

Trees in the Path of Destruction2
Soil and Water in the Path of Destruction . . .3
Recoup the Value or Preserve the Forest? . . .3
Assessing the State of Knowledge4
Trial By Fire4

Science

FINDINGS

“Science affects the way we think together.”
Lewis Thomas

POSTFIRE LOGGING: IS IT BENEFICIAL TO A FOREST?

Photo credit: K. Wattenmaker, National Interagency Fire Center



▲ *Severe wildfire kills many trees leading to a heated public debate: log it or leave it?*

“The debate on the policy of post-fire logging has been carried on without the benefit of much direct scientific information.”

Jim McIver

There’s the viewpoint that says if you log after a fire it’s like mugging a burn victim. And there’s the viewpoint that says if you don’t log after a fire you’re guaranteeing more and worse damage to come because of fuel buildup. The viewpoints in between are rarely heard above the fracas.

“The controversy over how to conduct postfire logging, or whether to conduct it at all, gets more intense in any area experiencing fires,” says Jim McIver. “There has historically been a rush to get usable timber off a burn site before the beetles move in, and agency planning processes are not set up to deal with this rush.”

Neither, apparently, are the available science data capable of dealing with the rush. “As environmental debate heated up on the salvage issue in the mid and late 1990s, it became obvious that there was little documented science background for the views of either side,” notes McIver, a research ecologist with the Forestry and Range Sciences Laboratory, PNW Research Station, in La Grande, Oregon.

An interesting statistic helps explain why the so-called salvage logging debate blew up so fast.

Because of the dramatic reduction in green-tree harvest after emergence of the spotted owl crisis in the early 1990s, the percentage of dead-tree harvest by the Forest Service in National Forests of Oregon and Washington rose from 14 percent of overall harvest in the 1980s to

IN SUMMARY

Public debate on postfire logging has intensified in recent years, particularly since passage of the “salvage rider” in 1995, directing accelerated harvest of dead trees in the western United States.

Supporters of postfire logging argue that it is part of a suite of restoration techniques, and that removal of timber means reduction of fuels for future fires (the “reburn” effect). Opponents argue that it causes damage to burned sites, particularly to soils, that it increases sediment transport, and that it removes large dead trees that have important ecological functions.

Considerable debate about the merits of postfire logging has been carried on without benefit of much scientific information. A recent review drew together the available scientific literature on postfire logging. At the same time, an experimental study in eastern Oregon was designed to test the “reburn” hypothesis and to examine soil and sediment transport in a major postfire logging operation.

21 percent in the mid-1990s. In the Wallowa-Whitman National Forest, taken alone, the rise was more dramatic for those decades—from 24 to 70 percent.

The proportional change brought the salvage programs rapidly into the spotlight, and the battle of words was begun. When the “salvage rider” directed federal land management agencies in 1994 to accelerate harvest of dead trees in the western United States, the noise reached a crescendo. As always, polarization was right behind.

A closer look at the conditions fire produces across dry landscapes helps clarify the arguments.



KEY FINDINGS



- The immediate environmental effects of postfire logging depend on the severity of the burn, slope, soil texture and composition, the presence or building of roads, type of logging system, and postfire weather conditions.
- Postfire logging can cause significant changes in the abundance and nest density of cavity-nesting birds, particularly those attracted to recently burned forests.
- The probability that insect pest populations will build up and infest adjacent-green-tree stands may be reduced through removal of vulnerable trees after fire.
- Fuel mass increased on the logged sites as a result of slash left over from harvest, and on the control site as the result of fire-killed trees falling over.

TREES IN THE PATH OF DESTRUCTION

When wildfire sweeps across a landscape, obviously the most conspicuous result is dead or dying vegetation, particularly trees,” says McIver. “Although extremely intense forest fires potentially can consume all aboveground biomass, normally a much lower percentage is consumed, even in so-called stand-replacement fires.” Percentages are affected by variables such as fire intensity, fire duration, weather, topography, fuel moisture, stand composition, and structure. Species composition, along with stem size and age, also play roles in levels of plant death.

