

The Facts and Myths of Post-Fire Management: A Case Study of the Biscuit Fire, Southwest Oregon

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Biscuit fire area, southwest Oregon, as viewed from TJ Howell Memorial Highway (D. DellaSala)

Report citation: DellaSala, D.A., G. Nagle, R. Fairbanks, D. Odion, J.E. Williams, J. R. Karr, C. Frissell, and T. Ingalsbee. 2006. The facts and myths of post-fire management: a case study of the Biscuit fire, southwest Oregon. Unpublished Report, World Wildlife Fund, Klamath-Siskiyou Program, 116 Lithia Way, Ashland, Oregon.

EXECUTIVE SUMMARY

Post-disturbance management, much like fire itself, has been the subject of intense debate and widespread misunderstanding regarding how and whether to treat regenerating landscapes following large disturbance events. The Biscuit fire of 2002, the largest in the

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nation at the time and in Oregon in the past 100 years, has been used to justify pre- (Healthy Forest Restoration Act of 2003) and post-fire (HR4200, S.2709) logging legislation under the assumption explicit in their titles that such activities are beneficial to fire risk reduction and ecosystem recovery, respectively. We conducted a three-day workshop on the Biscuit logging project with researchers having extensive background in disturbance ecology and field studies within the Biscuit and other fire areas to examine key assertions related to post-fire landscapes in general and post-fire logging in particular. We used literature reviews, preliminary field work, and extensive photo documentation of Biscuit logging units to refute suppositions having little or no ecological basis but often used to justify post-fire logging and related management. In particular, we provide seven key findings related to post-disturbance landscapes and their management:

1. **Post-fire logging is not a restorative action**, rather it harms regenerative processes by degrading soils, causing excessive erosion, delaying natural plant and animal succession, and introducing or spreading invasive species (impacts are more severe for ground- and cable-based logging than helicopter logging).
2. **Post-fire logging, rather than jump starting old-growth forests, inhibits the return of old-growth forest conditions** by removing the very components (large dead, dying, and downed trees) crucial in their development
3. **Post-fire logging can elevate hazardous fuels** by removing the least flammable portion of trees (trunks) and generating significant logging slash (in places where logging slash is treated with pile burning, damage to soils can have long-term consequences).
4. **Naturally regenerating landscapes following fire are some of the richest habitats in the Pacific Northwest** and need to be managed for their unique ecological values.
5. **Post-fire logging on steep and inaccessible areas like the Biscuit is a costly operation** with estimated costs exceeding revenues by ~\$14 million for logging that removed ~53.5 million board feet of timber.

6. **A three-month delay in producing the Draft Environmental Impact Statement and pushing back Biscuit logging an entire operating season was the result of Forest Service changes** (at top levels) that resulted in controversial and inflated timber volumes and management alternatives with unrealistic expectations.
7. **Public participation in forest planning should be expanded** (not reduced) in order to build agency trust in implementing post-fire management, particularly as interest in post-fire logging is scaling up at a time when federal agencies are less able to conduct rigorous evaluations due to reduced budgets and declining staff.

INTRODUCTION

How society treats post-fire landscapes is at the center of management and policy debates; some call for widespread post-fire logging while others advocate allowing forests to regenerate naturally. Large fires in recent years have stimulated legislative action designed to reduce fire risks (e.g., Healthy Forest Restoration Act 2003) and to manage post-disturbance landscapes by logging and related activities (HR 4200 and S. 2709). The Biscuit fire of 2002, the largest in the nation at the time and in Oregon in the past 100 years (see Box 1), has been especially controversial as decision makers have used the fire as an example to expedite pre- and post-disturbance logging. Additionally, prior to the fire, the area was nominated for national monument protections by conservation groups because of its globally significant levels of biodiversity (see DellaSala et al. 1999). Consequently, management decisions affecting the Biscuit fire area have conservation and policy implications exceeding the immediate area of interest.

Box 1 – Biscuit Fire Facts

The Biscuit fires, which burned within the Siskiyou National Forest and adjoining BLM lands in southwest Oregon, was actually a number of fires started by lightning (USFS, Pacific Northwest Region 2003) and subsequently supplemented by human-caused back fires that converged on the Kalmiopsis Wilderness and surrounding landscape. Here are some other facts about the fire complex:

- Lightning ignited 4 separate fires in remote portions of the Kalmiopsis region on July 13th, 2002.
- Because these fires were initially small, in remote locations, and were not spreading, they were not a high priority for fire suppression activities at the time.

- That situation changed when gusty hot and dry east winds began raking the Kalmiopsis region. The fires began to burn with much greater intensity and spread rapidly.
- Fire progression maps indicate that about two-thirds of the area that burned did so on just 6 days in late July and early August when the hot, dry and windy weather was most extreme (USFS Pacific Northwest Region 2003).
- This was also the period of intentional ignition of numerous very large, severe fires outside the perimeter of the wildfire in an attempt to prevent its spread into populated areas. An analysis of fire progression maps indicates that at least 30% of the burn area was inside such back-fire areas (Figure 1).
- Fire progression maps show substantially reduced rates of spread as the weather calmed and fire behavior was more subdued. But by then an exceptionally large burn perimeter had developed, leading to the most expensive fire suppression effort ever in the U.S., as a fire-line was built around much of this perimeter.
- When the fire complex was eventually contained and controlled by the arrival of fall rains, about 500,000 acres had defined the perimeter of the fire (this perimeter included a significant amount of unburned and lightly burned area).
- Weather was the primary factor in determining burn severity. Much of the area burned during extreme weather did so relatively severely, regardless of whether the area had burned in recent decades or whether management actions aimed at reducing fire hazards (e.g. thinning) had taken place.
- Vegetation mortality maps show that 44% of the burn perimeter had more than 75% canopy mortality while another 27% had 50-75% canopy kill (USFS 2002). These areas will fill in with trees and other plants over time to regenerate the new forest.
- In the broad ecological sense, the Biscuit fire reset successional processes to early stages of plant growth involving a diverse suite of biological communities, including regenerating trees, shrubs, lichens, bryophytes, fungi, and wildlife. The forest community that experienced the fire was not “lost,” but simply reduced temporarily in extent until a new forest develops on sites that support this vegetation. Legacies of snags, dead and dying trees, mycorrhizal fungi and other species are present in sufficient abundance to regenerate the forest ecosystem without intervention.

