one variable at a time. We need policies allowing landowners to meet their management objectives by utilizing approaches that maximize the long-term positive impacts of their actions and have minimal, short-term negative impacts.
Logic would have it that we forest owners would base our silvicultural practices on science rather than on mere conjecture or theory. Yet, landowners have different levels of understanding of applicable science. Montana has a unique program to provide this science to forestland owners. The program is offered as a three-day workshop developed by Montana State University Extension Forestry (MSUEF). Instructors are natural resource professionals who are trained and certified by MSUEF. The purpose of each workshop is to inform and educate forest owners on the science that governs good silvicultural practices. The workshop attendees are taught to understand the environmental consequences of stewardship decisions. For example, attendees learn how to identify and manage:

- the most prevalent plants, including a minimum of 11 grasses, six forbs and 17 shrubs;
- the important forest insects and diseases, including bark beetles, mistletoes, budworms, gall rust and root diseases;
- different tree species, including their relationships with elevation, aspect, shade tolerance, drought resistance, fire resistance and frost tolerance;
- stand dynamics, basal area, canopy importance and the relationship with wildfire;
- riparian areas requiring special consideration; and
- how a wildfire might behave in a managed forest.

After one day of instruction on the science of forestry, specifically how a forest reacts to a multitude of factors driven by nature or man, the workshop moves outdoors for four hours to learn how to take a forest inventory. Then, back in the classroom, each participant creates his own forest management plan. The workshop does not tell participants what to do with their forests. Instead, it provides the science behind each action or non-action taken so each owner is empowered to make his own management decisions.

The feedback from workshop attendees includes:

- Was I ever glad I attended the Bozeman workshop.
- Didn’t think you could get so much information in so little time.
- We’ve really come to appreciate our new knowledge and expanded vocabulary. Every tree in the forest has taken on a new appearance.
- I will never look at my forest with the same eyes again.
- If you have from one to a million acres of forest, this workshop would be valuable, especially if you have not paid much attention to your forest or are a new owner.

Workshop details can be found at: msuextension.org/forestry/under MSU Extension Forestry, select Programs, then Forest Stewardship. Learn to interpret and apply science!
Can a Bowl of Alphabet Soup Improve Forest Practices?

Recommended: Bring in at least one cook from each caucus to oversee soup assembly.

Ingredients:
- One large box of alphabet letters, to include, but not limited to: AMP, WRT, TFW, LWD, FPB, HCP, NSO, F&F, FPA, BAS, RMZ, DNR, WAC, OCH, etc.
- Plenty of fresh stream water, preferably with potential fish habitat for flavor. (The vegetarian option does not require actual fish.)
- Salt and pepper to taste

Recipe:
1. Add all ingredients to a large stockpot.
2. Place stockpot on stove.
3. Cover the pot and simmer on medium for many, many years. Stir occasionally to prevent scorching.
4. Taste monthly. Throw in more alphabet letters as needed.

To serve Alphabet Soup, place a hearty helping into bowls and require each cook to taste, evaluate and make recommendations for recipe improvement. Consensus among all cooks is recommended to make changes to this recipe. In Washington, this is known as the Adaptive Management Program (AMP).

I hope this tongue-in-cheek recipe gives you a chuckle, not heartburn. In our Alphabet Soup, the AMP is meant to provide a mechanism to improve Forest Practices, while still protecting sensitive areas, such as streams. The idea is that Best Available Science (BAS) should result in recommendations to the state’s forest practice rules based on evidence. Scientists have designed and implemented studies such as “Effectiveness of Riparian Management Zone Prescriptions in Protecting and Maintaining Shade and Water Temperature in Forested Streams of Eastern Washington” and “Breeding Bird Response to Riparian Buffer Width 10 Years Post-harvest.”

Unfortunately, very few recommended changes have come from these types of scientifically designed studies, as far as I can tell.

Nonetheless, as with most other areas of life, forestry regulations often lurch forward at breakneck speed with mixed outcomes when a disaster occurs, such as timber harvest rules around unstable slopes after the Oso landslide. Understandably, the visceral reaction is to prevent any further tragedies by severely limiting activities which might result in a similar outcome. This usually adds new Alphabets to the soup, whether scientifically supported or not.

Remarkably, the scientific conclusions from AMP-sponsored science to this point generally support the benefits of family-owned forests, as well as our soup bowls. With that context, I am happy to report that WFFA has many fantastic chefs who are diligently working on the Alphabet Soup recipe to ensure that any changes in Forest Practices rules are soundly based in science. Dare I say, “bon appétit”? ■

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- Olympia, WA 360-596-4232
- Longview, WA 360-414-3401
- Springfield, OR 541-729-3922
AUGUST

✓ In stands susceptible to engraver beetles, schedule cutting of trees over three inches in diameter after August 1 and before January 1 to prevent population buildup in fresh slash.

✓ Forestland is popular for hunting. Look into options for permitting and security.

✓ Maintain your fire prevention diligence until fire season is over in your area. Do you know what your fire danger rating is?

✓ While water levels are low, complete your instream repairs and improvements. Find out if a permit is required. Consider installing a guzzler or cistern for wildlife. Clear out and reestablish overgrown springs.

✓ If you’re planning a selection harvest, take the time to paint either the leave trees or the take trees. Or, with a reliable logger, develop clear logger-select guidelines and monitor the work as you go.

SEPTEMBER

✓ Invite a logger, forester or firefighter to survey and assess your roads for access, repair and maintenance needs. Take a look at the entire haul route(s) and assure that you have road use permits in place.

✓ Cruise the timber you plan to harvest or have a professional forester do it. Having a good estimate of volume and value helps you market the logs.

✓ While you’re cruising, take some core samples to see how your trees are growing. Do a few calculations to assure yourself that your efforts are paying off with accumulated growth, improved vigor and overall good forest health.

✓ Students are back in school and it’s a good time to host or participate in a forest tour. Help our future forestland owners learn about natural resources on site. It will be memorable!

✓ Check your management plan for next year. Discuss upcoming project opportunities with a consultant or agency representative.

OCTOBER

✓ Begin your road maintenance and improvement projects after some moisture has reduced the potential for dust and the road surface is workable.

✓ The end of fire season is often a good time for burning slash or prescribed burning. Use of fire requires planning and usually a permit or notification. The burn “window” is sometimes small, so be well-prepared to begin when conditions are right.

✓ Develop your tree planting contract or agreement and hire an experienced contractor. Get it done right the first time!

✓ Find out when and where to apply for cost-share incentives for next year’s projects.

✓ When you’re pleased with your project results, give your forester, logger, agency representative or hired hand kudos for a job well done.

FOR MORE INFORMATION...

check out these favorite websites and publications:

• oregon.gov/ODF/ForestBenefits/Pages/ForestHealth.aspx (I&D fact sheets)
• oregon.gov/ODF/Fire/Pages/FirePrevention.aspx (Oregon fire prevention requirements)
• dnr.wa.gov/ifpl (Washington fire prevention requirements)
• id.lida.gov/fire (Idaho fire prevention requirements)
• dnrc.mt.gov/divisions/forestry/fire-and-aviation/fire-prevention-and-preparedness (Montana fire prevention requirements)
• nrcs.usda.gov/Internet/FSE/Documents/nrcs144p2_042076.pdf (wildlife watering)
• knowyourforest.org/sites/default/files/documents/ec1137.pdf (forest road design)
• knowyourforest.org/sites/default/files/documents/Measuring_timber_products.pdf
• extension.iastate.edu/forestry/publications/PDF_files/PM2088A.pdf (developing a prescribed fire burn plan)
• knowyourforest.org/sites/default/files/documents/ec1192.pdf (sample contracts)
• file.dnr.wa.gov/publications/frc_webster_plantingforestseedlings.pdf

Down on the Tree Farm is a compilation of all of the excellent tips contributed to this column by experienced volunteers over the last 15 years. Suggestions are always welcome and may be sent to the editor at: annewithnww@gmail.com.

