

## MANAGING FORESTS AFTER FIRE



Tom Iraci

### IN SUMMARY

**F**ire is a part of the forest ecosystem, and its effects have been well documented in the scientific literature. But controversy remains about the effects of management options in a burned forest, and the scientific basis for decision-making about postfire management is uncertain and has not been effectively articulated.

Management concerns after a fire include minimizing erosion and its effects on aquatic systems, retaining adequate forest structure for fire-associated wildlife, capturing the economic value of the wood through postfire timber harvests, minimizing the likelihood of an insect outbreak among fire-stressed trees, reducing the potential for a severe reburn, and ensuring tree regeneration. Postfire timber harvest (often referred to as salvage logging) and its effects on a forest ecosystem have been hotly debated, but the existing studies on its effects are disparate in

geographic setting, study design, sampling, and analytical approach.

Scientists from the Pacific Northwest (PNW) Research Station and their colleagues from the other research stations and universities are currently synthesizing the science on the effects of postfire timber harvests following large wildfires in western North America. Their objective is to clarify the extent to which different issues related to postfire harvests are supported by scientific data.

Postfire timber harvests may lead to different outcomes depending on the biophysical setting of the forest, patterns of burn severity, and method and timing of tree removal. The management objectives for the area ultimately determine how these concerns are addressed. This story continues inside.



Bruce Marcot

Fire often leaves a mosaic pattern of burned and unburned stands across the landscape.

## How do fire patterns differ among forests?

The forests of western North America are diverse in terms of vegetation, geography, weather patterns, and management history. This means that the fire pattern, its frequency and severity, is particular to each forest type. Moist coastal forests, characterized by grand fir, western redcedar, and western hemlock, historically were subject to infrequent but high-intensity fires. In dry forests, such as those of Douglas-fir and ponderosa pine east of the Cascade Range in Washington and Oregon, frequent but low-intensity fires and mixed-severity fires were the historical norms.

A century of fire exclusion has altered some historical fire regimes. Fire regimes in moist forests are still generally within the historical ranges of frequency and severity. Fire exclusion has greatly impacted dry forests, however. Dead wood, or fuel, has accumulated and tree density is greater in these forests than in the past, making them prone to larger and more frequent stand-replacing fires than occurred historically.

Every fire is unique. The variation in weather and the fire's biophysical settings mean most large fires (25,000 acres or more) burn with varying intensity and severity across the landscape, resulting in different levels of tree mortality and landscape change. Factors such as past management activities, grazing, insects, and fungal pathogens interact with fire to create a mosaic of conditions across the landscape.

A surface fire is the lowest intensity and moves along the forest floor, consuming down wood, shrubs, and small seedlings. If hot enough, it can damage roots and kill trees. An understory fire is of medium intensity in terms of flame lengths and heat release. A crown fire moves through the tops of the trees, and usually kills all the trees in the stand. The survival and regeneration of certain species depend on the intensity of the fire. Depending on the terrain and wind patterns, the fire may skirt some stands, leaving islands of unburned trees.

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## Key Findings

- The timing of timber harvests after fire (same season as fire vs. subsequent years, winter vs. other seasons) can affect the magnitude of ecological and economic effects. Mortality to regenerating trees and understory vegetation is lessened if timber harvests are conducted shortly after the fire. Harvests within this timeframe also produce the highest wood volume and quality for commercial uses.
- Potential for insect attack following fire depends on local vegetation and climate. In some cases, this potential can be reduced if damaged, low vigor trees are removed.
- When followed by fuel treatments, timber harvests can reduce risk of reburn in some cases. If fine surface fuels created during the logging operation are not removed, the short-term fire hazard may increase. Depending on local vegetation and climate, the fire hazard may be whether or not management actions are taken.
- Short-term effects of tree removal on food resources, and short- and long-term effects on snag nesting sites, are negative for most wildlife species, but other species benefit from open conditions created by postfire logging. Species that nest in tree cavities may be negatively affected by harvesting standing dead and live trees, depending on their sensitivity to snag density and green-tree foraging or sheltering requirements.
- Aquatic systems are, for the most part, negatively affected by postfire timber operations in the short term, particularly if new roads are constructed. Riparian buffers that maintain areas of undisturbed vegetation and soil may reduce deleterious effects, and as vegetation regrows, negative effects generally diminish over time.
- Fire and timber harvests, individually and combined, affect hydrological processes. Streamflows may increase sharply after each event because less vegetation is present to withdraw and store water. Increased flows can lead to erosion, which decreases water quality. As vegetation regrows, these conditions improve.