Lessons learned from large post-disturbance landscapes like the Biscuit fire area can inform policy makers, land managers, and the general public on the most prudent approach to post-disturbance management. Ecological evaluation of the post-fire management in the Biscuit can also help society distinguish fact from myth, by assessing the outcomes when management alternatives are defined on ideological grounds rather than ecological reality (i.e., Sessions et al. 2003). Our objectives therefore were to: (1) examine assertions surrounding post-disturbance logging; (2) discuss post-fire regeneration within the Biscuit area in relation to logging activities; and (3) provide recommendations on restoration of post-fire landscapes that can guide decision makers.

This report is the product of a three-day workshop attended by scientists with backgrounds in disturbance ecology and natural resource management to examine post-disturbance logging on the Biscuit within the context of pending legislation. In addition, one of us (G. Nagle) spent 85 days making field observations and taking extensive photographs of 90 out of 220 logging units, encompassing 60% of the total area logged (Nagle 2005). Many of these photos are displayed here to support findings summarized from the literature.

In particular, proponents of post-fire logging (e.g., see Sessions et al. 2003; HR 4200, S. 2709 also see - <http://www.walden.house.gov/issues/forestrecovery> - active as of December 2005) are premised on a number of assumptions that warrant careful and deliberate examination: (1) post-fire logging is a “restorative” action; (2) tree planting linked to post-fire logging is essential to post-fire regeneration; (3) post-fire logging accelerates the return of old-growth forests after fire; (4) post-fire logging reduces future wildfire hazards; (5) burned landscapes are “biological deserts,” “moonscapes,” or “wastelands;” (6) post-fire logging returns money to federal coffers; and (7) public participation delays post-fire logging implementation. We examined each of these assertions by combining a literature review with field observations compiled by scientists working in the Biscuit area since 2002.

Assertion: post-fire logging is a “restorative” action.

Finding: post-fire logging and associated slash treatment often harms regenerative processes by compacting soils, removing “biological legacies,” delivering excessive sediments to aquatic systems, and introducing additional disturbances when regenerating forests are most vulnerable.

While knowledge will never be complete, available information clearly indicates that post-disturbance logging and related activities impede or prevent ecosystem regeneration. Strittholt and Rustigian (2003) examined 23 studies of salvage logging, concluding that there was no scientific evidence to support the claim that such logging benefits forest ecosystem health or promotes late-successional forest characteristics – in fact, most of the scientific papers document damage from this activity. Lindenmayer et al. (2004) raise similar concerns in *Science*, and other scientific syntheses (Karr et al. 2004, Beschta et al. 2004) conclude that post-fire logging can be a significant deterrent to forest regeneration following natural disturbances (Donato et al. 2006). In congressional testimony to the House Subcommittee on Resources (November 10, 2005), prominent forest ecologist and University of Washington Professor Jerry Franklin said “*timber salvage is most appropriately viewed as a ‘tax’ on ecological recovery. The tax can either be very large or relatively small depending upon the amount of material removed and the logging techniques that are used.*”

In general, post-fire logging impedes regeneration when it compacts soils, removes “biological legacies” (e.g., large dead standing and down trees), introduces or spreads invasive species, causes soil erosion when logs are dragged across steep slopes, and delivers sediment to streams from logging roads (Karr et al. 2004, Beschta et al. 2004). Tractor logging generally causes the worst damage with cable logging also causing damage when done without proper suspension of logs (photo 1, left). Although soil impacts can be reduced by helicopter logging (photo 1, right), such operations are expensive and typically the largest trees must be removed in order to pay for the operation (i.e., heli-logging is typically twice as costly as cable-based logging).



Photo 1. Cable logging (photo on left; C. Frissell) along landslide-prone headwalls within the Fiddler logging unit (Biscuit logging project). Note the steepness of terrain and potential for soil erosion within this late-successional reserve. Best management practices (USFS and BLM 2003) limit such soil impacts across more than 15% of a treatment area but this was greatly exceeded on this site. Heli-logging within the Briggs unit #4 (photo on right, G. Nagle) with buffered riparian area on far left. Timber from this unit was sold for \$42.50 per mbf and most of the large Douglas-firs were removed.

In particular, aquatic systems are often severely stressed in the period immediately following fires (Karr et. al 2004). Increasing sediment inputs by post-fire logging should be avoided during this period, especially in watersheds that have already suffered aquatic degradation from past management activities. Even the simple use of logging roads during the wet season can increase sediment loads (Reid and Dunne 1984) and for that reason some national forests have severe restrictions on logging when roads are wet. This is especially true in the Siskiyou's where stream drainage density is high, roads intersect the stream network at high frequency, and a large portion of the sediment generated or transported on road surfaces enters and impacts surface waters (Wemple et al. 1996, Trombulak and Frissell 2000).

Assertion – tree planting linked to post-fire logging is essential to post-fire regeneration.

Finding – restocking with conifers after logging does not offset the negative effects associated with logging activities.