Trees killed by wildfire and left standing take on roles that change the ecological services they previously provided as components of a green-tree system. They still offer some shade, which in a burned environment can slow the heating of surface waters and the soil surface. They may also provide more rapid recruitment of large wood into streams. Decomposing fallen trees provide nutrients, shelter, and early structure for a rejuvenating forest floor.

With the arrival of beetles, the dynamic changes more dramatically. Dead trees attract a wide variety of bark and wood-boring beetle species, which can build up large populations that serve as a source for infestation of adjacent green-tree stands, McIver explains. The increased abundance

of insects tends to attract insectivorous birds, such as the black-backed woodpecker in eastern Oregon’s Blue Mountains.

“As a consequence of changes in food composition and breeding habitat, burned forests typically support significantly different bird communities, with many species dependent on stand-replacement fires to maintain their populations across the landscape,” he says. “Usually there’s an increase in cavity-nesting, insectivorous birds such as woodpeckers and certain species of flycatchers.”

Plant succession after a fire also affects wildlife response. Species composition of bird communities, for example, is altered first by the fire itself, then by development of a shrub stage, and then by the advancing young tree community.

Similarly, mammal species composition is changed by wildfire; everything from deer and elk to small forest-floor mammals have compositional responses to fire. Wildfire, like any other large-scale disturbance, including management, will favor some species and reduce the occurrence of others. McIver points out that a full historical mix of species across the landscape depends on a shifting mosaic of landscape conditions, to which fire is a crucial contributor.

Purpose of PNW Science Findings

To provide scientific information to people who make and influence decisions about managing land.

PNW Science Findings is published monthly by:

Pacific Northwest Research Station
USDA Forest Service
P.O. Box 3890
Portland, Oregon 97208
(503) 808-2137

Sherri Richardson Dodge, Editor
srichardsondodge@fs.fed.us

Send new subscriptions and change of address information to
pnw_pnwpubs@fs.fed.us

Carlyn Mitas, Design & layout
mitasc@cascadeaccess.com



United States
Department of
Agriculture



Forest Service

Science Findings is online at:

<http://www.fs.fed.us/pnw>

SOIL AND WATER IN THE PATH OF DESTRUCTION

Soil changes alter hydrology, erosion rates, stream characteristics, and vegetation regrowth. Under severe burning, soils can become water repellent. This occurs in depths proportional to the intensity of burn, so severe burns can reduce functional soil depth from several feet to several inches. McIver adds that tree death contributes to lower rates of evapotranspiration, so that postfire soils tend to remain more saturated and less able to accept water from big precipitation events.

“The result is increased overland flow capable of carrying more sediment, and therefore able to cause more erosion. Combined with the removal of vegetation by fire, erosion potential can be very high compared with unburned watersheds,” he says.

In addition, fire usually results in the loss or alteration of nutrients, and sometimes the exposure of mineral soils. These changes can significantly affect site productivity.

RECOUP THE VALUE OR PRESERVE THE FOREST?

Standard practice on federal lands has been to harvest trees soon after fire. Objectives can be ecological—rehabilitation and restoration—or economic—seeking to recoup as much economic value as possible before trees begin to decay, and particularly before beetles arrive to hasten the process. In Ponderosa pine stands, the beetles generally arrive at major fire sites within months or years, and their feeding can lower economic value significantly within a year or two following infestation.

“Land managers generally have a strong tendency to do some form of active management after a fire. In many cases, they view logging as one component in an array of rehabilitation and restoration techniques, many designed to mitigate adverse environmental effects perceived to be due to the fire itself,” McIver says.

Such measures include scattering of logging slash, placement of logs on the

 **LAND MANAGEMENT IMPLICATIONS** 

- There is so much variation in burned forests, and so much variation in logging equipment used, that small-scale experimental studies are unlikely soon to provide general principles for mitigating ecological damage in the postfire environment.
- Managers could benefit by comparing different practices and prescriptions applied to similar stands in an operational context, even if such comparisons were unreplicated or uncontrolled. In other words, adaptive management may be the best tool at hand.
- The Summit fire results suggest that by using logging over snow in areas with heavy soils and low slope, postfire logging can be conducted with relatively little transfer of sediment to perennial streams.