Although the effects of fire in different forest types have been well documented in the scientific literature, much uncertainty remains about the outcomes of different management options following a fire. Scientists from the PNW Research Station and their colleagues from other research stations and universities are synthesizing the science on the effects of postfire timber harvests following large wildfires in western North America. Their objective was to clarify the extent to which different issues related to postfire harvests are supported by scientific data. “The objective of research is to reduce uncertainty in decisionmaking,” explains David Peterson, a research biologist at the Pacific Wildland Fire Sciences Laboratory. “If we can help managers determine the likely outcomes of management actions after a fire, in a given setting, that assists them with planning and implementation.”

## What happens in a forest after a fire?

Trees that are severely damaged by fire but not killed immediately usually die within 2 years. Dead needles fall to the forest floor during this period, followed by small and then larger branches. The snags that remain provide habitat for wildlife and a long-term source of nutrients to the forest floor when they eventually fall.

After a fire there are several pathways the new forest might take as it regenerates. These paths represent different combinations of past and future events: How severe was the fire? What was growing before the fire? How long ago was the last fire? What management actions will occur?

Different species of trees and vegetation respond differently to fire. What grows back after a fire often depends on what was there before, and the coping mechanisms of trees and understory vegetation depend on the historical fire regimes. In ponderosa pine and dry Douglas-fir forests, the fire regime was historically characterized by frequent, low-intensity and sometimes mixed-severity fires. Mature ponderosa pine and Douglas-fir, for example, have thick bark that helps them resist fire damage. In forest types where the fire regime was historically more severe, species like lodgepole pine often have cones that require heat to melt the resin and release the



*The thick bark of a mature Douglas-fir can help it survive a fire and become a seed source for the regenerating forest. Other species, such as fireweed, are opportunistic, with light seeds that can be carried into a burned area by the wind.*

Tom Iraci



Brett Morrisette

Fire can alter the chemical properties of the soil. Here, researchers are collecting soil samples from the Siskiyou National Forest so they can study the effects of burn severity on soil nutrients.

seeds, which then fall on the cleared ground. Plant species with seeds that are easily transported from other sites, by wind or other mechanisms, will also take advantage of the cleared ground. Other species endure fire by resprouting from their roots. Species that do not have a fire strategy will likely be absent from the site for an undetermined period. Soil and weather conditions affect the regeneration of trees and the forest understory.

### ***Multiple environmental factors influence the severity of an insect outbreak in a burned stand.***

Heat from fire can alter the chemical properties of the soils and the availability of nutrients. The specific effects depend on the temperature and duration of the heat. In some cases, the availability of nutrients increases with low-intensity fires, whereas with high-intensity fires, soil fertility may be diminished for up to 5 years. Soil may become temporarily impervious to water after a hot fire, increasing the amount of water runoff. Water runoff also increases after a fire because there is less groundcover and fewer trees to absorb it. As a result, the timing of waterflows within aquatic systems can change, with greater variation between peak and low flows. Sedimentation and erosion also increase with greater runoff. Changes in water yield are greatest in the first few years after fire and decrease over time as vegetation regrows.

Because of the variation in fire effects across the landscape, after a large fire, different management approaches may be taken within different portions of the burned area. In some portions, active management may be needed to meet certain management goals. In other portions, passive management, that is, leaving the burned area alone, may be the best way to meet management goals.

Active management includes activities such as aerial seeding to help a slope revegetate more quickly and thus reduce chance of erosion. Other management activities that may reduce the delivery of sediment to streams include (1) installing larger culverts with the capacity to handle increased runoff; (2) building structures to trap sediment such as silt fences, riprap, and gabions (wire baskets filled with rocks); and (3) stabilizing stream channels with large woody materials, hay bales, or check dams. If timber is harvested, woody debris, or slash, following a harvest operation may be spread on the ground to provide immediate ground cover. Tree seedlings may be planted or the area may be left to regenerate naturally. All these activities, including passive management, influence postfire recovery and the composition of the new forest.

## **Do insect outbreaks increase after fire?**

One of the big management concerns after a fire is an outbreak of insects, usually bark beetles and wood borers that attack fire-damaged trees. In this weakened state, the physical damage from insects and decay fungi introduced by insects kills the trees, which then become fuel for the next fire. “Bark beetles attack living, stressed trees. If enough beetles build up, they can attack large, live trees. Sometimes this happens, sometimes it doesn’t. We really don’t have enough data to quantify what’s going to happen,” explains Peterson.

General tree health before and after a fire, soil moisture, and the proximity to existing outbreaks all influence the severity of an insect outbreak in a burned stand. Stand density and species composition also are factors. Bark beetles tend to be species specific, which means mixed stands tend to be more robust than pure stands. But the interplay of these factors on a specific site is harder to determine. “We need more empirical data on the factors that predispose a burned forest to large-scale insect outbreaks,” says Peterson.