Post-fire logging is often justified as a mechanism to pay for tree planting under the assumption that regeneration following fire is inadequate (Sessions et al. 2003). But, careful observations of Yellowstone National Park following the 1988 fires and other fires such as the Storrie fire of 2000 (Lassen and Plumas National Forests, CA) and Star

Fire of 2001 (Tahoe and Eldorado National Forests, CA) indicate that post-fire regeneration can be surprisingly prolific even on severely burned sites (Turner et al. 2003). In a recent field study of the Biscuit fire area, Donato et al. (2006) report that natural conifer regeneration two years after the 2002 Biscuit fire was variable but generally abundant even in high-severity burn areas where conifer densities (306.8 per acre) exceeded regional standards for fully stocked stands. Based on field plots replicated across the burn area before and after logging, these authors concluded: (1) post-fire logging reduced median regeneration density by 73% and significantly increased downed woody fuels and short-term fire risks; (2) post-fire logging impacted conifer seedlings by damaging soils and by physical burial of seedlings by woody material due to logging; (3) post-fire logging significantly increased both fine- and coarse-woody fuel loads; (4) if post-fire logging is conducted in part to facilitate reforestation, replanting could result in no net gain in early conifer establishment (i.e., due to logging related losses in seedling establishment); and (5) post-fire logging therefore can be counter productive to the stated goals of ecosystem restoration.

Strittholt and Rustigian (2003) report that approximately 84% of moderate to severely burned areas (mapped using GIS and estimates of canopy mortality) on the Biscuit fire area were within 660 feet of unburned areas that can act as natural seed sources for re-establishment (see photo 6 below). The patchy burn pattern and resulting proximity of residual seed trees helps explain the abundance of naturally regenerating conifers in burned areas observed in the field (see Donato et al. 2006).

Conifer establishment in the Siskiyou forests involves complex ecological interactions (above and below ground) among conifers, shrubs, and resprouting hardwoods necessary to post-fire regenerative processes (Perry et al. 1989, Bingham and Sawyer 1991, Odion et al. 2004a). In particular, many shrub species viewed by some as “competitors” of conifers (Sessions et al. 2003) in fact play essential roles in conifer establishment. Examples include California-lilac (*Ceanothus sp.*), a nitrogen-fixing shrub, and manzanita (*Arctostaphylos sp.*) a symbiont with ecto-mycorrhizal fungi, which is important in facilitating nutrient uptake by conifers, forest regeneration, and the pattern

of plant succession post-fire (Amaranthus and Perry 1994). In particular, management practices that create intense disturbance and loss of organic matter (soils) can decrease the ability of plants to form linkages with ecto-mycorrhizal fungi (Amaranthus and Perry 1994). Similarly, alder (*Alnus* spp), once viewed as a “trash species” by some foresters, is an important nitrogen-fixing species involved in early soil development and conifer establishment following disturbances (Atkinson and Hamilton 1978).

Planting conifers following fire is intended to fill the opening left after fire with a vigorous growth of trees. While this practice can abbreviate the period of high abundance for hardwood trees, shrubs, grasses, and forbs that are displaced by the conifers (Sessions et al. 2003), such even-aged management has been associated with low levels of wildlife diversity in managed forests throughout the Pacific Northwest (see Muir et al. 2002 for review). The resulting structurally homogeneous stands in fact appear to be predisposed to high severity fires. In a study of fire behavior in the Klamath Mountains, for example, Odion et al. (2004b) report densely stocked tree plantations had average fire severity twice that of natural forests. It remains uncertain what effects on stand successional dynamics and fire vulnerability are caused by inter-planting of trees at relatively low densities, as was generally the case on the Biscuit.

We also note that lags in tree regeneration are not unusual, or necessarily ecologically problematic, particularly on semi-arid or xeric sites. In some special and rare cases, however, planting and seeding of native vegetation after disturbance may be appropriate, using local genetic stock, if it is conducted with much caution and is based on a clear scientific understanding of local vegetation types and conditions. In these limited cases, planting should be de-coupled from post-fire logging. In fact, in many cases, post-fire logging is likely to undermine the ultimate success of efforts to restore natural forest vegetation, through its negative effects on overall forest and soil productivity. Moreover, the often subtle but nonetheless important micro-evolutionary changes that occur in association with human disturbance and anthropogenic change require more “evolutionarily enlightened” resource management decisions (Ashley et al. 2003). Post-fire logging, planting, and seeding therefore are separate activities. There is no sound

ecological or evolutionary reason to continue to wed them, and circular rationalization results when they are linked in management plans without clear identification of intent and need for each action.

Assertion: post-fire logging accelerates return of old-growth forests after fire

Finding: forest landscapes are degraded (not restored) by salvage logging and the return of old growth forest is delayed

Forests are born out of disturbance events like wildfires and wind storms. Old-growth forests experience periodic natural disturbances ranging from stand-replacing fires to small gaps in tree canopies caused by natural tree mortality (Spies et al. in press). Therefore, while fire and other large-scale disturbances (e.g., hurricanes, floods, volcanic eruptions) are viewed by some as “catastrophic” to forest regeneration (e.g., as in HR4200), in reality, these disturbances reset the successional “clock” to early pioneering species essential to the regeneration and future development of older forests and other plant and wildlife communities. There are certainly examples where intervention to reduce the probability of crown fire (e.g., thinning small trees to reduce ladder fuels in fire-prone regions) is important to the maintenance of older forests because these forests are in short supply and additional losses are unacceptable (e.g., east of the Cascades and in the Klamath province; Spies et al. in press). However, scientific data do not support assertions that post-fire logging can accelerate the return of old-growth conditions.

Because such logging targets the largest trees for their commercial value, it deprives post-fire forests of these “biological legacies” essential to the regeneration of complex forests (Franklin and Agee 2003). Ecologically, nothing in a forest is “wasted;” dead trees play a vital role in the return of old-growth forests after fire. Large dead and dying trees (the legacies of old-growth forests), in particular, are vital to post-fire regeneration and development of old-growth conditions as they: (1) “anchor” soils and impede erosion; (2) provide shade and necessary microclimatic conditions for developing seedlings; (3) contribute essential habitat for fish and wildlife species; and (4) provide the “food” for developing new forests and soils (Lindenmayer et al. 2004). In the Pacific Northwest, up

to 150 species of birds, mammals, and amphibians depend on dead and dying trees, many of which are insectivorous and thus perform vital checks and balances on insects that otherwise might become large outbreaks (Rose et al. 2002). Other estimates of the importance of dead wood, particularly large pieces, include up to one-half to two-thirds of forest dwelling animal species (both vertebrates and invertebrates) that rely on these important structural features (J. Franklin Congressional Testimony November 10, 2005 to the House Resource Committee). Thus, rather than being a restorative action, post-fire logging removes biological legacies that speed natural regeneration.