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Application of Science and Adaptive Management in Support of Forest Conservation and Use

By TOM SPIES AND BRAD WITHROW-ROBINSON

Science and communication of science to managers has been foundational to forestry in the United States for over 120 years, when Bernard Fernow and Gifford Pinchot, pioneers of American forestry, first brought scientific forestry ideas to the U.S. from Europe. For example, one of those early scientific ideas (called “new forestry” in 1900 by one author) was the notion that forests needed to be replanted after logging, a practice that was novel to many landowners in the U.S. at that time. Science and its application to guide forestry practices was institutionalized in U.S. Forest Service in the early 20th century through the activities of the State and Private Forestry branch (established in 1908) and the Research branch (established in 1915). At the state level, forestry research was supported at some select universities starting in the early 20th century. Broader and accelerated support for forestry research at land grant universities and other institutions began in the early 1960s when federal funding was expanded to support forestry research. Large industrial forest owners and non-profit research institutes also have a history of supporting applied forestry research in areas such as tree improvement, silviculture, watershed protection, wildlife habitat and climate change.

Science is important in forestry because forests are complex and benefits are diverse. Conserving and managing complex forest ecosystems for different benefits requires specialized knowledge of biology and the environment. It requires a multi-disciplinary, long-term perspective of decades or centuries. Science helps inform us how actions today might affect different values of the forest in 10 or 100 years. Science is also needed to help us understand how forests differ geographically according to climate, soils, plant communities and natural disturbance agents, such as fire and insects. Forests are not all the same and science can help landowners avoid applying approaches that may be right for one forest and set of objectives but would be wrong for another forest or different set of objectives.

There are many types of science that relate to forests. Two major types are basic (pursuit of knowledge for knowledge’s sake) and applied science (pursuit of knowledge to promote ecological, social or economic benefits). Differences between these two may not always be that great. Often an applied question (e.g., how to grow a certain species of tree or how to maintain native biodiversity on a site) requires a fundamental understanding of biology and the environment. It requires a multi-disciplinary, long-term perspective of decades or centuries. Science helps inform us how actions today might affect different values of the forest in 10 or 100 years. Science is also needed to help us understand how forests differ geographically according to climate, soils, plant communities and natural disturbance agents, such as fire and insects. Forests are not all the same and science can help landowners avoid applying approaches that may be right for one forest and set of objectives but would be wrong for another forest or different set of objectives.

“The object of forestry is to discover and apply the principles according to which forests are best managed. Although it is composed of trees, the forest is far more than a collection of trees standing in one place. It has a population of animals and plants peculiar to itself, a soil largely of its own making, and a climate different in many ways from that of the open country. The forest is as beautiful as it is useful. Perhaps no other natural agent has done so much for the human race and has been so recklessly used and so little understood.”

From Chapter 1, Primer of Forestry.

Gifford Pinchot 1903
goals this fundamental understanding has already been worked out. Applied science is only needed to figure out how to achieve management goals in specific situations or under particular economic constraints. In other cases, new issues (e.g., effects of climate change) or new goals (e.g., maintaining or restoring native species and ecosystems) requires new fundamental research and knowledge about forest biology and ecology as well as applied research.

The application of science to forestry is almost always dependent on management objectives that may

range from conservation of native biodiversity to commercial timber production. Forest ecosystems produce different benefits depending on the type of forest and what the landowner wants. These include ecosystem services, such as clean water, wildlife habitat and carbon storage, in addition to wood products. The need to set objectives in forest management and conservation is common to all landowners whether they are managers of large federal forests, industrial forests or small private forests. In this article, we illustrate how science is being applied in federal forest management in the Pacific Northwest, how the use of science can be similar for large and small forest owners and how federal science can be relevant to woodland owners.

Science informs forest management many ways, not just by providing information to landowners. For exam-

–Continued on next page–
ple, in forestry for management of public lands, the public can be a consumer of science and use that information to try to influence public land management or forest practices rules for private forestlands. Some members of the public have used scientific information about the influence of riparian forests on stream environments to advocate for changes to forest practices rules in the region. In public debates about forestland management, the science may be selectively used by groups to promote their values. This situation makes it important to have research institutions, such as the PNW Forest Service Research Station and Oregon State University, where scientific knowledge can be critically assessed and vetted through publication in peer-reviewed scientific journals. These institutions and the scientific process do not ensure that our present knowledge is correct nor free of bias (e.g., by choices of what aspects of a forest to study and what to ignore) but they do ensure that over the long run our understanding of forests and forest management outcomes will continually improve and hopefully avoid some costly ecological or economic mistakes.

The use of science is also not just about finding answers to questions about how to achieve landowner goals. In many cases, science is needed to help define the questions, goals or objectives. For example, for landowners interested in conserving native plants and animals of a forest it is necessary to first understand what aspects of biodiversity are possible given the characteristics of their forest, including its type, size and location in the larger landscape. The science can then be used to help define the objectives that are possible, given intersection of a broad vision for the forest, the current characteristics of the forest and our understanding of the relationships among the plants, animals and forest environment.

Once goals, objectives and desired outcomes are identified, science and researchers can help design management approaches (passive and active) to reach goals. These approaches can be in the form of silvicultural prescriptions that detail how, when and where the forest can be manipulated to reach desired outcomes.

Most forest plans are based on knowledge that contains gaps and uncertainties, and on assumptions about future environments (e.g., climate, insects, disease) that may not be correct. This is true of plans for a government, a large industrial landowner or small landowner. Given these uncertainties, forest owners and managers ideally would monitor progress to ensure that they are on the right track. If not, they can identify problems and make changes to activities or plans as needed. The systematic process of making informed management decisions, monitoring, evaluating the results and revising the management practices accordingly is called adaptive management. The history of forestry can be written in terms of management practices that have changed in response to new science or knowledge gained through management successes and failures. For example, think how our understanding of forest ecosystems and management have changed in the last half century. We have learned that suppressing fire in fire-prone ecosystems can lead to increased insects, disease, fire severity and other unintended consequences. We’ve learned that it is important to plant trees that are genetically adapted to the environment of the forest site where they will grow. We have learned that good anadromous fish habitat depends on heterogeneity of stream channels, which is promoted by the presence in streams of large, dead tree boles.

All forests, even intensively managed plantations, are natural ecosystems that are subject to unforeseen events and influences that are outside
the control of the forest owner. Gaps in scientific knowledge, uncertainties in our understanding and outright surprises come with the territory for forest managers. Managers and applied scientists often must make informed judgements about what to do in specific cases where there is uncertainty about the science and how to meet objectives. The guiding principle from management science in these cases is to use adaptive management, including trying different approaches while documenting actions and outcomes so that future managers can learn from knowledge of what was done in the past.

Science in support of Federal Land Management: The case of the Northwest Forest Plan

A prime and highly visible example of the application of science in forest conservation and management is the Northwest Forest Plan (NWFP). The NWFP covers federal forests across the range of the northern spotted owl in Washington, Oregon and Northern California. While science is used throughout federal forest management in the United States, this case is noteworthy, because scientists played a prominent role in developing it in the early 1990s. The goals of the plan, as outlined at that time by then President Clinton, were to conserve and restore old-growth forest habitats used by the spotted owl and other terrestrial and aquatic species, and also to provide a sustainable level of timber that did not degrade the environment. The NWFP was motivated by court rulings that shut down federal timber management activities across the region that were found to violate federal environmental laws. The backbone of the new plan rested on designation of large blocks of older conifer forests (e.g., late-successional reserves) and riparian reserves where timber management was excluded. In the matrix (areas outside these habitat conservation areas), the goal was to produce some timber while still providing ecological diversity. The scientists developed options with different degrees of environmental protection and timber production, and the President selected one of those options that was implemented in 1994.