## **Are burned forests more likely to burn again?**

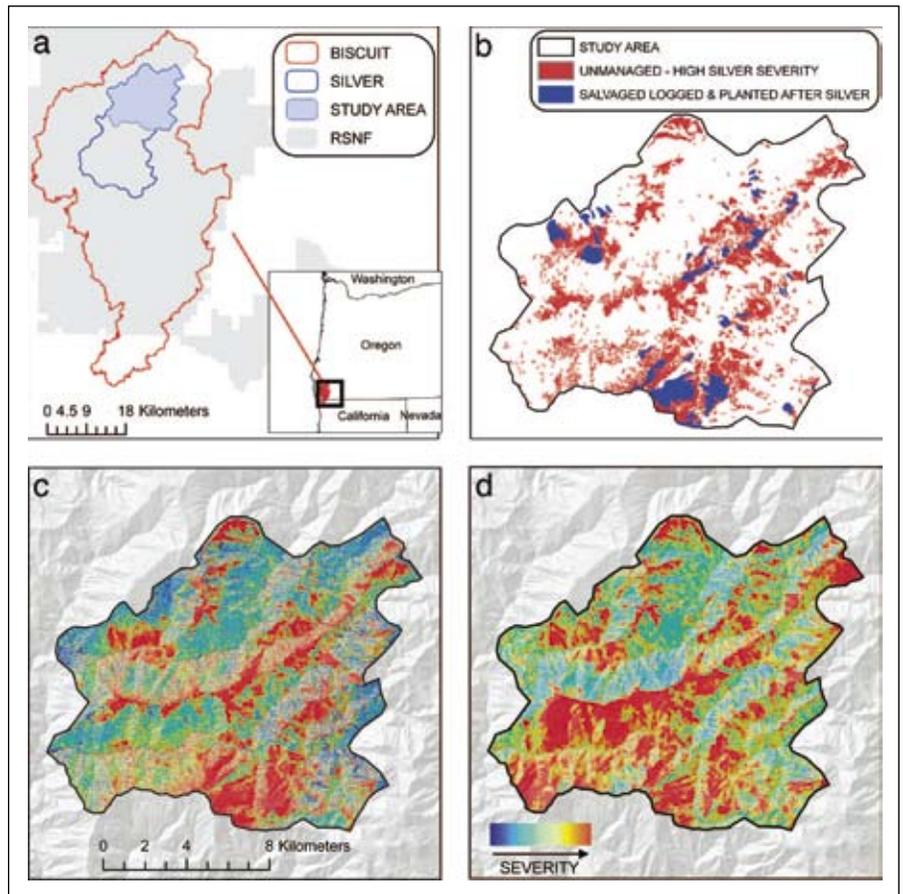
Fire hazard changes over time as forest conditions change. The reburn potential of a forest ultimately depends on local conditions and ignition circumstances. Fine fuels smaller than 3 inches in diameter are used to predict surface fire behavior. The amount of surface fuel and its rate of accumulation depend on (1) the live and dead biomass present before the fire; (2) events after the fire, such as logging or a windstorm, that can rapidly change the amount of fuel present; and (3) the length of time since the fire.

After a fire, regenerated understory vegetation and fine woody debris that falls from remaining tree crowns begin accumulating as surface fuel. Annual grasses, either naturally regenerated or seeded as an emergency rehabilitation response will be an immediate fuel source within 1 year of the fire. The flammability of shrubs and perennial species depends on their density and moisture content. Bracken fern, for example, creates persistent fine fuel that as it accumulates, may have more influence on fire behavior than fine woody fuel. The quantity of fuel, depth of the fuel bed, and moisture levels are all factors in fire behavior.

Logging operations alter the amount of surface fuel, either increasing it or decreasing it, depending on the harvest method and the mitigation treatments used afterward. Each treatment has a different effect on the amount of fuel and when it reaches the ground. When talking about the effects of logging on reburn potential, Jim McIver, a research professor at Oregon State University's Eastern Oregon Agricultural Center explains, "Logging slash can certainly contribute to future fire behavior. But whether slash generated by logging a burned forest will be a problem for the new developing stand depends on the contribution of slash to fire behavior, **in the context of the whole system.** For example, young trees that regenerate after the wildfire may not be big enough to withstand **any** reburn in their first 20 years of life, even a reburn occurring without logging slash. This is because other components of the fuel bed, particularly grasses and shrubs, also contribute to fire behavior."