Photo 2. Large dead and dying trees like these provide habitat for many bird species. The photo on the left shows a threatened Northern Spotted Owl (*Strix occidentalis caurina*; Quartz Creek fire area, southwest Oregon) in a burned large tree (D. Clark, Oregon State University); the one on the right shows an American Robin (*Turdus migratorius*) nest site in a dead burned tree within the Biscuit area (M. Cannon, Oregon State University).

The Biscuit fire generated a pulse of dead and down logs (i.e., coarse woody debris) that scientists believe is vital to post-fire development of old-growth forests in mixed-severity fire regimes (Brown et al. 2003). The fire produced large dead trees that these forests depend on for decades to centuries (J. Franklin, Univ. Washington, comments to the Forest Service on the Draft Environmental Impact Statement for the Biscuit). Salvage logging within late-successional reserves removes these legacies at the expense of old-growth development.



Photo 3. View of salvage logging unit #5, Fiddler late-successional reserve (LSR), Biscuit sale area (photo G. Nagle) showing loss of old legacy trees (note - blackened trees downslope are within a protective riparian reserve; these trees represent size classes removed upslope by logging. Also note the dense shading effect cast by dead trees in the riparian reserve, which is crucial to seedling establishment. Plot counts of tree seedlings reveal higher levels of conifer seedlings in protective buffers like these).

Assertion: post-fire logging reduces future wildfire hazard

Finding: post-fire logging often increases hazardous fuels

Salvage operations target the tree bole (trunks), the least flammable portion of the tree, leaving behind finer materials (branches and needles) on the forest floor that can contribute to future fire spread (Box 2). Logging slash on the Biscuit was piled and burned in places as part of post-fire treatment efforts designed to reduce fuels. However, data from Biscuit field studies indicate slash levels were significantly higher than unlogged sites in the surface fuels class (mainly un-merchantable logging slash <3 inches in diameter; Donato et al. 2006). These fuels can act as kindling for future fires, thus raising fire risks not lowering them. However, gathering the logging slash into piles for burning, and the sustained high soil temperatures that often result when they are burned, can cause soil damage (photo 5). Thus, the Forest Service was faced with a management conundrum. On the one hand, fuels were elevated by logging and needed to be treated to reduce future fire risks. On the other hand, reducing fuels through pile and/or “jackpot”

burning had obvious impacts on soils (see Korb et al. 2004, Donato et al. 2006 for similar concerns).

Box 2 – Salvage Logging Elevates Future Fire Risks

Even in a very severe fire, trees are killed, not consumed by fire. Since remaining branches and tops of trees are widely spaced from one another and held well off the ground, they are less likely to contribute to a fire in the years after wildfire. Logging brings branches and tops of trees to the ground, concentrating fuels in a loose arrangement that allows easy air circulation and intense combustion (photo 4). If a fire burns through this logging slash it is apt to damage soils and kill re-establishing vegetation. Further, the significant economic losses associated with deficit sales from this project, make it unlikely that fuels will be treated through the construction of fuel management zones (FMZs) envisioned by the agencies in the Draft Environmental Impact Statement (USFS and BLM 2003).



Photo 4. Briggs salvage unit# 3, Biscuit area, showing extensive build up of ground fuels from logging slash left behind (photo – G. Nagle).

In cases where old-growth regeneration is the management objective (e.g., reserves), post-fire management should avoid increasing fuels that cause soil damage lest managers compromise old-growth potential.



Photo 5. Fiddler (Biscuit logging project) late-successional reserve where slash was piled and burned resulting in soil impacts (blackened areas). Photo on right is soil aggregate from superheating of soils within slash burn piles (photos – C. Frissell). Although localized, these impacts occurred in late-successional reserves originally set aside for development or retention of old-growth characteristics.

Assertion: burned landscapes are “biological deserts,” “moonscapes,” or “wastelands.”

Finding: naturally regenerating landscapes following fire are some of the richest habitats in the Pacific Northwest.

Large infrequent disturbances, such as extreme floods, the Mount St Helens volcanic eruption, and the 1988 Yellowstone National Park fires create landscape diversity integral to biodiversity and regenerative processes (Parsons et al. 2005; photo 6). Because post-fire logging can inhibit natural regeneration, and because it has in the past been such a widespread practice, naturally regenerating, un-logged areas are among the rarest and richest landscapes in the Pacific Northwest (Franklin and Agee 2003).



Photo 6. Two aerial views of Biscuit burn, southwest Oregon, taken July 2003, showing patchy nature of the fire and juxtaposition of live trees and severely burned areas (photos – S. Whitney).

Recent studies of post-fire landscapes indicate they are remarkably rich in bird species. According to Smucker et al. (2005) (also reported in the *Missoulian* August 11, 2005), Western Tanagers (*Piranga ludoviciana*) appear to thrive in low-severity fires. Dark-eyed Juncos (*Junco hyemalis*) use medium-severity burns and Black-backed Woodpeckers (*Picoides arcticus*), Mountain Bluebirds (*Siala currucoides*) and Olive-sided Flycatchers (*Nuttallornis borealis*) use high-severity burns. Woodpeckers prefer thick-barked trees like Ponderosa pine (*Pinus ponderosa*) and Douglas-fir (*Pseudotsuga menziesii*) for nesting, these two species often persist under low to moderately severe fires. In the Western U.S., most cavity-nesting birds do not use heavily logged burns, although some cavity-nesters persist in partially logged burns (Kotliar et al. 2002).