The role of science did not end with the development and implementation of the plan. Since that time, managers and scientists have monitored the forests, spotted owls, aquatic ecosystems, marbled murrelets and numerous other species, as well as socio-economic conditions and tribal relations, to evaluate how effective the plan has been in reaching its original goals. In addition, research has provided new information about forest ecology, fire ecology, aquatic ecosystems, spotted owls and novel forest restoration techniques. The new science will be considered by managers when they start the process of revising the National Forest plans within the NWFP area.

The recent science related to the NWFP will be synthesized by the Pacific Northwest and Pacific Southwest Research Stations later this year. This synthesis will not make recommendation on what managers should do or provide plan options, as was done in 1993. Instead, the report will characterize what has happened to federal forests and selected species since 1993, and what is known now about the possible consequences of management actions or inactions to ecosystems, species and socio-economic values. The forest managers will use this information to consider how they might revise the plan to meet the original goals, and take into account new knowledge and challenges.

Peeking into the report, we find that our understanding of the habitat requirements of the northern spotted owl has not changed much since the...
development of the NWFP in 1993. Older, multi-layered forests are still the key to nesting and roosting habitat. However, we have also learned through monitoring and research that the loss of owl habitat to logging was not the only threat to the species. The barred owl, a more aggressive species that has migrated into the region, is now displacing the spotted owl in many areas. This new understanding led the U.S. Fish and Wildlife Service to adopt additional measures to conserve the owl, including protecting more habitat and experimenting with removal of barred owls in some areas.

Another example of new science comes from research on how climate change over the next several decades might affect forests, including increased drought and wildfire in some parts of the NWFP area. The synthesis summarizes possible ways to increase resilience of forests to climate change and fire. These may include reducing density of forests in drier environments, reintroducing fire where possible, or planting species or genotypes that may be better adapted to a climate with warmer and possibly more extreme conditions.

A key part of science synthesis is the identification of uncertainties and knowledge gaps, and areas where additional research is needed. The synthesis also reveals that the original goals for use of adaptive management in the plan have not been met, making it difficult for managers to implement new approaches based on experience and formal studies. On the plus side, the agencies have been able to maintain monitoring efforts that have been invaluable in learning about what has happened to forests, wildlife, timber production and human communities in the 23 years since the NWFP was implemented.

Relevance of federal science to woodland owners

The role of science in federal forest policy and management may seem quite distant and unrelated to the use of science by small woodland owners, but that is not necessarily so.

Yes, the NWFP’s goal of conserving centuries-old forests in blocks of hundreds of thousands of acres is not directly relevant to people who might own 20 acres of young forest near the urban interface. Despite these obvious differences, the application of science in support of federal forest management can be relevant to small woodland owners, especially those who have a goal of conserving native forest biological diversity or integrating economic and ecological goals.

Second-hand science may be the only science available to family landowners wanting to use current knowledge. Since there are no large research programs focusing specifically on their needs, family landowners need to find their information in the science commissioned and conducted by others. Sources include research done by forestry corporations, university-based research cooperatives, as well as state and federal research programs. Research-based information about genetics, reforestation, restora-
tion, insects and diseases is available and is relevant to a wide range of management objectives. The challenge for family landowners is to find information that relates to their interests and apply that towards their own management goals, rather than to simply mimic management actions of a corporate or government neighbor.

For better or for worse, there are similarities in process and usefulness of science produced by the various types of landowner. The first similarity is the challenge of setting goals, whether it be a politically diverse group of public stakeholders or an older sister in Seattle.

The next similarity is the challenge of finding the science that is relevant to a forest. While teams of scientists are conducting studies to meet the needs of federal land managers, their work is often a drop in the bucket compared to the size and diversity of the federal forestlands. So, federal land managers, like many private family land managers, are often working with incomplete information, adapting information as best they can from distant, small studies of limited duration to their particular situation.

The challenge of finding relevant science is partly due to the lack of people who can translate the science for managers. Practical, understandable and management-oriented sources of science-based information can be hard to find. Even when their research is highly applicable, scientists are often consumed by the endless task of writing grant proposals to fund their research. Then there is the arduous process of publishing research in peer-reviewed journals (which can take years) to ensure that the science that they produce meets scientific standards for quality. This leaves little time for most scientists to translate the science from highly technical formats to something that is practical for land managers.

Although government agencies like the Forest Service and Bureau of Land Management do have people whose job it is to translate and communicate science to land managers and society, they are few and information does not always flow as far as it could. Fortunately, there is often a fair amount of communication and collaboration between the various research entities, many of which have some affiliation with universities, including the land grant universities. Land grant universities, and particularly their Forestry Extension programs, play an important role in helping translate and communicate relevant research to various audiences as appropriate, including family forestland owners. For more information about available Forest Service science in this region see: fs.fed.us/pnw.

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Monitoring the Effectiveness of Forest Practices Rules in Protecting Aquatic Resources

By HANS B. BERGE, HOWARD HAEMMERLE AND TERESA MISKOVIC

Private landowners manage roughly 11.6 million acres of forestland in Washington State. This acreage is divided nearly equally between commercial industrial owners and non-industrial forestland owners. While each must meet economic performance objectives, their approaches and objectives for their forests vary widely. The pattern of forestland ownership also varies significantly between eastern and western Washington. In western Washington, where forest productivity is greatest, the area of industrial forestland ownership is more than three times higher than it is in eastern Washington. Small forestland ownership acreage is roughly the same when comparing eastern and western Washington.

Forest practices on state and private working lands in Washington are regulated by the state's Forest Practices Act [chapter 76.09 Revised Code of Washington (RCW)], Forest Practices Rules [Title 222 Washington Administrative Code (WAC)] and the Forest Practices Habitat Conservation Plan (HCP). These protections are in place to safeguard public resources, such as water, soil and wildlife during forestry operations. It represents one of the most comprehensive and protective systems in the United States.

Background

Regulation of logging and silviculture in Washington began in earnest in 1974 with the passage of the Forest Practices Act. The act sought to balance protecting Washington's natural resources with maintaining a viable forest industry. The Forest Practices Board (Board) was established as the independent state agency responsible for adopting the rules necessary to fulfill the act. Over time, the forest practices rules and associated guidance were more fully developed through several collaborative, multi-stakeholder agreements.

In 1986, the Board proposed new regulations for riparian zone protection and cumulative effects (from past, present, and possible future action) resulting in serious disagreements between and within the Board and stakeholders. Negotiations between the Treaty Tribes, the timber industry, environmental groups and state agencies began, and the Timber Fish and Wildlife Agreement (TFW) was finalized in 1987. The state legislature amended the Forest Practices Act to follow the recommendations made in the TFW Agreement, which laid the foundation for the cooperative management of the state's forestlands that continues to this day.

The long-term commitment of the participants resulted in the 1999 Forests and Fish Report, the permanent forest practices rules adopted in 2001 and the subsequent approval of the Forest Practices Habitat Conservation Plan (HCP). The resulting Forests and Fish Report reflected the commitment to statewide salmon recovery, restoration of related riparian ecosystems and the necessity for tribal involvement in all phases of forest management and rule making. The authors of the Forest and Fish Report also recommended an adaptive management program. Specific areas of scientific uncertainty, key questions, resource objectives and performance targets were developed for the program to address.

The Forest Practices Aquatic HCP was the first in the nation to cover a statewide regulatory program. It covers over nine million acres of state and private forestland and is a critical piece of the state’s salmon recovery strategy. It provides Endangered Species Act (ESA) and Clean Water Act (CWA) assurances, which in turn provides regulatory stability for Washington's forest landowners and timber industry. The HCP specifically endorses the
Forest Practices

Adaptive Management Program (AMP) as being a necessary component to protecting aquatic species.