The type and amount of large fuel is also affected by time since fire and rates of decay. Even without logging, snags decrease over time as they decay and fall to the forest floor, becoming logs and eventually decomposing. Logging will alter woody debris by removing snags and eventually the log volume.

Often when a burned area is logged in the Pacific Northwest, it is replanted with conifers. Conventional wisdom has been that logging after a fire can reduce the severity of future fires, and replanting will hasten the recovery of desirable species. Tom Spies, a research forester at the Corvallis Forestry Sciences Laboratory, and his colleagues seized an opportunity to test these hypotheses after the Biscuit Fire burned more than 499,000 acres of Southwestern Oregon in 2002. Fifteen years prior, the Silver Fire had burned through some of the same acreage, and postfire management activities included logging and replanting in selected areas. Spies and his colleagues examined how fire severity differed during the Biscuit Fire in stands that had been managed or unmanaged



*The Biscuit Fire burned more than 499,000 acres in southwestern Oregon; of that about 99,000 acres had burned 15 years earlier in the Silver Fire. Both fires left a mosaic of live and dead vegetation. (A) the area studies by Thompson, Spies, and Ganio (2007), (B) management after the Silver Fire, (C) burn severity after the Silver Fire, (D) burn severity after the Biscuit Fire.*

after the Silver Fire. They found that in this mixed-conifer and mixed evergreen-hardwood forest, the 2002 fire was more severe in stands that had been logged and replanted following the 1987 than in those that had not.

"In our study, we were unable to separate the effects of salvage logging from planting," explains Spies. "But our work does indicate that in this forest type for this period since the last fire, logging and other postfire management actions did not reduce the risk of high-severity fire.

"In this forest type" is an important distinction that has a tendency to be overlooked in the clamor for definitive answers to questions that are really quite complex. As Spies explains, "A one-size-fits-all story of how fire behaves in forests is not possible."

For example, another study that examined historical fire records in the Entiat watershed in northeastern Washington found "fire boundaries" where previous low-intensity fires had consumed fuels so subsequent fires burned different area than in the past. Ponderosa pine is the dominant species in this area, a different forest type altogether from the mixture of Douglas-fir, tanoak, sugar pine, white fir, and chinquapin found where the Silver and Biscuit Fires burned. "The Entiat watershed and Siskiyou are actually a great comparison for highlighting the differences in fire behavior in forest type,"

## Wildlife and Fire

Forest wildlife species have evolved with historical fire patterns and have ways to cope with the heat and smoke. Burrowing mammals, for example, can escape fire damage by remaining underground, whereas larger mammals like elk move away from the fire. The season that fire occurs is a factor. Ground nesting wildlife and insects that are in an immobile life stage, such as being buried in leaf litter, for example, may suffer high mortality compared to more mobile species.

The postfire conditions and specific habitat needs of a species determine how long before animals move back into the burned area—it could be a matter of days or years. Insectivorous birds, such as woodpeckers, benefit from insect outbreaks, and the standing dead and damaged trees provide habitat for them and other cavity-nesting birds. Mammals that favor open areas and increased browse opportunities often benefit from the changes created by fire. Species that prefer varied forest structures tend to be negatively affected in the short term, although the size of the fire and variability in its intensity may make a difference: large-scale, stand-replacing fires may negatively affect some species, whereas small-scale, stand-replacing fires or mixed-severity fires create habitat patchiness beneficial to the same species.



Bruce Marcot

*The American kestrel is one species that takes advantage of the changes fire brings. It may nest in burned snags and feed on the insects and other small animals that also flourish after a fire.*

Severe fires in riparian areas heat the water and change its chemistry, thus killing fish and other aquatic organisms. Again, the change to habitat is a factor for these species as it is for the terrestrial species. After a fire, the timing of runoff may change and sedimentation may increase. Loss of streamside vegetation may increase water temperatures and there may be less down wood available to provide



Bruce Marcot

*Small mammals may den in the cavities of fire-damaged trees.*

structure and habitat in the streams. Like the terrestrial wildlife, aquatic species have also experienced disturbance over time. A habitat change that may be negative in the short term, like a slope failure that increases sedimentation, may provide beneficial habitat in the long term by increasing the amount of wood in streams and variation in the channel structure.

Postfire timber harvest compounds the habitat impacts from fire, whether they are negative or positive. The ultimate test of postfire harvest impacts on wildlife is how it affects population viability across the larger landscape. For example, removing snags from 10 percent of a large wildfire will have some effect on snag-dependent species, but the small area affected likely will have little impact on populations that are distributed across the larger area. The threshold at which postfire removal of trees, in addition to fire-caused mortality, has no further effect on populations is unknown for most species. The removal of green trees can negatively affect species that nest or forage in tree canopies. Species that are associated with open-canopy stands may benefit from postfire logging in dense stands where it would take years for the snags to fall on their own to create open conditions.