Preliminary observations of the Biscuit fire area reveal a rich avifauna using burned forests, including several species nesting in tree cavities and within the crevices of burned trees (M. Cannon, pers. communic., Oregon State University – also see photo 2). Additionally, preliminary monitoring (using radio telemetry) of the threatened Northern Spotted Owl (*Strix occidentalis caurina*) indicates owls use a range of burn severities (low to high) on the Biscuit and other burned areas in southwest Oregon (see photo 2).

The Biscuit area is a mosaic of vegetation communities in different stages of post-fire regeneration. The spatial heterogeneity in plant communities generated by fire in this

landscape is a major contributing factor involved in the area's unique biodiversity (Odion et al. 2004a). Notably, the Biscuit area is the northern extension of the California Floristic Province, a global hot spot of plant richness and endemism (<http://www.biodiversityhotspots.org/xp/Hotspots>).

Finally, researchers consistently conclude that burned areas are rich in naturally regenerating trees, shrubs, forbs, and grasses that in turn act as valuable habitat for insects, birds, small mammals, ungulates and predatory mammals. Thus, the reality on the ground is the opposite of what is suggested by the apocalyptic language of those arguing that burned areas are “biological deserts,” “moonscapes,” or “wastelands.”

Assertion: post-fire logging returns money to federal coffers.

Finding: post-fire logging in remote areas is a money loser for taxpayers when costs of salvage are fully considered.

Under the congressional “salvage rider” of 1995 that expedited federal salvage sales, industry rejected 17% of the volume offered (Wolf 2004a). Since that time, the market for federal timber has declined even further as many mills across the western U.S. shut down and the industry relied on cheaper wood imported from overseas. Stumpage rates for federal timber sold, in nominal dollars, have fallen from \$205 per thousand board feet (mbf) in 1993 to \$86 per mbf in 2003 (Wolf 2004a).

The assumption that a large market exists for burned timber logged from steep federal lands using long reach cable or helicopter logging is not supported by the facts. On the Bitterroot National Forest in western Montana, for example, the Forest Service initially proposed a 180-mmbf post-fire salvage program. Later negotiations reduced this to 60-mmbf but the agency was only able to sell 23-mmbf (Wolf 2004a).

The 220 Biscuit sale units were concentrated for the most part along main ridge-top roads, adjacent to old clearcuts. These units were the most accessible of all the possible sale areas in the 19,465 acres proposed for sale (USFS and BLM 2003). In general, post-

fire logging on the Biscuit was a money loser when costs of salvage are fully considered, including cost of writing the environmental impact statements, sale preparation, sale administration, and other factors.

During 1998-2002, the Siskiyou National Forest sold green timber for an average of \$400 per mbf² at an overall cost of \$413 per mbf.³ In the Final Environmental Impact Statement for the Biscuit, the agencies projected an average sale price⁴ of \$296 mbf for logs sold during the summer of 2004 (USFS and BLM 2004).

In an April 23, 2004 request to the Regional Forester for an Emergency Situation Determination on the Biscuit, the Forest Service used the potential sale income of \$250 per mbf to justify protection from appeals in order to accelerate logging. This emergency exemption was granted on June 3, 2004.

Coming up with solid estimates for losses under different scenarios is difficult since we do not have access to complete data. Based on the data we do have, a large gap exists between revenue projections and actual income stream (Tables 1 and 2) as noted below.

- With so much of the ground needing expensive helicopter logging the Forest Service had to ask for very low minimum bid prices. Out of the 12 sales, nine had only one bidder, with 8 of these sold at or just above the minimum acceptable bid price (Rogue-Siskiyou National Forests 2005).

² Figuring out actual total revenue from sales is often difficult. We assumed that this \$400/mbf sale price includes revenue from purchaser deposits for slash treatment and roads. These averaged about \$20/mbf and \$8/mbf respectively in the five sale summaries obtained for the Biscuit.

³ These costs included sale preparation at \$84/mbf, timber related overhead costs in the regional and Washington offices at \$16/mbf, and post-logging cleanup costs at \$164/mbf. We do not have specific data to account for the remaining costs that make up the \$413 but this would include the \$947/acre cost of tree planting used by the Forest Service in the Biscuit Fiddler sale area (figure cited in 11/15/04 letter of Robert Wolf to Senator Gordon Smith and other Oregon congressional representatives) and the approximately 25% of sales revenue paid to counties in lieu of property taxes (ECONorthwest 2003).

⁴ This figure of \$296 was derived from a discount factor of 0.89 for two-year-old, fire-killed Douglas-fir on a green tree sale value of \$333 in southwest Oregon (USFS and BLM 2003, Appendix I: I-4). This estimate did not include additional revenue from deposits for slash disposal and road maintenance.

- Despite the inflated revenue assumptions based on an income of \$250/mbf that was used to obtain an emergency exemption, the advertised minimum acceptable bid prices for the 12 Biscuit sales still only ranged from \$15 to \$108 per mbf with an average of \$51 per mbf (Rogue-Siskiyou National Forests 2005).
- The 12 Biscuit sales sold for \$15 to \$304 per mbf at an average price of \$74.58 per mbf (Rogue-Siskiyou National Forests 2005).
- The agency spent \$5.8 million on planning alone for the Biscuit sales, not including other costs such as emergency post-fire rehabilitation work. This figure does not include the cost of administrating timber sales or replanting the 6,000 acres planted thus far (Durbin 2005).
- Robert Wolf, a noted forest policy analyst with the Congressional Research Service, figured that at a sale price of \$153 per mbf, the Forest Service would lose about \$1666 per acre on Biscuit salvage (Wolf 2004b). With actual prices averaging only \$74.58 per mbf, Wolf's figures indicate that the agency is losing about \$3417 per acre on Biscuit salvage for a total loss of about \$13 million after logging 3800 acres⁵.