Streams within burned areas may suffer many related fire effects: loss of woody debris sources, increased sediment and nutrient transport, increased water temperature, changes in magnitude and timing of peak flows, and decreased habitat diversity. Nonetheless, fish species in these

areas are presumably adapted to the mosaic of landscape patterns created by natural disturbance regimes.

With these well-known effects of wildfire, particularly of more intense burns, what of the debate about postfire logging?

contour, and cross-ditching of skid trails—all to reduce postfire erosion. Tree bole removal is designed to slow drip erosion at the base of fire-killed trees. Timber removal is believed to slow buildup of insect populations, and remove fuel from the path of subsequent fires. The latter, the “reburn hypothesis,” contends that the removal of dead trees after a fire can reduce fuels and thus the intensity of fires that may occur in the future.

“You have to look closely at the type of material brought down by a fire, though,” says Roger Ottmar, a research forester with the Seattle laboratory of the PNW Research Station, who provided methodology and data reduction for a recent postfire logging experiment undertaken by McIver.

“If it is left unlogged, it may indeed increase fire hazard as the fire-killed trees begin to fall and add fuels to the ground. However, that hazard drops dramatically over the years as the material decays and

is compacted by snow. Similarly, the slash left by logging initially increases fuels available to burn if the fuels are not treated immediately; but the fuel level rapidly drops as the slash decays and compacts.”

Opponents of postfire logging argue that logging causes damage to burned sites as a result of the harvest operations themselves, or removes structure that has important ecological functions, particularly the habitat provided by both standing and down wood. “In particular, it has been suggested that postfire logging operations exacerbate local or watershed effects induced by fire, such as erosion, nutrient loss, and the introduction of exotic plant species, and that as a consequence, standards and guides should be at least as strict on burned sites as on ‘green-tree’ sites,” McIver explains.

For example, an oft-cited report by Robert Beschta and colleagues in 1995 recommended a passive (i.e., “hands-off”)

WRITER'S PROFILE

Sally Duncan is a science communications consultant and writer specializing in forest resource issues. She lives in Corvallis, Oregon, and is a doctoral candidate in environmental sciences at Oregon State University.

approach to both wildfire and postfire management in light of inferred, predominantly adverse effects of active management practices (including salvage logging).

With little direct scientific data to support either position, closer examination was warranted for both the custodial approach aimed at protecting postfire areas from any

logging activity, and the idea of reducing dangerous fuel accumulations through salvage logging. McIver and Lynn Starr concluded a literature review that summarized information through February 2000 on the environmental effects of salvage harvest in fire-killed forests.

The review focused on the environmental effects of timber harvest itself, and not on

the associated practices of rehabilitation, such as planting and seeding, that typically occur after harvest. Geographic scope of the review was the dry, forested intermountain West, with some work from other parts of the country and the world, all involving forest types with relatively short fire-return intervals.

ASSESSING THE STATE OF KNOWLEDGE

Only 14 studies isolated the actual effect of logging of burned timber compared to an unlogged control. Another seven documented “management experiments” in which the effects of various management treatments were compared without an unlogged control. Without the control, McIver points out, it is difficult to determine the relative contributions made by fire versus logging.

Nonetheless, many of the available findings concur on issues pertaining to postfire logging. Just like in green forests, road-building is likely to cause the greatest increase in sediment transport off-site. And burned forests themselves, most researchers agree, are at least as sensitive as green forests, and the same care and attention needs to be paid to their management.

TRIAL BY FIRE

The immediate environmental effects of postfire logging depend on the severity of the burn, slope, soil texture and composition, the presence or building of roads, type of log retrieval systems, and postfire weather conditions,” Ottmar notes. “The complexity of these elements makes study of any one site difficult, and makes it almost impossible to extrapolate results to other sites, especially without controls.” The normal delay of research, he adds, means that although we now have far greater priority for the postfire logging question, we still have only very preliminary answers.

A perfect setting for adaptive management. “With the numerous variations that occur within and between sites, cloud-bursts that affect one small area and not another, and other unique responses, adaptive management offers the chance to leave some stands untouched by postfire

“When you run machines over a burned site, you’re more likely to get increased compaction and displacement,” says McIver. He adds that although logging can increase sediment movement over and above what fire has already done, certain logging systems mitigate such effects. Logging over snow, using aerial logging systems, using grabbing systems rather than skidding for log retrieval, and minimizing site entry in general, all help to keep soil problems down.