DecAID is a computer decision-support system developed by PNW scientists, managers, and their collaborators that provides a synthesis, quantitative guidelines, and links to existing research on wildlife use of snags and down wood, primarily in Oregon and Washington. It also provides statistical summaries of forest inventory data on snags and down wood in unharvested forests. This information enables managers to operate within the historical range of variability for an area. The forest inventory data for unharvested forests dates only from the early 1990s, however, so DecAID does not account for the effect of a century of fire exclusion on the amounts and characteristics of snags and down wood.

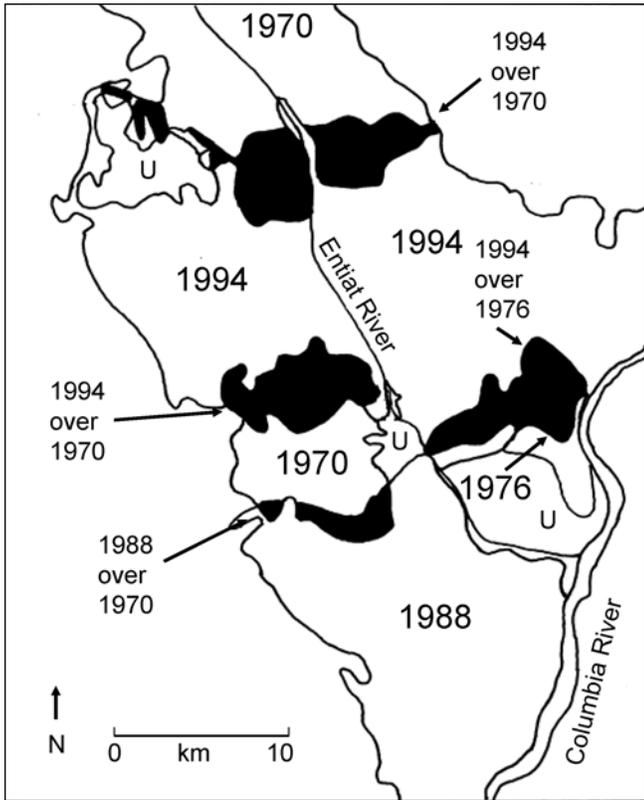


Figure courtesy of Jim Agee, University of Washington

A study in the Entiat River watershed in eastern Washington found that previously unburned areas appear more likely to burn than burned areas, and that fires have stopped adjacent to or within old burn boundaries.

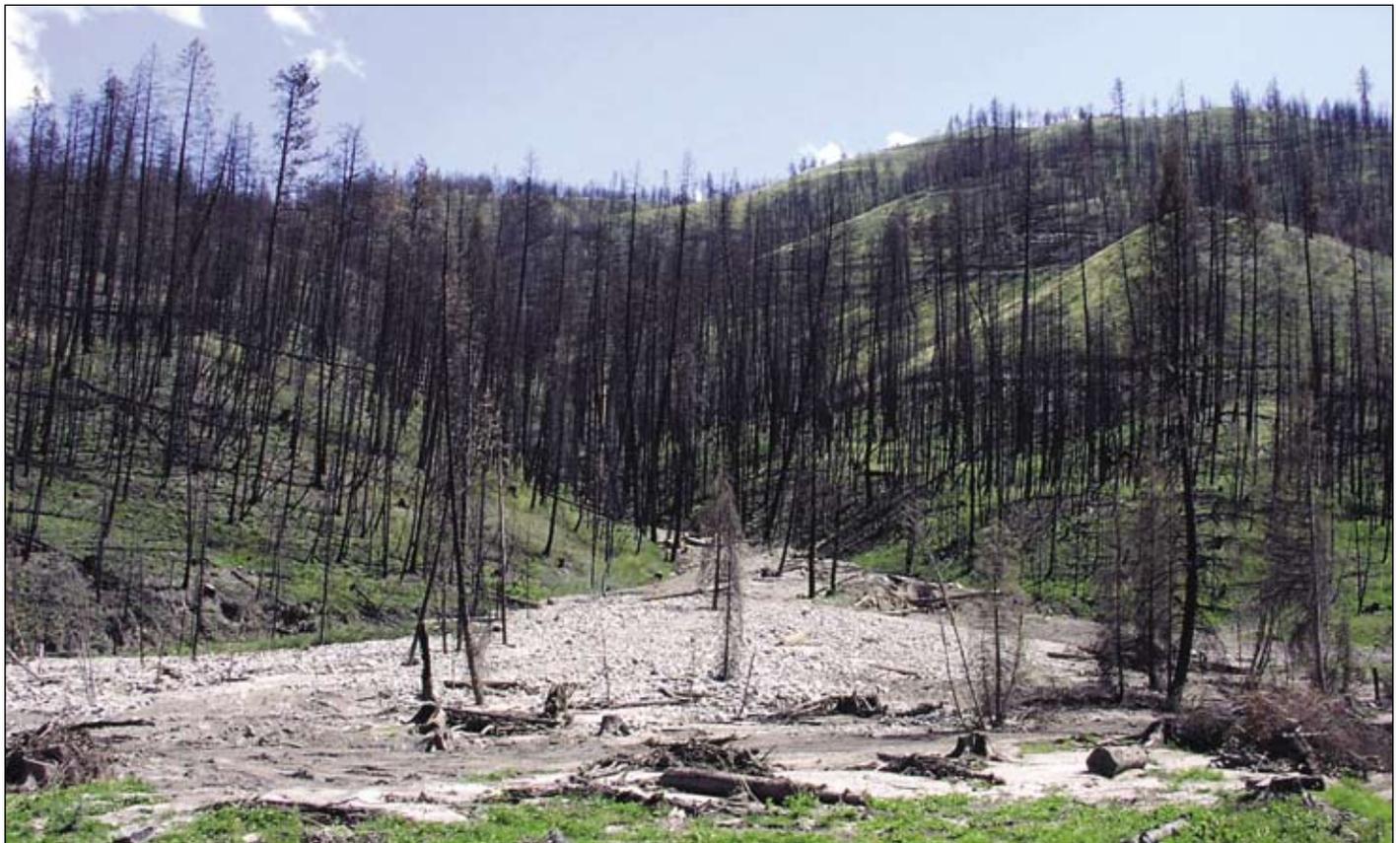
says Peterson. “Once again, we are reminded that we can’t take an inference from one system and necessarily extrapolate it to another.”