⁵ A year after the fire, the Forest Service also sold 13.5 mmbf in roadside hazard tree logging. These sales with the easiest possible access used very inexpensive cable logging and attracted an average bid price of \$276 per mbf, generating about \$3.7 million in income. If this figure is subtracted from the loss of \$13 million based on Wolf's figures, it indicates that the Siskiyou National Forest still lost about \$9.3 million in Biscuit sales.

Table 1. Summary of expected and actual revenues from salvage sales

Best case* scenario for timber prices using agency estimates	Expected bid price for two year old burned trees after accounting for 11% discount for decay	Price quoted in Forest Service request for emergency determination April 2004	Actual average bid price for all Biscuit sales
\$333/mbf	\$296/mbf	\$250/mbf	\$74.58/mbf (range: \$15-304/mbf)

* Based on projected bid prices that were much lower than actuals.

Table 2. Economics of Biscuit logging project under “best case” economic scenario and under actual bid prices.

Best case scenario for timber prices using agency estimates (USFS and BLM 2003)	Expected costs per thousand board feet under best case scenario	Total loss on sales of 53.5 mmbf under best case scenario	Average actual bid price for all Biscuit sales	Expected costs per thousand board feet under actual bid prices	Total loss on sales of 53.5 mmbf under actual bid prices
\$333/mbf	\$381 (This includes a 25% payment to counties on an average price of \$333/mbf)	\$2.35 million	\$74.58 (range: \$15-304/mbf)	\$348 (This includes a 25% payment to counties on an average price of \$74.58/mbf)	\$14.6

In addition to the above economic losses, extensive logging took place along popular recreational access routes that decreased the recreational value of areas along the T.J. Howell Memorial road; an area that receives considerable use from local residents and others using the Siskiyou National Forest and popular Kalmiopsis Wilderness for recreation.



Photo 7. Views of logging within a late-successional reserve (Fiddler Unit #5) positioned at the entry of the popular Kalmiopsis Wilderness trailhead (left and center photos - G. Nagle, right photo - D. DellaSala), which also access the Babyfoot Lake Botanical Area. Although some hazard tree removal close to parking areas can be justified, this was well beyond what was necessary to address safety concerns and has impacted recreational values along this trailhead.

Assertion: public participation delays salvage logging

Finding: public participation is important in forest management decisions

It is not generally understood by the public that an entire logging season was lost due to political interference by the Bush administration during the planning process for the Biscuit (see Durbin 2005). The Forest Service during scoping initially proposed a much more modest proposal (see USFS Rogue and Siskiyou National Forest 2003 – alternatives and proposed action), but agency planners were pressured into adding two other alternatives based on a report submitted by Sessions et al. (2003). This additional analysis pushed the completion of the plan back three months into October (compare Durbin 2005 with USFS Rogue and Siskiyou National Forest 2003 proposed time table regarding the Record of Decision), thereby foregoing an operating season. The addition of timber sales in late-successional reserves and proposed sales in inventoried roadless areas to meet unrealistic timber targets resulted in major public controversy that continues to this day.

Problems that emerged during Biscuit logging, such as erroneous boundary marking and subsequent logging of 17 acres within the Babyfoot Botanical Area (photo 8), are evidence of the need for careful planning and close public involvement in planning and monitoring of sale areas. Problems like these can best be reduced by limiting logging and log-hauling operations to areas where implementation can be carefully monitored with existing agency staff capacity. Expedited post-fire logging on a large scale and a short time frame, as proposed in current legislation (e.g., HR 4200) makes avoidable problems such as the Babyfoot boundary infractions all but inevitable. In addition, many forests no longer have the field staff to expedite logging without significant environmental consequences. In initial planning for much of Biscuit, the agencies could not field check many areas proposed for logging and had to rely on satellite imagery that seriously misrepresented tree mortality and the volumes actually available for salvage on-the-ground (USFS and BLM 2003).



Photo 8. Erroneously marked and logged 17-acre area within the Babyfoot Botanical Area (G. Nagle).

Moreover, to expedite very rapid harvest a year after the fire, a "categorical exclusion" from appeal was granted by the Regional Office for what turned out to be sometimes extreme roadside "hazard tree" logging in the Biscuit area. Trees deemed "hazards" were cut up to 120 yards from roads, including along many short dead-end spur roads with

minimal use, and along major recreational routes. Although a justifiable case can be made for some hazard tree removal, harvesting of trees more than 100 yards from a road seems excessive. As a result, credibility with the public is eroded, a fact that adds another dimension to the problems created by expedited salvage operations.



Photo 9. Roadside hazard tree logging above and below Game Lake road, Horse sale area. Trees were logged 120 yards above the road. (G. Nagle)

Finally, to expedite post-fire logging, the Siskiyou National Forest lifted restrictions on logging during the wet season. These restrictions were specifically designed to limit the spread of a deadly root disease (*Phytopheris lateralis*) that has greatly impacted Port Orford cedar (*Chamaecyparis lawsoniana*), a species endemic to the region. This was one of the most serious and potentially damaging consequences of expedited logging. Units in Port Orford cedar protection status (i.e., for seasonal road closures) on the Biscuit were still being logged after rains began and slurry developed on some roads. New infections have been found on the access road into Horse sale units and within Fiddler logging unit 2, although it is difficult to pin this definitively on the logging traffic.

PRE AND POST-FIRE RESTORATION AND FIRE RISK REDUCTION: CONCLUSIONS

The Biscuit fire area represents an important opportunity for scientists to study fire's ecological role in maintaining the area's unique ecology (much like the post-disturbance attention given to Yellowstone National Park and Mt. St. Helens National Monument). Thus, the Biscuit area should receive consideration for future Research Natural Area designations as studies of post-fire regenerative processes at the plant association level in this area are scant (although several are now underway). In light of the area's ecological significance and interests in pre- and post-fire management, we offer the following recommendations to help guide policy and management decisions regarding how best to treat such lands when natural resource values clash.

