Fire Severity and Post-Fire Vegetation Recovery in Riparian Areas of the Biscuit and B&B Complex Fires, Oregon

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Riparian zones have great ecological importance relative to the area they occupy in the landscape. Although natural disturbances, such as fire and landslides, are integral in the dynamics of riparian systems, very little is known about the role of fire in riparian areas. Riparian zones have unique physical characteristics as well as unique vegetation structure and composition, all of which have the potential to influence fire behavior in riparian zones. Upland fire behavior has been well studied, but there is no consensus on how fire behaves in riparian areas compared to uplands; some researchers have found that fire is less severe in riparian areas than in uplands, whereas others have found that fire is more severe in riparian areas. No work has been done on what factors control or predict riparian fire severity. There is also very little information on vegetation recovery patterns in riparian areas following fire.

The present study was initiated in portions of the Biscuit fire in southwestern Oregon and the B&B Complex Fire in the Cascades of central Oregon. Two objectives of the study reported on here were 1) determining how the severity of fire in riparian areas compares to that in uplands in the Biscuit and B&B Complex Fires and 2) determining what factors are associated with fire severity in riparian areas of the Biscuit and B&B Complex Fires. Meeting Objectives 1 and 2 will allow land managers to predict fire severity in riparian areas and establish what properties of riparian areas could be altered by silvicultural and fuels treatments to modify fire effects. Fire severity of uplands, aspects of local topography, and aspects of fuel quantity and composition were measured and considered as potential factors associated with riparian fire severity.

A third objective of this study was determining what factors are associated with post-fire recovery patterns in riparian zones of the Biscuit and B&B Complex Fires. Meeting Objective 3 will provide managers with information for a predictive model for the type and rate of riparian vegetation recovery after fire. Meeting Objective 3 will also provide managers with guidance in deciding on the type and locations of post-fire rehabilitation that may be necessary in riparian areas and guidance in determining the short- and long-term effects of prescribed burning on riparian vegetation. To meet this objective, we measured post-fire abundance of herb, shrub, hardwood and conifer regeneration, and measured factors such as fire severity, width of floodplains/terraces, and stream size as potential factors associated with post-fire riparian recovery patterns.

Information on the behavior of fire in riparian systems will lead to a greater understanding of the role of fire as a disturbance process in riparian areas in fire-prone regions of Oregon and will aid in the understanding of how environmental factors related to riparian zones can affect fire regimes at local and landscape scales in these regions. Information gained in this study will also aid in setting pre- and post-fire management goals for riparian areas of Oregon.

METHODS

Site Descriptions

Biscuit Fire

The Biscuit Fire is located in the Siskiyou National Forest of southwestern Oregon (Figure 1). The fire was a result of four separate lightning-ignited fires merging together in southwestern Oregon in early July 2002. The fire covered an area of approximately 200,000 ha before it was extinguished by rain in early November 2002.

Climate in the study area is characterized by cool, wet winters and warm, dry summers. Average annual precipitation in the study area ranges from 250 to 300 cm. Most precipitation falls between the months of November and April. The mean temperature in January ranges from two to five degrees Celsius, and the mean temperature in July ranges from 18 to 20ºC.

Terrain in the Biscuit Fire region is complex and steep. Elevation of study sites ranged from 200 to 1200 m in elevation. Streams in the region are fed primarily from groundwater and surface runoff. Major soil subgroups include Typic Dystrochrepts and Typic Hapludults. Parent material in the study area is primarily schist-phyllite, metamorphic/volcanic, metasedimentary/conglomerate, and metasandstone/siltstone.

Dominant forest overstory species in the study area include *Pseudotsuga menziesii* (Douglas-fir), *Abies concolor* (white fir), *Pinus lambertiana* (sugar pine), *Chamaecyparis lawsoniana* (Port-Orford-cedar), and *Tsuga heterophylla* (western hemlock). Common midcanopy species include *Lithocarpus densiflorus* (tanoak), *Quercus chrysolepis* (canyon live oak), *Chrysolepis chrysophylla* (golden chinquapin), and *Umbellularia californica* (California laurel), and the understory is characterized by *Rhododendron macrophyllum* (Pacific rhododendron), *Gaultheria shallon* (salal), *Mahonia nervosa* (dwarf Oregon-grape), and *Rubus ursinus* (wild blackberry).