Time since the last fire appears to have more influence on fire danger than logging or not logging. For a fire to transition from a surface fire to a crown fire, it needs a “fuel ladder” to help it bridge the gap. At a certain stage, young, regenerating trees can serve as this ladder. As time passes and the regeneration grows taller, the distance between the forest floor and low-hanging branches will increase, minimizing the fuel ladder effect. As more time passes, some trees will die, branches will fall, and fuel ladders will naturally form again.

*The timing of the harvest, removal method, and the size of the harvested area all have different potential effects on the forest as it regrows.*

### How does postfire logging affect the forest ecosystem?

When evaluating the effects of postfire logging on the ecosystem, there are four points to consider: (1) the effect of removing large trees and whether the trees being removed are living or dead; (2) ground disturbance, which depends on the harvest method used and road construction; (3) treatment of fuels after harvest; and (4) types of mitigation to minimize



After a fire, water runoff can increase, filling waterways with sediment and woody debris.

U.S. Geological Survey

erosion, such as grass seeding, and stabilizing structures such as silt fences, riprap, or rock to reduce sedimentation flow to streams. The effects of postfire logging depend on the intensity of each of these actions.

The timing of the harvest, method for removing trees, and the size of the harvested area all have different potential effects on the forest as it regrows. Peterson explains, “Harvest within the first year causes the least damage to tree regeneration, and incidentally this is when the wood has higher commercial value. This is one area where biological concerns and economic objectives are in agreement.” Timing includes both time since the fire and the season that it occurs. Harvesting timber soon after the fire can cause considerable soil erosion and alter the local hydrology, although logging during the winter when snow serves as a buffer can minimize disturbance to the forest floor.

The woody debris, or “slash,” created during a timber operation is another consideration. Without treatment, slash becomes an immediate fuel source, even as it protects the soil surface from erosion. However, slash treatments can damage or kill tree seeds and seedlings through ground disturbance and prescribed fire. If another seed source is not nearby, this can have a long-term effect on the development of the forest. Peterson points out, “If you’re concerned about natural regeneration, then timing is everything. But if the management objective calls for replanting to achieve a specific density of a selected species, then timing of slash treatment is not as critical.” Slash can be treated various ways. It can be left in place, scattered across the ground, collected and removed from the site, or piled and burned. If it has no commercial value, it is unlikely it will be removed from the site, explains Peterson.

Because fire has been excluded for most of the past 100 years, dry forests that historically had frequent, low-intensity fires now have more trees than they did in the past. Elevated prefire tree densities mean elevated levels of postfire snag densities when a fire does occur. Postfire harvests, especially of smaller trees, can be used to ensure that one of the legacies of these altered fire regimes is not a future fuel loading that greatly exceeds the historical norm.