Pre-fire recommendations: the role of fire in maintaining ecological processes and regional biodiversity cannot be overstated. Mixed-severity fires, such as the Biscuit, provide the building blocks for ecologically diverse and productive landscapes, including a variety of plant species and communities found only in this region (see DellaSala et al. 1999, Odion et al. 2004b). Moreover, there is increasing recognition of the importance of landscape heterogeneity created by large wildland fires (see Beaty and Taylor 2001, Smucker et al. 2005), particularly where fire can be safely managed through risk reduction techniques strategically applied before-hand. Fire's beneficial ecological role, however, has been constrained in areas mostly affected by fire exclusion, past grazing, logging or thinning without slash clean up, plantation establishment, and human-ignited backfires (see DellaSala et al. 2004). Thus, fire risk reduction should begin with a prioritized (spatially explicit) identification of fire-prone situations and places at the landscape scale with initial concentration on the wildland-urban interface and fire-prone tree plantations (Dombeck et al. 2004, DellaSala et al. 2004). In general, risks are greatest where hazardous fuels and anthropogenic ignition sources co-occur. In particular, home ignition zones need to be treated to effectively reduce potential for structure ignition and to allow for greater tolerance of fire across the landscape. Greater emphasis could be placed on alternative locations for harvesting timber (home ignition

zones, wildland-urban interface, plantations, areas where biotic integrity is already compromised) rather than removing timber from ecologically sensitive areas (e.g., roadless areas, late-successional reserves) pre- or post-fire. While thinning is often used as a tool for fuel reduction, it has been shown, however, to increase fire severity on the Biscuit when not followed by burning (Raymond 2004).

Post-fire recommendations: post-fire logging in naturally regenerating, post-disturbance landscapes like the Biscuit impacts regenerative processes and damage may persist for decades. Trees that survive disturbances even for a short period of time are critical as seed trees. Those that die as a result of fire (whether they fall or remain standing) are essential to regenerative processes preceding the development of new forests and provide critical habitat for fish and wildlife. Should decision-makers, however, decide that economic factors outweigh ecological consequences, then the following guidelines may help reduce ecological damage.

Land-use designations and post-fire guidelines - Post-fire logging restrictions on the Biscuit should be scaled to the particular land-use designation and applied most stringently in areas of highest ecological concern such as inventoried roadless areas (where it should be restricted entirely) and late-successional reserves (LSRs). The Northwest Forest Plan regional standards and guides (USFS and BLM 1994 Appendix C-13) allows for a “conservative” amount of post-fire logging within LSRs. While “conservative” is a subjective word, the Northwest Forest Plan provides clear biological requirements that the agencies are expected to meet whenever considering logging within LSRs as such:

“salvage guidelines are intended to prevent negative effects on late-successional habitat, while permitting some commercial wood volume removal. ... While priority should be given to salvage in areas where it will have a positive effect on late-successional forest habitat, salvage operations should not diminish habitat suitability now or in the future” 1994 ROD p. C-13.

Based on our interpretation of the standards and guides with respect to elevated status of LSRs and the literature on post-fire logging impacts and general principles for post-fire logging (Henjum et al. 1994, Beschta et al. 2004, Karr et al. 2004), we recommend the following:

- Retain all large (mature and old trees: >20 inches diameter at breast height and/or >150 years old⁶) legacy trees (live, dead, damaged, standing and downed logs) within LSRs.

Outside, LSRs, however, where logging is emphasized (based on land-used designations – e.g., matrix areas):

- Retain at least 50% of the standing volume with an emphasis on large trees (although based on standards and guidelines for the particular land-use designation, this guideline can be adjusted accordingly).
- Avoid entering previously un-entered stands if possible. Obtain most volume from areas where ecological values are already most compromised rather than spreading damage to new areas.

Economic guidelines - because the Biscuit was a money loser, we also recommend:

- Post-fire logging should be limited to areas where logging will not result in a net loss to the taxpayer.

General guidelines (regardless of land-use designations) - in addition to the above guidelines we recommend the following general principles on post-fire logging be adopted as modified from Henjum et al. (1994), Beschta et al. (2004), and Karr et al. (2004):

⁶ The size and age of trees represent structural correlates associated with ecological processes important to wildlife species and these size classes are generally in short supply - due to logging. Both diameter and age, however, can vary widely at the site level and care needs to be taken to ensure that the oldest and largest trees representative of site conditions are maintained.

- Intervene only in ways that promote natural recovery; for example, controlling exotic species and erosion from roads (i.e., removing “stressors”).
- Retain all live trees regardless of age or size within disturbance perimeters.
- Prohibit timber harvest in areas prone to landslides or erosion (steep and unstable slopes, severely burned soils, ecologically fragile areas) unless peer-reviewed scientific study conclusively demonstrates that harvest does not degrade soils or release sediment to streams.
- Because soils are irreplaceable in human lifetimes, post-fire management practices that compact soils, reduce soil productivity, or accelerate erosion should be prohibited.
- Prohibit logging within riparian buffers, roadless areas, and critical watersheds for salmonids and other sensitive aquatic species.
- Avoid creating new roads and landings in the burned landscape.

Using similar post-fire logging “screens” and GIS analysis, Strittholt and Rustigan (2003) estimated that between 75 and 95-mmbf was potentially available from the Biscuit fire area without the need to enter inventoried roadless areas, while allowing some level of logging (i.e. retention of trees >20 in dbh) within LSRs and lower retention levels in the matrix (i.e. retention of 15-20% standing volume). These researchers aptly noted that the estimated potential logging levels (i.e., using several screens), while representing a four-fold increase in average annual logging levels on the Biscuit prior to the fire and under the Northwest Forest Plan, were significantly lower than the agencies preferred alternative (518-mmbf) at the time of the Draft Environmental Impact Statement (DEIS). However, the estimated timber volume generated by the screens used by Strittholt and Rustigan (2003) is within the range of estimates (20-100-mmbf) considered by the Forest Service prior to the DEIS and before the Sessions et al. (2003) report when the agency was conducting scoping and proposing to stay out of roadless areas and LSRs (see USFS Rogue and Siskiyou National Forest, July 2003 – proposed action). Thus, while it is unknown whether the agencies could have moved timber more swiftly had they followed

through on earlier proposals to avoid controversial areas (as bid prices remained low), there is little doubt that their reputation with the public would have been as tarnished.