Most soil movement after a fire appears to take place in the first few years. If a site can hold steady for about 5 years (until it develops some shrubs and some return of the forest floor structure) soils will also have lost their water repellancy, and damage will be reduced.

logging and just take a look at what some of the differences are. Create new knowledge. Sprinkle a variety of prescriptions across the landscape, kind of like Nature does. See what happens,” McIver says.

At one site in eastern Oregon, McIver has been able to test some postfire logging hypotheses, including the one that states adaptive management would yield the most results. The 1996 Summit fire burned across 40,000 acres in the Umatilla and Malheur National Forests, with varying intensity. Four replicates of three treatments were established the following year at low elevations, in areas historically dominated by ponderosa pine. One treatment was no postfire logging, one logged one-third of the remaining viable timber, and one logged all of the remaining viable timber.

The logging was done over snow, with a feller-buncher to cut the trees down, and a

Removal of dead trees, of course, has its impacts on wildlife. Four studies in the mid-1990s demonstrated that black-backed woodpeckers are less attracted to burn sites that have large dead trees removed, and it’s almost always the large trees that get removed first if economics is the driver, McIver points out.

“The boom and bust of species composition occurs on the backs of fires,” he explains, “and removing those big trees removes habitat for wildlife.” Creating and destroying habitat are the potential twin results of fire, just as they need to be considered as potential twin outcomes of postfire logging.

skidder to tow whole trees back to landings. The skidder traveled on a limited number of main trails to which logs were yarded and stacked from where they were felled. No new roads were built.

The focus of the study was on soil impacts and reburn potential. The experimental study found that the use of logging machinery disturbed between 8 and 20 percent of soil area in the study units, with displacement and compaction the principal types of disturbance. Sediment transport out of the area was minimal, probably because the slopes were low, and no new roads were constructed.

Logging removed between 43 and 46 percent of timber basal area, a significant amount when viewed in terms of habitat, for this is likely to change the abundance and nest density of certain fire-dependent birds.

“But the jury is still out on the reburn question,” Ottmar says. “All size classes of woody fuels actually increased on the logged as well as control units in the experiment. But logging added more small-diameter woody fuel in the short term due to handling of the felled logs. This resulted in slightly higher post-logging fuel loads in the harvested units.” Yet logging also reduced the amount of standing fuel, in the form of dead trees, he notes. As these dead trees fall down, they will contribute to future fuel loads. If their decay rate is fast and the next fire doesn’t happen for a long while, the initial fuel differences between control and salvage won’t matter much. But if decay rate is slow, or if the next fire happens soon, then a “reburn” effect could occur, Ottmar explains.

Model projections reveal that logged units might have less fuel in the long run and may burn less intensely. But, and it is a big “but,” the rates of decay of down material make a huge difference to these results. Rapid decay, rapid loss of fuel. Slow

decay, plenty of fuel for subsequent fires for up to 50 years.

The Summit postfire logging study suggests that logging can be done with acceptable effects on soils and minimal sediment transport off-site, provided the right equipment and approach are used, McIver says. “Studies are needed that measure sediment transport at drainage scales and adaptive management experiments to see how site differences play out,” he adds.

The Summit study is only a little step on one site, and the researchers are very wary of applying its results to other places. Needed, they say, are more studies of large fire events, instrumented green and burned landscapes, and well-designed research augmented by adaptive management to see how site differences play out. Fuel loadings, fuel treatments, and reburn potential remain complex and challenging issues.

The debate, as people slowly become better informed, will no doubt continue.