***Management activities can either complement ecosystem recovery processes to help minimize long-term damage, or exacerbate damage, depending on the activity.***

The removal of both dead and live trees negatively affects most wildlife habitat in the short and long term. Burned areas and the snags they contain are the primary habitat for some species. Dead and dying trees are hosts to insects that are important food for wildlife, including birds, small mammals, and even bears. Snags are vital for primary cavity-excavating birds that nest in them and for secondary cavity-nesting birds and small mammals that cannot excavate their own cavity. DecAID is a computer tool that helps managers determine the

size and number of snags and down wood needed to help meet wildlife management objectives.

Another concern about postfire logging is its effect on water quality. Fire and logging both reduce the amount of living vegetation available to take up and store water, which alters the hydrology of an area. Fire may cause greater changes in annual water yield than logging because more understory vegetation is killed and consumed. Thus, after both events, the quantity, timing, and quality of waterflows can change, explains Peterson. Water yields increase detectably when approximately 20 to 40 percent of the vegetative mass (basal area) is removed.

Management activities can either complement ecosystem recovery processes to help minimize long-term damage, or exacerbate damage, depending on the activity. Fish, aquatic amphibians, and macroinvertebrates are likely affected by the removal of snags from the landscape, mainly near streams, because large logs in streams tend to create their habitat. High levels of sediment in a stream can bury fish and amphibian eggs and the stream structure used by aquatic life. The effects of mass wasting and debris flows associated with road and culvert failures can last for decades.

Culverts that were put in to handle a certain amount of waterflow may be insufficient with increased runoff after a fire. The woody debris and sediments being washed down may clog the culvert during storms, leading to culvert failure and greater erosion. After a fire, existing culverts may need to be upgraded to handle the greater flow, and racks may need to be installed at the culvert intake to prevent clogging.

Forest roads are the largest source of erosion and sedimentation after wildfires. The greatest erosion occurs during the first year or two after construction. New roads constructed soon after a fire, combined with the natural postfire increase in streamflow and overland flow have the greatest impact on water quality. Peterson explains, “Erosion from roads typically causes most of the damage; the erosion associated with the logging activities isn’t as great. The worst thing you can do is put in new roads; the second worst thing is using roads that are not set up for heavy use.” Old roads now outmoded by new harvest technologies are at risk of failure, and thus may potentially degrade aquatic systems. Logging by helicopter is one method used to avoid road construction, but as Peterson points out, it is extremely expensive and not an option in all locations.

## **Planning for postfire management**

“It’s not a matter of if a fire will happen,” says Peterson, “it’s a matter of when it will happen and being prepared for it. Right now postfire management is often treated as crisis management. We treat the fire as an anomaly, but it’s not.” However, given that there is so much diversity among forests, site conditions, and fire regimes, a one-size-fits all approach is not possible. “Every site is different,” explains Peterson. “A fire this summer in Oregon will not be the same as a fire next summer in Idaho. There are different trees, the weather will be different.”

## *How does fire affect wood quality?*

Although the outer bark of a tree may be scorched and charred, the interior wood still has commercial value, if it can be harvested before insects, staining fungus, and other decay make it unusable. Dennis Dykstra, a forest products technologist at the Portland Forestry Sciences Laboratory, explains that insect damage often provides an entry point for fungus and bacteria. Even without insects, however, the sapwood of a tree, just under the bark, will begin deteriorating fairly quickly because of its high moisture content. The heartwood takes longer to deteriorate, and this rate is determined by the species, age, and size of the tree. Weather also causes deterioration. A tree with bark damaged by the fire may start to crack as it dries and shrinks unevenly, reducing the amount of usable wood.

The length of time that a fire-killed tree retains commercial value depends, in part, on the species and its use, explains Dykstra. Ponderosa pine, for example, is generally used as appearance lumber for products such as

window sills and door frames. But like other pines, it is very susceptible to fungus that stains the wood, thereby reducing its value. Douglas-fir, on the other hand, is typically turned into construction lumber, such as 2 by 4s, rather than finishing pieces, and it is less susceptible to staining fungi. “Douglas-fir that’s badly stained can still be used for construction lumber—the grade of the piece will be reduced, but it will still have strength,” Dykstra explains.

“The length of time between a fire and the logging operation affects the quantity of wood that is usable and its quality,” says Dykstra. Research shows trees harvested within the first year after a fire produce the highest value timber. Dykstra explains, “Most people assume that 3 to 5 years after a fire, most of the value is gone; but whether it will cost more to log than what the wood can be sold for depends on the environmental conditions and the market.”



*Eini Lowell*

*One year after fire, significant blue stain and beetle larval activity are evident in this ponderosa pine log, negatively affecting its value for appearance products.*



Rhonda Mazza

Researchers measure down wood remaining 1 year after fire on the Gifford Pinchot National Forest.