Adaptive Management Program

Adaptive management is an iterative process of robust decision-making in the face of uncertainty, with an aim to reduce uncertainty through monitoring (Holling, C.S. 1978. Adaptive Environmental Assessment and Management). It relies on learning through actions and is a systematic approach for improving resource management by learning from outcomes. Scientific investigation and inquiry is well-suited to inform adaptive management since the emphasis is placed on learning and adapting.

The AMP in Washington was created to provide science-based recommendations to assist the Board in determining when it is necessary or advisable to adjust rules and guidance (see RCW 76.09.370(7)) for the protection of aquatic resources. The four goals are:

1. To provide compliance with the ESA for aquatic- and riparian-dependent species on non-federal forest lands;
2. To restore and maintain riparian habitat on non-federal forest lands to support a harvestable supply of fish;
3. To meet the requirements of the CWA for water quality on non-federal forest lands; and
4. To keep the timber industry economically viable in Washington.

The AMP is comprised of the Board; the Timber, Fish and Wildlife Policy Committee (Policy); the Cooperative Monitoring, Evaluation, and Research Committee (CMER); the Adaptive Management Program Administrator (AMPA) and the Independent Science Peer Review process (ISPR) (see Figure 1).

The structure of the AMP includes three functions: policy, science, and implementation. CMER reviews existing science and contributes applied research to the program. The intent is to provide unbiased science for consideration by Policy and the Board. Policy uses that unbiased information

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Figure 1. Schematic of the structure of the Adaptive Management Program.
Wildland Fire: Nature’s Fuel Treatment

The Irish poet William Butler Yeats was fascinated by a cyclical view of history—the idea that, just as the four seasons repeat themselves year after year, history follows a cyclical course. His poetry is filled with allusions to birth, death and renewal, such as reincarnation, the 28-day lunar cycle and the phoenix, the mythical bird that dies in a self-created fire and is then reborn from its own ashes.

Yeats would likely approve of the research conducted by Sean Parks and others at the U.S. Forest Service. A research ecologist based out of Missoula, Montana, Parks sees wildland fire as part of a self-regulating cycle that temporarily reduces landscape-level vegetation and fuel—a natural process that can reduce the size, spread, severity and even the occurrence of future fires. Wildland fires can reduce live and dead vegetation, while the ashes that remain can release nutrients that have been locked in older vegetation, which benefits surviving or regenerating trees and other vegetation. Wildland fires can also improve forest health by reducing the density of trees, which reduces competition for necessary resources such as light and water.

Parks and his colleagues focus on several aspects of fire ecology in the forested regions of the western U.S., including the analysis of wildland fire as a method of reducing future fire impact. As Parks describes it, “I conduct scientific studies that evaluate what happens when a fire runs into a previously burned area.”

“A number of plant species have evolved with fire and have adaptations that allow them to persist after fire,” Parks goes on to say. “These adaptations may include thick bark, the ability to resprout and the ability to easily reseed. Once you remove fire via fire suppression, you throw ecosystems out of whack. Given that fire will inevitably burn any given area, removing fire today often sets the stage for a more severe fire in future years.”

Though it’s not always thought of as a fuel treatment, wildland fire has the potential to consume fuel and alter vegetation structure in much the same way as prescribed fires. However, wildland fire—whether naturally occurring or an accidental, human-caused blaze—leaves a much bigger footprint than prescribed fire. According to data from the National Interagency Fire Center, wildland fires in the conterminous western U.S. burned more than 10 times as many acres on average from 2011 to 2015 compared to prescribed fires. As Parks explains, “In the western U.S.,
prescribed burns are typically only a couple hundred acres or less—they barely make a dent. Wildland fires cover a lot more ground and have a lot more treatment impact.”

What does this mean to land managers? Faced with a wildland fire, land managers need to know when and where to suppress the fire, and when and where to allow nature to take its course.

It’s not an easy decision. According to Carol Miller, who works with Parks at the Aldo Leopold Wilderness Research Institute under the umbrella of the Rocky Mountain Research Station, “It can be really hard for a wilderness manager to let a fire burn. There are neighboring properties to consider, for one thing. And there’s the fact that we’ve been suppressing fires for so long that the result of a fire may not be what people want to see.”

Researching nature’s fuel treatments

Given an increased emphasis on restoring landscape resilience, along with the expectation that extreme fire weather is becoming more common, Parks and his colleagues believe that land managers will be asking the following questions with increasing regularity:

• Will a previous or presently occurring wildland fire be an effective fuel treatment: If so, for how long?
• How do local weather conditions and ecosystem type impact the length of time that wildfires serve as effective fuel treatments?

To help answer these questions, Parks and his colleagues used satellite data and other resources to research fires from 1972-2012 in four federally.

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Ongoing Forest Service fire research can help land managers decide where to suppress a wildland fire and where to let it burn.
protected areas: the Frank Church-River of No Return Wilderness in central Idaho, the Selway-Bitterroot Wilderness in north-central Idaho and western Montana, the Crown of the Continent region of northern Montana, and the Gila and Aldo Leopold Wilderness Areas in New Mexico. All four regions have an established history of allowing wildland fires to burn.

According to Parks, the research shows that past fires limit the size, spread, severity and occurrence of subsequent fires in the northern Rockies and the Southwest. The lower severity his team found in reburns compared to no-reburns is likely due to the consumption of dead and down fuel by previous fires, which reduced fuel availability for subsequent fires. Another possible reason is that previous fires can cause changes in vegetation amount, structure and composition, a process that reduces ladder fuels and the likelihood of torching of the upper canopy during subsequent fires.

Overall, Parks and his team found that wildland fire can act as a fuel treatment that:
- Reduces occurrence of subsequent fire for eight to 25 years or more
- Limits size of subsequent fire for six to 18 years
- Limits severity of subsequent fire for 20 years or more

Parks explains that the wide time ranges are the result of factors such as ecosystem type, fire weather and topography. For example, Parks and his colleagues found that the length of time that a fire was an effective treatment was shorter in the warm and dry study area in New Mexico compared to the cooler, wetter areas in the middle and northern Rocky Mountains.

Likewise, the length of time that a fire was an effective fuel treatment was shorter when an area experienced increasingly fire-conducive weather conditions. Specifically, in the Selway-Bitterroot Wilderness study area, Parks and his team found a 70 percent likelihood that a 15-year-old burn scar will limit the spread of a fire under moderate fire weather conditions. Under extreme fire weather conditions, that likelihood is only 25 percent. As a result, Parks says, “Suppressing a fire can be a lost opportunity to restore ecological resilience, especially during non-extreme weather conditions.”

Parks cautions that several factors they did not explore can affect where and when fires stop spreading. These variables include wind direction, natural fuel breaks and man-made features such as roads.

### Applying the knowledge

Parks is hopeful that his team’s research will help land managers broaden their perspective of fire. “Managers typically don’t make a fire decision based solely on ecological principles or science,” Parks explains. “Things like air quality, public perception, and land use are often the deciding factors. A land manager may get a phone call saying, ‘I have an elk camp there; you need to put out that fire.’ But it’s important that managers also consider the long-term benefits of fire and not simply the perceived short-term costs.” Land managers can use the research in conjunction with the Wildland Fire Decision Support System (WFDSS), a decision support system that was chartered by interagency fire management executives, to assess risks and fire behavior during a wildland fire. (wfdss.usgs.gov)

“The information is out there in the published literature,” Parks says, “but if a land manager needs to find out the implications of a past fire, they’re always welcome to contact us.” For Parks and his colleagues, it all comes down to giving land managers the information they need to make informed decisions. As William Butler Yeats once said, “Education is not the filling of a pail, but the lighting of a fire.”

For more information or to get an opinion on a specific fire scenario, land managers can contact Sean Parks at sean_parks@fs.fed.us or Carol Miller at cmiller04@fs.fed.us.