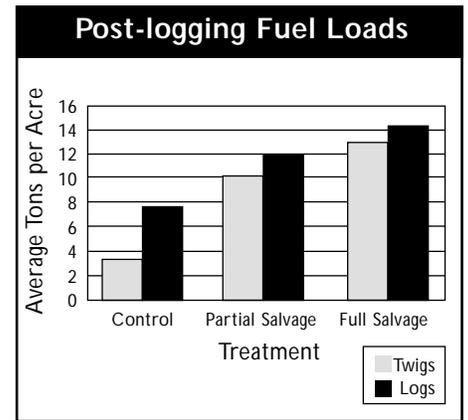
FOR FURTHER READING

Klock, G.O. 1975. *Impact of postfire salvage logging systems on soils and vegetation*. Journal of Soil and Water Conservation. 30 (2): 78-81.

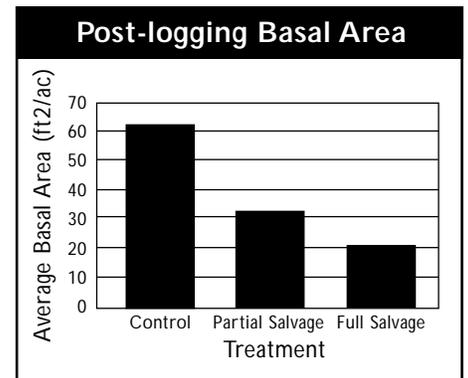
McIver, J.D.; Starr, L. 2001. *A literature review on the environmental effects of postfire logging*. Western Journal of Applied Forestry. 16 (4): 159-168.

McIver, J.D. [and others]. [N.d.] *Fuel reduction, soil impacts, and sediment transport after postfire logging in northeastern Oregon*. To be submitted to Forest Ecology and Management.

Saab, V.J. Dudley, J. 1998. *Responses of cavity-nesting birds to stand-replacement fire and salvage logging in ponderosa pine/Douglas-fir forests of southwestern Idaho*. Res. Pap. RMRS-RP-11. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.



▲ Average post-logging fuel loads in control, partial, and full salvage units at the Summit fire.



▲ Average post-logging basal areas for control, partial, and full salvage units at the Summit fire.

STATION LAUNCHES NEW PUBLICATION

Science Update, a 12-page color publication, offers scientific knowledge for pressing decisions about controversial natural resource and environmental issues. It can be found online at the PNW Research Station Website at www.fs.fed.us/pnw.



U.S. Department of Agriculture
 Pacific Northwest Research Station
 333 S.W. First Avenue
 P.O. Box 3890
 Portland, OR 97208-3890

Official Business
 Penalty for Private Use, \$300

PRSR STD
 US POSTAGE
 PAID
 PORTLAND OR
 PERMIT NO G-40

SCIENTIST PROFILES



JIM MCIVER is a research ecologist with the Disturbance Team, Managing Disturbance Regimes Program of the Pacific Northwest Research Station. His research interests include evaluation of fire and fire-surrogate treatments for restoration of dry coniferous forests, the relations of arthropods to invasive plants, and the ecology of social insects.

McIver can be reached at:
 Pacific Northwest Research Station/USDA Forest Service
 Forestry and Range Sciences Laboratory
 1401 Gekeler Lane
 La Grande, OR 97850
 Phone: (541) 962-6528
 E-mail: jmciver@fs.fed.us



ROGER OTTMAR is a research forester in the Fire and Environmental Research Applications Team, Managing Disturbance Regimes Program of the Pacific Northwest Research Station. He has conducted research in fuels, fire, and smoke for more than 22 years. He is currently leading efforts to

develop a natural fuels photo series, fuel consumption models for forested and nonforested fuel types; and a new fuel characterization system for the United States. Ottmar recently completed research to assess fuel loading, fire behavior, and emissions from different management scenarios in the interior Columbia River basin. He also assessed wildland firefighter exposure to smoke and the associated health risk.

Ottmar can be reached at:
 Pacific Northwest Research Station/USDA Forest Service
 Forestry Sciences Laboratory
 4043 Roosevelt Way, NE
 Seattle, WA 98105
 Phone: (206) 732-7826
 E-mail: rottmar@fs.fed.us

COLLABORATORS

(All collaborators are USDA Forest Service employees)
 Robert McNeil, Malheur NF
 Steve Howes, Pacific Northwest Region
 Bob Brown, Rocky Mountain Research Station
 Bill Elliot, Rocky Mountain Research Station
 Pete Robichaud, Rocky Mountain Research Station