***Given the diversity among forests, site conditions, and fire regimes, a one-size-fits all management approach is not possible.***

One way to avoid a crisis mentality, explains Peterson, is to base postfire management on the forest management plan in place before the fire.” With clearly stated management objectives, which may include physical, biological, and economic components, postfire treatments can be applied to help achieve these objectives. If desired forest structure and ecological functions are specified, then an economic objective, such as postfire timber harvests, can be administered to be compatible and minimally conflict with the other objectives.

At present, no single decision-support system exists for selecting alternatives for postfire management. Existing tools have been developed for single resources, such as vegetation, fuels, or wildlife, leaving integration to resource managers and local scientists. “Management can be based on good science, but local managers will still need to make judgments based on local situations and local management objectives,” says Peterson.

Adaptive management, the process of learning by doing and incorporating new information into management as it is learned, is one approach for moving forward. “This is the progress we want to target,” says Peterson, “We want to use our best science now, base our management on it, and then after fire, monitor to see what is happening and use these data to guide future forest management.” For example, the work by Spies et al. after the Biscuit Fire was only possible because



Nan Vance

Each fire presents an opportunity to study postfire management treatments.

management records for the area since the previous large fire were available.

Each large wildfire presents an opportunity to implement local studies and expand our knowledge about postfire management. But site-by-site studies have their limitations. As McIver explains, “We have to be careful about applying the results from one place to another, because each place is truly unique. In fact, ecology is often described as a ‘science of place’ because even though the processes may be the same from site to site, the way they play out can’t typically be predicted very well. That’s why a process like adaptive management, where we ‘learn by doing’ each time we try something, is so important.”

In addition to adaptive management, McIver and Peterson both recommend long-term, multisite studies as an efficient way to fill existing gaps in the science of postfire management. With replicated, statistically sound studies, explains McIver, we can attempt to create models and identify the mechanisms that drive them to provide information that is useful beyond the study site where it was generated.

Scientific research can yield information about likely outcomes given a particular scenario, but deciding which outcome to manage for is a matter of values. In terms of postfire timber harvests, “comparing economic values with restorative values is like comparing apples and oranges,” says Peterson. “Scientific research can yield information about likely outcomes given a particular scenario, but society ultimately decides which values are managed for.”

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## For Further Reading

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## Web Resources:

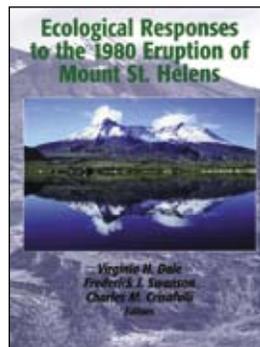
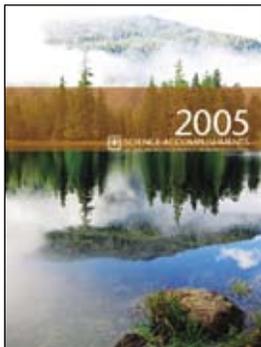
Mellen, K.; Marcot, B.G.; Ohmann, J.L. [et al.]. 2006. DecAID, the decayed wood advisor for managing snags, partially dead trees, and down wood for biodiversity in forests of Washington and Oregon. Version 2.0. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Region and Pacific Northwest Research Station; U.S. Department of the Interior, Fish and Wildlife Service, Oregon State Office. <http://www.notes.fs.fed.us:81/pnw/DecAID/DecAID.nsf> (20 February 2007).

U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. Information about all the Station’s research and access to all Station publications. <http://www.fs.fed.us/pnw>. (20 February 2007).

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## Got Science?



Two Station publications were honored recently by chapters of the Society for Technical Communication (<http://www.stc.org>), the world's largest professional organization dedicated to technical communicators. *2005 Science Accomplishments of the Pacific Northwest Research Station*, the Station's annual report for 2005, was recognized by the Puget Sound Chapter; *Ecological Responses to the 1980 Eruption of Mount St. Helens*, edited by colleague Virginia Dale and by Station scientists Fred Swanson and Charlie Crisafulli, and published by Springer, was recognized by the Willamette Valley Chapter.



Both publications—*2005 Science Accomplishments* and *Ecological Responses*—received the Society's highest rating of "Distinguished"—which is reserved for publications demonstrating the highest level of excellence. What's more, *2005 Science Accomplishments* went on to receive an "Excellence" award in the Society's international publications competition.

*2005 Science Accomplishments* is available for download or viewing online at <http://www.fs.fed.us/pnw/publications/accomplishments.shtml>.