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**Key Findings**

- Wildland fires can act as fuel treatments that reduce the size, severity, spread and even occurrence of subsequent fires because they reduce fuel loads.
- The length of time that wildfires serve as effective fuel treatments varies by ecosystem type and diminishes under severe fire weather conditions.
- There may be long-term benefits from a wildland fire that is managed for resource benefit, whereas suppressing a fire may represent a lost opportunity to restore ecological resilience, especially during non-extreme weather conditions.
- U.S. Forest Service research can help land managers determine how effective a past fire might be in reducing the size and severity of a subsequent fire in the same location.
Interpreting and Applying Climate Change Science in Northwest Forests

By BECKY K. KERNS AND JOHN KIM

Warming temperatures, changes in temperature variability, rainfall patterns and changes in climate-related disturbances (windstorms, floods, wildfire) are happening all around the region. These new trends raise concerns among Northwest forest managers about climate change and how best to manage forests in the face of it. Whether or not people agree about the causes of global warming, it’s apparent that the future is going to be quite different than the past.

One thing scientists agree on is that temperatures will continue to rise. Scientists use many global climate models developed by the world’s top research labs to simulate past and future climate. These models agree that by the year 2100 the climate will be much warmer worldwide, including in the Pacific Northwest (PNW). The average annual temperature in the PNW may be as much as 11 degrees Fahrenheit warmer than today under the “business-as-usual” scenario. Most of the PNW is expected to shift into a warmer climate (termed “climate departure” by some) unlike the recent past, perhaps as soon as mid-century (Figure 1). Future rainfall patterns are not as clear, but many global climate models suggest we could see more rainfall in the PNW, especially in the winter and/or spring, and our summers may be drier, hotter and last longer.

Changes in climate will change our forests. Some changes might involve the timing of budburst, which could occur both earlier and later, depending on location and species. For example, in some areas, Douglas-fir is projected to burst bud more than two months earlier by 2080 under the “business-as-usual” climate change scenario, while trees in locations with warmer winter temperatures are projected to burst bud later than they do now. Most tree species in the PNW, including Douglas-fir, require a minimum amount of chilling in the winter to successfully burst bud in the spring. Trees that experience fewer chilling hours, and thus burst bud later, may not be able to grow enough before droughty conditions occur. Some species may shift in distribution (e.g., move north or up in elevation) or become locally extinct. The largest changes will likely occur in areas where species are currently stressed or along the edges of their current ranges, such as at treeline or the transition zones from forest to shrubland or grassland. Our understanding of past climates suggests many tree species may remain in their current locations but be less common or more common, rather than become locally extinct. In other words, climate change means there will be winners and losers.

The big picture

Forest and woodland responses to climate change will vary by site, stand age, land use and disturbance history. Forests west of the Cascade crest generally receive abundant rain in the winter and most sites are not water-limited. These forests are dense and typically have a lot of biomass. Warmer temperatures, longer growing seasons and increased rainfall brought on by climate change could make these forests even more productive if the summer droughts are not too dry

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Figure 1. The anticipated arrival of record-setting temperatures or when average annual temperatures will be outside historical ranges within the United States if current greenhouse gas emissions continue.

SOURCE: KERNS ET AL. 2016
However, if summer droughts intensify it may offset some of the benefits of a warmer and wetter climate. Some studies show that in forests where limited light and available nutrients reduce growth, productivity has increased over the past 100 years due to warming. But where forests experience summer water deficits, mortality rates are increasing. As some species are unable to tolerate these new conditions, other species may move in.

In warmer climates thousands of years ago, Douglas-fir, oak, madrone and giant chinquapin were common on warm and dry sites, and maple and alder expanded in riparian zones. Some simulation models also suggest that westside maritime forests may support more types of hardwood species in the future, and the mixed conifer and hardwood species typical of the warmer southwestern Oregon and northern California may expand north.

Warmer climates are also projected for east of the Cascade crest. Minimum winter temperatures are projected to rise, and milder winters, combined with possible increases in rainfall and a longer growing season, are projected to increase forest productivity and expand forest cover, especially in cold, high-elevation areas. Subalpine forests are projected to almost disappear, although some may persist in climate refugia. Species more common at lower elevations, such as ponderosa pine and Douglas-fir, could expand upwards in elevation into former subalpine forested zones, especially after fire or some other disturbance. In warmer climates of the distant past, ponderosa pine and oak woodlands were more common across the landscape and grew at higher elevations than today. In areas where a given tree species is more stressed, such as drier and warmer margins of its current extent, the species may be less productive or not regenerate as well, especially as summer drought intensifies. Juniper woodlands, which have been increasing in recent decades, may continue to expand and densify, although more frequent fire and/or wetter conditions may alter species composition and reduce juniper abundance.

What about the increasing carbon dioxide (CO₂) in the atmosphere? The “fertilization effect” of increasing concentrations of CO₂ in the atmosphere is only partially understood. Experiments show that higher concentrations of atmospheric CO₂ may allow trees to use water more efficiently in photosynthesis. However, laboratory results may not translate to real forests, as increasing drought stress, other nutrient limitation, effects of insects and pathogens and increased fire activity may also come with climate change.

Ecological disturbances such as fire and insect outbreaks are expected to increase in a warmer climate. These disturbances will affect species distribution, stand age and structure (successional stage), and will typically catalyze the major changes in forest conditions. Mountain pine beetle may be particularly important in lodgepole pine and ponderosa pine forests. Western spruce budworm and Douglas-fir tussock moth may also increase periodically. Even the moister westside forests may become prone to fire as the climate warms. A series of drought years may lead to large, stand-replacing fires like those seen in the early 1900s.

**Climate-smart strategies**

Current management practices in PNW forests and woodlands are predicated on a relatively stable climate and may not be designed to address climate change. What can managers do, especially when the specifics of what might happen are uncertain? Below are some “climate-smart” approaches that may be helpful. No single approach will suit all forests, owing to different degrees of forest
vulnerability to climate change, species’ inherent ability to adapt and different management goals.

**Triage.** Triage is the act of strategically selecting projects to invest in to maximize successes. Some species and forests may be highly vulnerable to climate change because they are already at the edge of their ranges, and thus may not be the best places to invest limited resources. An example might be areas where regeneration attempts have failed repeatedly. Maintaining current forest characteristics in these areas may become increasingly difficult under a warming climate. Areas where uncertainty about the future climate is high—for example, where changes in rainfall patterns are critical or where there is high uncertainty about the biology and ecology of a species—could be given lower priority relative to areas where future climate conditions and plant biology are better understood.

**Reduce other stressors.** Responding to climate change can seem overwhelming for an individual property owner. But climate change may be just one of many environmental stressors affecting a forest (Figure 2). Some of these other stressors can be addressed more directly. Invasive species, insect and disease outbreaks, pollutants, overstocked stands, and uncharacteristic or excessive disturbance (e.g., fire and herbivory) are all additional stressors forests and woodlands face. Addressing one of these stressors may simultaneously address climate change as well.

For example, forest thinning to allow more water and nutrients for trees, or to reduce fire severity, will also reduce tree vulnerability to drought stress and increased fire activity brought on by climate change. Although managing fuels in a stand may effectively reduce the severity of fire effects, it has limited potential for changing broad scale patterns of wildfire unless a “big picture” landscape viewpoint is used to strategically place treatments to alter fire behavior and spread.

Mitigating unwanted exotic or invasive plant species provides more growing space and nutrients for native plants to maintain healthy populations. This can be especially valuable under climate change, where native plants may experience greater environmental stress. When removing an unwanted plant species, planting a more desired one in its place can keep weeds from returning.

Where domestic grazing regimes are being restructured, it may be an opportunity to introduce new, climate-smart regimes. Existing grazing regimes likely reflect relatively stable and cooler climate patterns of the recent past, and may no longer suit projected future climate with milder winters, earlier springs, and hotter and possibly drier summers. Identifying and addressing these co-occurring environmental stressors helps build more resilient forests without singling out climate change.