Final Conclusions - the impacts of post-fire logging on the Biscuit were many, including impairment of natural vegetation, reduction in conifer seedling establishment, damage to soils and watersheds, and increases in fuel accumulations in the years after logging. These impacts were readily apparent for cable logging operations and are expected to persist for decades following the initial activities. In general, post-fire logging depletes forests of regenerating conifers and large dead trees, and replanting with conifers does not offset these effects. It also fails to treat the primary cause of human damage on the landscape, pre- and post-fire--the road system (Trombulak and Frissell 2000). Finally, the economics of post-fire logging are questionable, particularly in inaccessible areas where the full costs of logging are an economic liability.

Because of both ecological and economic concerns raised in this report and given the area's unique ecological values, post-fire logging activities need to be significantly scaled back through the use of screens and unique areas should be set-aside as Research Natural Areas (or other appropriate designations) for scientific study. Agency down-sizing and monitoring short-falls are another set of implementation problems that have plagued post-fire logging on the Biscuit, such as mistakes in boundary and tree markings. These types of mistakes compromise resource values and build a climate of mistrust surrounding logging activities. The continued practice of reducing agency resource specialists and planners is expected to exacerbate these problems. Legislation that seeks to expedite post-disturbance logging and increase the scale of such activities nation-wide should avoid this rush to log, as evidence from the Biscuit indicates that (1) resource values will inevitably be compromised in these biologically rich and unique landscapes, and (2) the timber sales that do move forward are a drain on the public treasury.

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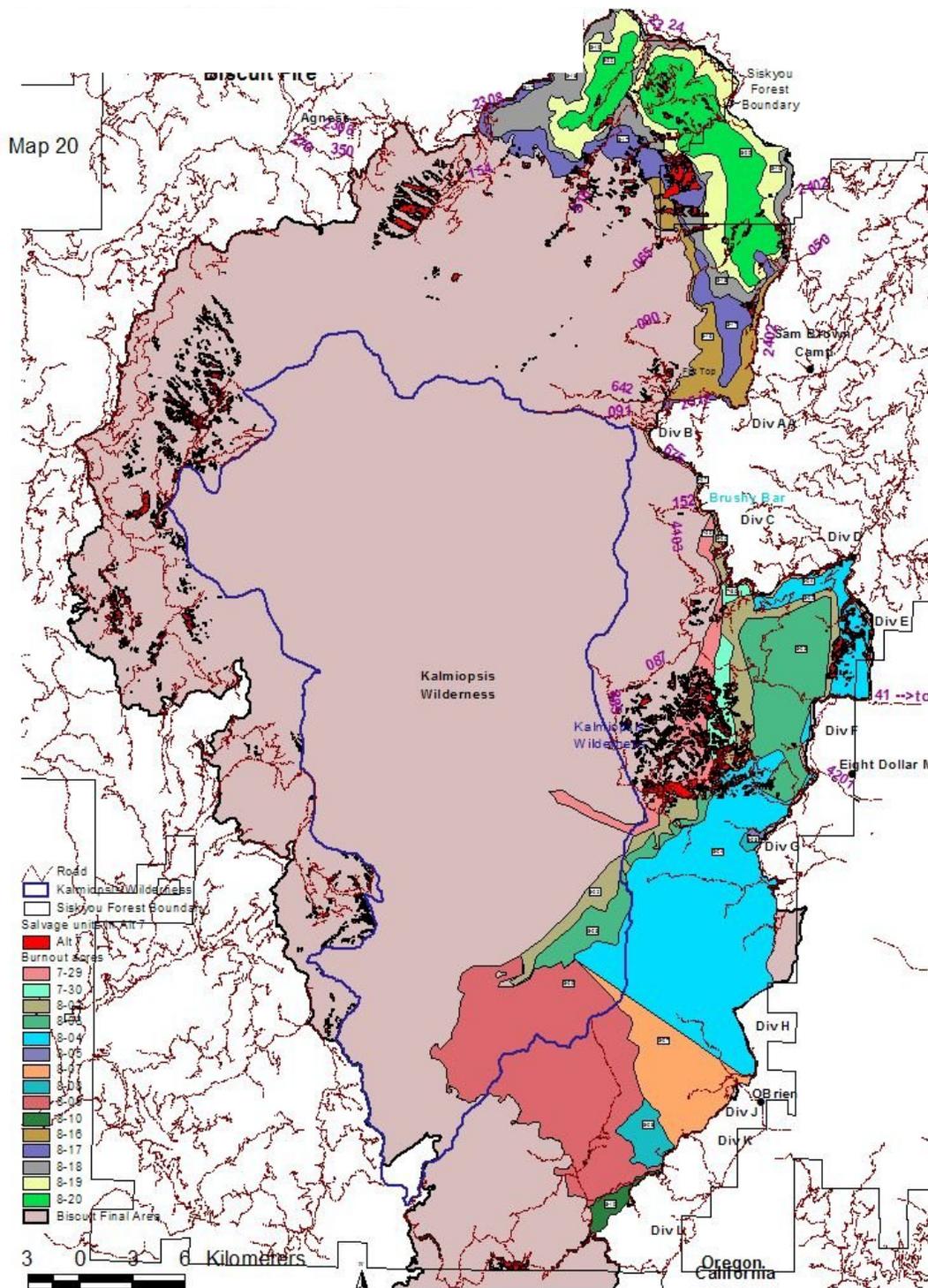


Figure 1. Back burn areas from fire progression mapping (see legend) with salvage units overlaid based on Alternative 7 (USFS and BLM 2003).