**Diversify stands.** Climate change will result in both “winner” and “loser” species. Certain species may grow better; resist insects, pathogens and fires better; or regenerate better after disturbance or harvest. These patterns may vary with different site conditions across the landscape. Since not all winners and losers can be predicted, diversifying forest conditions within sites, as well as diversifying stand conditions across sites on the landscape, may be prudent for ensuring some level of success. By diversifying species at a given site, managers can allow the future climate to select winners. Similarly, by diversifying stand conditions across the landscape, managers can help ensure that certain services (e.g., logging, water quality, recreation or wildlife habitat) remain functional on the landscape.

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Colonel Mustard in the Library with a Candlestick? Using Science to Solve a Fisher Mystery

By SUE LIVINGSTON AND ELIZABETH MATerna

It was a dark and stormy (maybe) night back in 2009 when researchers in the Sierra Nevada Mountains in California found a dead fisher. This fisher appeared to be in excellent health—no sign of bite marks or other puncture marks that might indicate predation—but there were no other obvious injuries that might explain the cause of death. So, what happened? This mystery was solved by science.

Science is a process of formulating questions and developing testable predictions (hypotheses) that can be methodically evaluated. While laboratories provide a tightly controlled environmental setting for applying the scientific method, there are more challenges when studying natural environments, not limited to finding and capturing individual animals that are elusive like the fisher. In this article, we unfold the science of how this mystery was solved. And, as an added bonus, we will use this story to illustrate how we apply science to assess the species’ status and inform our actions to recover it.

Fishers are about the size of a house cat and belong to a family of mammals including weasels, mink, martens and otters. They live in low- to mid-elevation forests across much of northern North America. In the 1800s and early 1900s, the fisher’s range was reduced dramatically through trapping and predator control, followed by changes to their forest habitat that came about from logging, fire, urbanization and farming.

The first step to figuring out what happened to the dead fisher was for researchers to conduct a necropsy: an examination after death, like an autopsy on humans. What they found was eight ounces of pooled blood in the body cavity. But the blood could not be traced to a traumatic injury that would have caused the bleeding. Pathology tests on the liver revealed three different compounds of anticoagulant rodenticides (AR). Anticoagulants kill by causing the animal...
to bleed to death through the inability of the blood to form clots. This would explain the large amount of blood in the animal’s abdominal and chest cavities. A variety of products sold as baits for use in rodent control are laced with one of several different anticoagulant active ingredients.

Researchers began testing archived liver samples from fishers across multiple study areas in California to determine the extent of the exposure. Initially they tested 58 fishers and found 46 of them (79 percent) had AR compounds, confirming exposure to these rodenticides. Of the 46 fishers exposed, all but two had been exposed to more than one AR.

The next immediate question was where had the fishers obtained these AR toxicants? Fishers could intake the ARs by either consuming the poisoned bait directly, or by eating the rodents or other animals that had consumed the ARs. Anticoagulant rodenticides work slower compared to other rodenticides, and an animal consuming the bait may survive up to a week before succumbing. Thus, fishers could readily take and consume a small mammal that had been poisoned by an AR but had not yet died.

Federal and state regulations limit the use of ARs to specific agricultural or urban settings for controlling rodents around buildings or crop-lands. Therefore, these fishers must have somehow encountered these chemicals at an urban or agricultural site. Yet, most of the tested fishers were not found near any agricultural or urban settings, and several exposed fishers were monitored with radio collars their entire lives and had home ranges limited to public lands where human structures are rare or non-existent. Scientists surmised there must be some widespread, non-regulated use of these ARs on public lands where many of the exposed fishers were found. But what could that be?

Law enforcement agents provided the next piece of the puzzle when they shared their experience with illegal marijuana cultivation sites on public lands. These “trespass grows” are often associated with drug trafficking organizations, and the size and number of grows on public lands has been increasing since the late 1990s, mostly coming from public lands in California. These grow sites typically contain a broad suite of ARs and other pesticides, including ones banned in the U.S. Agents reported large quantities of multiple chemicals applied indiscriminately to poison anything that might harm the crop. The number of these trespass grow sites is big. As an example, a single remediation crew has cleaned up over 600 large-scale marijuana grow sites on just two of California’s National Forests, which likely represents just a fraction of the existing sites on these forests, let alone other forests in the west. The scale of the trespass grow problem, and the scale of fishers exposed to ARs found at these sites, implicated grow sites as the source of the ARs found in fishers.

The U.S. Fish and Wildlife Service was first petitioned to list the west coast population of fishers (see Figure 1) as an endangered species under the Endangered Species Act (ESA) back in 2000. When implementing the ESA, our agency must rely on the best available scientific information to evaluate the status of the species and reach a conclusion that is rational and supported. But back in 2000, we did not have this information on the threat of ARs. The most recent status assessment was done in 2016 when the information on ARs was available and it was one of multiple stressors to fishers we evaluated. But were these stressors at a level sufficient to reach a determination that the fisher warranted listing under the Endangered Species Act?

To assess the level of threat to fisher from these grow sites for our status review, we had to determine the effect that AR exposure had on the entire population of west coast fishers. As of 2015, of 119 fisher carcasses tested across the west coast population, 97
(82 percent) had evidence of ARs present. Yet, researchers could only conclude that the ARs directly caused the death of 11 of these animals. The direct cause of mortality for the remaining animals was attributed to other sources, mostly predation. However, we do not know the sublethal effects of these ARs. That is, to what degree does the amount of AR consumed limit their ability to hunt, avoid predators, fight disease, dodge vehicles, or sustain any number of biological processes necessary for survival and reproduction? In addition, we do not know to what degree these ARs are affecting prey populations of fishers, which could in turn affect fisher populations. Research in California found that female fishers with greater numbers of illegal marijuana grow sites within their home range had lower survival rates; while this association is strong, it still doesn’t confirm a cause and effect relationship between marijuana grow sites and their associated ARs with fisher survival.

The existing information on ARs and effects on fishers does not yet solve the puzzle. While ARs certainly kill individual fishers, and most likely make them more susceptible to other forms of mortality, we don’t know how much AR in fishers is lethal or makes them more likely to die from other sources. Nor do we have the data to confirm that existing AR exposure is influencing the west coast fisher population as a whole. We remain concerned about the effects of ARs on fishers and continue to monitor and research the problem.

While west coast fisher population growth rates fluctuate near zero and populations do not seem to be expanding, considerable stakeholder support and proactive conservation measures improve the long-term conservation outlook for fishers. Reintroductions in Washington and California have increased fisher distribution in their historic range. Ninety fishers were released in Olympic National Park between 2008 and 2010 and now the species is widely distributed across the Peninsula and successfully reproducing. Beginning in 2015, 69 fishers were released in the south Cascades of Washington and release of 80 more fishers are planned for the north Cascades. In the northern Sierras of California, 40 fishers were released in 2009 through 2011 and reproduction is occurring. In addition, private landowners are supporting these reintroductions by voluntarily implementing conservation practices compatible with their timber operations by enrolling in formal Candidate Conservation Agreements.

Mysteries remain and the science and research goes on. Since completing our species status assessment we have conducted systematic surveys to better understand what part of the historic range of fishers in Oregon continues to be occupied by the species. We have found that there are extensive amounts of suitable habitat in the central and northern Cascade Range in Oregon that do not contain fishers. For example, while fishers have been present near Crater Lake National Park in the southern Oregon Cascades for close to 30 years (a reintroduced population from Minnesota and British Columbia), they have not expanded into adjacent suitable habitat to the north. Fishers are not a species that naturally exhibits explosive population growth rates to be sure, but with the reductions of habitat loss on federal lands over the past two decades and the closed trapping seasons that have been in place since the mid-1900s, we would expect some expansion of west coast fishers into suitable areas of their historic range, much as they have done in eastern North America.

So, the next mystery to solve is to figure out what specifically is limiting west coast fisher populations. Research projects are currently underway across the west coast to tease out these limiting factors. In all three
states, we are working with private, state and federal landowners to implement conservation measures that will benefit fishers based on our current knowledge and interpretation of the available scientific data. Fisher reintroductions are occurring in California and Washington, both to expand their populations and as an opportunity to learn more about how fishers use available habitat. In Oregon, we have developed a feasibility assessment that considers existing factors which could affect the success of fisher reintroductions and, from this, identify general areas where reintroduction might be most successful. Potential reintroduction areas were identified by combining what was known about fisher habitat, as well as potential stressors such as habitat loss and ARs. By applying this information, it was determined that the western slope of the northern and central Cascades in Oregon may be the more optimal location for fisher reintroduction given the amount and distribution of fisher habitat, as well as the relatively low levels of habitat manipulation and occurrence of known toxics.

We could not have solved the mystery of the dead fisher without science. And while we have solved this mystery, the next mystery to solve is whether fisher expansion is limited by predators, prey, habitat, anticoagulant rodenticides or some other factor. Understanding the reasons for this lack of expansion will help us focus fisher management on those aspects that may be more likely to result in increasing fisher populations on the west coast. With ongoing research, we hope to have more puzzle pieces to use when next we assess the status of the west coast fisher.

**Sue Livingston** is a Certified Wildlife Biologist with the U.S. Fish and Wildlife Service in Portland, Oregon. She has worked for USFWS for 23 years, primarily on forest wildlife species such as fishers, Pacific martens, red tree voles, spotted owls and marbled murrelets. Sue has also collaborated extensively with silviculturists and forest ecologists designing and implementing projects to restore dry forest ecosystems and to develop old forest structural characteristics valuable to wildlife. Sue can be reached at 503-231-6179 or sue_livingston@fws.gov.

**Elizabeth Materna** serves as the public affairs specialist in the U.S. Fish and Wildlife Service’s Oregon state office. Prior to her present position, Elizabeth was a Fish and Wildlife Biologist in the Environmental Contaminants Program for over two decades, primarily dealing with water quality issues. She has been with the USFWS for 27 years. Elizabeth can be reached at 503-231-6912 or elizabeth_materna@fws.gov.
Monitoring the Effectiveness of Forest Practices Rules in Protecting Aquatic Resources  
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to make recommendations to the Board for decision. The AMPA coordinates the flow of information between Policy and CMER according to the Board’s directives. The AMPA is a neutral resource for the Forest Practices Board.

The desired outcomes of the AMP include:
1. Certainty of change as needed to protect aquatic resources;
2. Predictability and stability in the process of change so that forest landowners, regulators, and interested members of the public can anticipate and prepare for change; and
3. Application of quality controls to scientific study design, project execution and interpretation of results.

A clear reliance on science to accomplish the desired outcomes helps structure the AMP, but only after thorough interpretation of scientific evaluations in the context of implementation can actions result on the ground. This decision-making framework relies upon clear communication between scientists (products), Policy (interpretation), and decision-makers (implementers).

The purpose of CMER is to advance the science needed to support adaptive management. CMER is responsible for understanding available scientific knowledge that is applicable to the questions at hand, selecting the best and most relevant information and synthesizing it into reports for Policy and the Board. CMER is composed of scientific representatives of participating caucuses who are expected to maintain an objective scientific perspective.

The Policy committee interprets science to develop solutions and make recommendations to the Board on issues that arise in the Forest Practices Program. Issues (and the resulting recommendations on rule or program effectiveness) or policy questions on the implementation of forest practices are identified in scientific/technical products from CMER. Policy also provides guidance to CMER and makes recommendations on AMP issues. Policy reviews key questions, resource objectives and performance targets, and recommends CMER program priorities for scientific study to the Board. This includes development of Board manual sections dealing with matters relating to aquatic resources and small forestland owner programs, adaptive management funding and federal assurances of the HCP and Clean Water Act assurances. Policy operates based on consensus of all parties, and if consensus cannot be reached then there is a formal dispute resolution process.

The Board represents the decision makers. They establish resource objectives and set priorities for the program by approving CMER studies, work plans and expenditures. Biennially, the Board approves the budget and determines if the program complies with the Master Project Schedule. If the program is not in compliance, then the Board notifies the National Marine Fisheries Service and U.S. Fish and Wildlife Service.

When consensus cannot be reached in decisions at CMER or Policy, a formal dispute resolution process can be initiated. This process includes two stages (facilitation followed by arbitration or mediation) with a specified timeline for completion. If the dispute cannot be resolved, then minority and majority position papers are presented to the next level in the AMP. If the dispute reaches the second stage at CMER, then the position papers are delivered to Policy for a decision. If the dispute resides at Policy, then the position papers are delivered to the Board to decide on the dispute.

The Board has rule-making authority. On aquatic resources the Board needs to use the AMP to deter-
mine when and what needs to change. The only other way aquatic rules can change is if legislation is passed directing the Board to change, or if a court decision necessitates a rule change. Any rule that is directly or indirectly related to water quality needs to be agreed to by the designee from Ecology before the Board can adopt the rule.

Funding for the AMP is provided through two major sources. The first is the Forests and Fish Support Account (FFSA) and the second is from the state general fund (through the legislature). The source of the FFSA is a surcharge on the timber industries business and occupation tax that totals approximately $8 million per biennium for the program. Strong stakeholder support for the AMP at the legislature has been crucial to securing funding for the program.

The AMP is a very complex program that relies on steady commitment from each stakeholder at CMER, Policy and the Board. The foundation of the AMP is in science, but for the science to be integrated into decision making by the Board, the perspective from Policy is required. Because decisions require consensus to proceed at CMER and Policy, it is necessary for each participant of those committees to seek opportunities to collaborate and support differing perspectives to meet the four goals and desired outcomes of the AMP. That is the strength of an adaptive management model like ours.

**Conclusion**

When a real management choice is to be made (e.g., rules) it is important to ensure that the choices are based on data. The AMP relies on a history of diverse interest groups working together toward a common goal in the TFW and incorporates that structure into a program linking science with policy considerations to make rules that can endure. Although no process is perfect, this model has worked well to keep the timber industry viable in the state by providing regulatory certainty while protecting aquatic resources.

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TreeSmarts: Answers to Your Tax Planning Questions

TreeSmarts: Answers to Your Tax Planning Questions appears every other issue in Northwest Woodlands. The column is edited by John P. Johnston, a partner, CPA, and CMA with Bancroft Buckley Johnston & Serres LLP in Seattle, Washington. He is a member of the AICPA, IMA and WSCPA.

Questions can be emailed directly to John at jjohnston@bbjsllp.com.

R&D Credit on the Tree Farm

Here's an opportunity many folks don't consider when growing or harvesting trees—saving taxes by conducting research and development. Is that possible? Does it make any sense to try to do that? Is it hard? Well, the answer to all three of these questions is the same: a very strong maybe.

What we're talking about is technically called the Research & Experimentation Tax Credit (R&D Credit), a general business tax credit made permanent a few years ago. The expression is a slight misnomer because for me it invokes images of greying scientists with clipboards and lab coats hovering over some Habitrail of glass beakers and test tubes. That is not what this is about.

As expected, the tax code and regulations detail elaborate definitions of what qualifies, but I'll try to paraphrase “the four-part test.” In short, whatever it is you're trying to do, it must be for the purpose of creating or improving performance, reliability or the quality of a process, and you must eliminate uncertainty surrounding this. The process of experimentation must rely on principles of the physical or biological sciences, engineering or computer science.

There is a surprisingly broad array of activities that can qualify for the R&D credit. Since you may employ existing technologies and principles to satisfy the requirements, it follows that the engineering in felling a tree, biology in propagating seedlings or science behind deterring browse are all ripe for improvement in performance, reliability or quality. There's no reason you can't be working on this research while performing the tasks as you would anyway. In fact, I think most would agree that these things are subject to regular evaluation while being performed. A little documentation of intent and results might be all that is needed to justify the credit.

What are the dollars involved with this? It is important to make sure we distinguish the difference between a tax deduction and a tax

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credit. If you had $1,000 of taxable income and a 30 percent tax rate, your tax would be $300. An additional $300 deduction would change your tax to $(1,000 - 300) \times .30 = $210$, a $90 savings. But a $300 credit is much better, as it comes straight off the calculated tax and, in this case, eliminates it. Also, this credit can be carried back one year and forward twenty years if you can’t use it all in the current year.

Now that we’re clear on the fact that this is a credit, the next question is how to determine the amount. This is complicated and there are several permissible methods and nuances for making the calculation. But generally, the R&D Credit allows 20 percent of qualified expenditures that exceed a calculated base amount. Qualified expenditures are generally wages and related supplies, and pertinent payments to third parties.

This R&D Credit can yield some meaningful tax savings. Here is some caution: normally the R&D activity must be big and/or regular enough to justify the effort. For example, tracking wages and related expenses (e.g., payroll tax, benefits and others) normally provides the largest figures for eligible expenditures. But tracking and documenting these costs are cumbersome processes, and the IRS is persnickety about compliance. It is often advisable to employ special software and use a specialist to help you set up and monitor your compliance. With a large enough project, these costs are quickly offset. But trying to avail yourself of the credit by doing this only from time-to-time or for modest efforts is not likely to warrant the exertion.

So, all in all, the R&D credit can be a great thing, saving substantial tax dollars and yielding improved business processes. If you’re considering going down this road, you should first get in touch with a niche professional who can help guide you through a cost/benefit analysis. Fortunately, this process is normally free in the hopes that you turn out to be an ongoing client for the specialist, and the in-house effort is normally not overwhelming. It’s a good thing a lab coat isn’t needed—I don’t think Carhartt makes lab coats!

Send in Your Tax Question

Do you have a question that relates to accounting, business, or tax planning? If so, send it to tax expert John Johnston (jjohnston@bbjsllp.com) and he will answer it in the next scheduled column.

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Send in Your Tax Question

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We count trees, not beans.
DEAR READER, In 1996, “Tips from the Treeman” first appeared in the Master Woodland Manager Gazette (MWM Gazette), a quarterly newsletter dedicated to trained volunteers of Oregon State University Forestry Extension. The initial concept was to have a “Dear Abby” of forestry-related topics. The parameters were initially maintained but, over time, the interpretation of forestry-related topics broadened and morphed into a discussion of natural resources. Well, for the most part, anyway.

Later that year, Treeman received the following letter:

Dear Mr. Treeman, How much longer are we going to have to tolerate your writings? —Just Curious

Dear Curious, In the supreme wisdom of higher authorities, Mr. Treeman will be around for at least a couple more newsletters. So, keep your chin up, nothing lasts forever.—The Treeman

Yes, the submission was an authentic letter. One wonders if Curious continues to peruse Treeman, or indeed found the concept and its writer intolerable, and has since moved on to greener forests? After all, that was over 20 years ago.

In June 2017, Treeman will end his tenure with OSU Extension Service. The edition before you is the last one you will endure from Treeman as a contributing member of said organization. A number of individuals have inquired whether Treeman will continue to grace the pages of Northwest Woodlands (NWW). Thus, to the consternation of a select few, the glee of fewer yet, and the ennui of the multitudes, Treeman will continue for at least one more edition.

We say “one more” because who can affirmatively state whether an integral part (Treeman) of an occupation (forestry extension) will be an indispensable part of the next one? Treeman needed NWW readers far more than you needed Treeman. NWW and its readers provided a lifeline in a work environment permeated by political correctness and often times devoid of logic and common sense.

The question has been raised on numerous occasions whether letters to Treeman are authentic letters or merely editor’s license. A small percentage of Treeman articles are cursive letters addressed to the editor. A slightly larger portion are emails or phone conversations containing Treeman questions. The largest percentage of topics originate from questions obtained through workshops and visits to woodland properties. And yes, a portion are spawned deep in the crevices of Treeman’s cranium.

Irrespective of origination, the intent remains the same: educate and entertain, sometimes in reverse order, but present nonetheless. Who can honestly state they were without a chuckle when reading about the eradication of moles? Tell me you chuckled when reading about the woodpecker keeps from blowing their brains out while pecking a tree? And were we absent a chortle upon reading the various sobriquets for outhouses? We are reasonably certain you were entertained and even a trifle educated/informed at the same time: mission accomplished.

And, most importantly, the fun and learning works both ways. A Tips from the Treeman article requires two or three days for completion. It is quite possible, likely probable, Treeman learns more in researching the various queries than the answers digested, or expectorated, by the readers. Working as a sciolist under the guise of an expert, as well as an adroit academician masquerading as the dunderhead, the intent is to keep the reader thinking, or guessing, or both.

But even the dunderhead can ascertain Treeman has a perspicuous political philosophy and is not afraid of projecting a distinct point of view. Too many educators develop and deliver programming, doing their best to offend no one. We do not proselytize but, at the same time, delivering some milquetoast analysis of a topic only offends the recipient and bores the author. Alexander Hamilton said,”If you don’t stand for something, you’ll fall for anything.” So, stand up and be counted, irrespective of who is watching—especially when someone is watching!

As with most Treeman communiques, it takes a while to get to the point: a little rhetorical perambulation, perhaps. But again, there is a method to the madness. It is the journey, not the destination. Who has not experienced the satisfaction of a job well-done and, after a brief interlude of reflection, is overcome with a sense of vacuity wondering what’s next? There is no neutral in life: either we’re moving ahead or falling behind. The direction may be up for debate, but not the movement.

So, Treeman moves on to the next destination unknown and will continue to write about it. Prolif, perhaps; succinct, likely not. And in case anyone is interested, the new Treeman email address is stevebowers@earthlink.net. For you Luddites out there, bless you: Steve Bowers, 31514 Bowers Drive, Harrisburg, OR 97446. And may the forest be with you.—Treeman
help managers strategically select climate-smart seed lots for a given site. Conditions at planting sites can be chosen to represent current or future climates based on selected climate change scenarios.

**Consider another type of forest.** A more genetically favorable seed source may not always be sufficient to address climate change. Where climate and climate change-driven disturbance patterns are projected to change dramatically from the recent past, and where planning horizons are long (e.g., long-lived tree stands), directly creating another type of forest may be a viable option. In this strategy, a fundamental change is planned, such as creating a completely new forest type. People have moved plants for millennia, but intentional movement as a climate adaptation strategy (assisted migration) has only recently been proposed.

Foresters in Alberta, Canada, for example, are considering ponderosa pine and Douglas-fir, now absent in the province, as replacements for lodgepole pine because they may do better under future environmental conditions. Extension foresters and scientists can help identify particular species to plant, along with information from the past and vegetation models as described in the “Big Picture” section above.

**Periodically assess progress.** Climate change and its effects on forests are not fully understood and will vary greatly according to site and stand structure. Thus, the efficacy of climate adaptation practices is also not always clear. In this time of significant change and uncertainty, forest landowners may want to intensify their monitoring programs so that tree responses to climate and treatments, and possibly new insect and pathogen outbreaks, are identified and management strategies adjusted accordingly.

**Keeping an eye on the future**

Climate change is here. The climate of the PNW could be very different than today within the next 40 years. The projected changes are already primed, and the climate will continue to change regardless of the degree of global efforts to reduce greenhouse gases. Although the exact path of the future climate is unclear, managers have opportunities to implement climate-smart practices to reduce the vulnerability of their forests and woodlands to climate change. These strategies can help build resistance to adverse effects in the short term, or facilitate accommodating responses in the longer term. There are many unknowns, but a warmer future is certain. The good news is that a suite of tools and strategies are available for forest landowners to begin taking action.

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