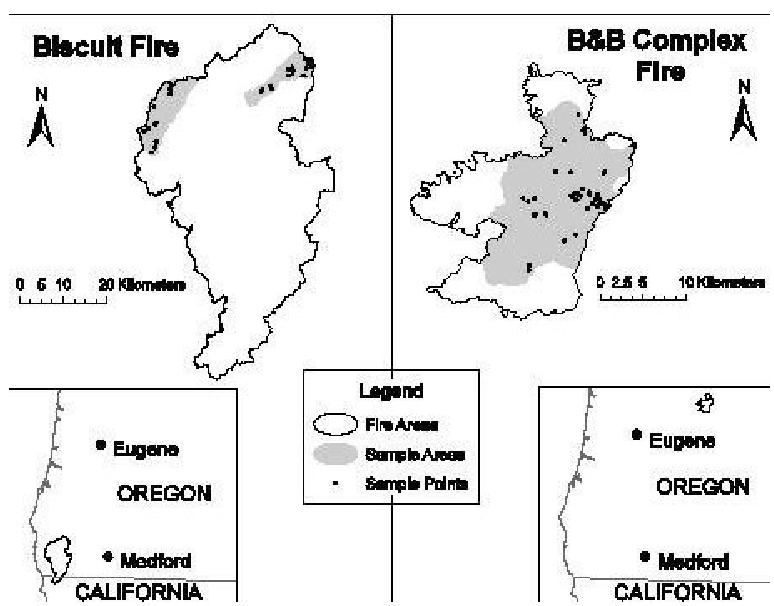

Figure 1. Locations of Biscuit and B&B Complex Fires and study sites within fires. Note that the scales for the two fire areas are different; the Biscuit Fire was a 200,000 ha fire, and the B&B Complex Fire was a 37,000 ha fire. However, area of the watersheds chosen for sampling in the two fires was similar (16,000 ha in the Biscuit Fire and 13,600 ha in the B&B Complex Fire).

B&B Complex Fire

The B&B Complex Fire was the result of the merging of two lightning caused fires, the Bear Butte and the Booth Fires on the east slope of the Cascade Range in Oregon (Figure 1). From mid-August through late September of 2003, the B&B Complex Fire burned over approximately 37,000 ha. The fire burned mainly within the Deschutes and Willamette National Forests.

Climate in the fire area is moderate with cool, wet winters and warm, dry summers. Precipitation rates in the fire area range from 50 cm at the lower elevations to 140 cm at the upper elevations. Most of the precipitation occurs from November to March. Precipitation above 1,000 m falls mainly as snow in the winter.

The B&B Complex fire area is characterized by gentle to moderately steep topography. Slope aspects within the fire area are generally easterly with north and south facing valley slopes. Elevation of sample areas ranged from 800 to 1500 m. The east slope of the Cascades where the B&B Complex Fire burned is a geologically young and complex volcanic region. Due to the high porosity of the volcanic soils, stream density is low, most streams in the area are spring-fed and stream flow is stable.

Dominant forest overstory species in the B&B Complex Fire area include *Pseudotsuga menziesii* (Douglas-fir), *Pinus ponderosa* (ponderosa pine), *Abies grandis/Abies concolor* (grand fir and white fir hybrid), *Picea engelmanii* (Engelman spruce), *Pinus monticola* (western white pine), and *Larix occidentalis* (western larch). The forest understory was dominated by *Ceanothus velutinus* (snowbrush), *Symphoricarpos albus* (snowberry), *Purshia tridentata* (antelope bitterbrush), *Mahonia nervosa* (dwarf Oregon-grape), *Rosa gymnocarpa* (little wood rose), and *Rubus ursinus* (wild blackberry).

Study site selection

Biscuit Fire

Two sixth field sub-watersheds in the Biscuit Fire area were selected for study (Figure 1). The first watershed (Watershed 1), on the east side of the fire, is characterized by relatively low rainfall and forest productivity. The second watershed (Watershed 2), on the west side of the fire, is characterized by relatively high rainfall and forest productivity. A stratified random sampling design was used to select points in each watershed that represented a range of broad fire severity classes, forest size classes, and stream sizes.

Within a geographic information system (GIS), a fire severity map created for the Forest Service by a remote sensing group was used to separate each watershed into three broad fire severity categories (low, moderate, and high severity). This map was created by comparing color infrared satellite images of the fire area; an image taken around 2001 was compared to an image taken near the time the Biscuit Fire was contained in 2002. Areas that showed little change in the amount of reflected infrared light (a measure of greenness) between the pre-fire and post-fire image were considered low severity areas. Areas that showed a high amount of change in reflected infrared light between the pre-fire and post-fire image were considered high-severity areas.

For a given watershed and fire severity class, all existing first-, second-, and third-class stream segments were identified in a GIS, where Class 1 streams are fish-bearing streams with a steady flow, Class 2 streams are also fish-bearing with moderate flow, and Class 3 streams have few fish and low flow. Once stream segments were identified in each watershed and fire severity class, points on the stream segments were randomly selected in a GIS to represent a range of adjacent forest size classes (small, medium and large size classes). The forest size class information was based on aerial photographs, with size class 1 being the smallest size class (0-14.9" dbh), followed by size class 2 (15.0-19.9" dbh), and size class 3 (20.0" + dbh) being the largest. One point for each fire severity class/stream class/forest size class combination was selected and sampled in each watershed. Approximately 23 points were sampled in each watershed, as not all combinations of fire severity class/stream class/forest size class were found.

B&B Complex Fire

The site selection procedure for the B&B Complex Fire closely followed that in the Biscuit Fire. However, for site selection in the B&B Complex Fire, only areas in certain plant associations within selected watersheds (five sixth field sub-watersheds) were chosen for study in the fire area (Figure 1). Three plant associations, including ponderosa pine (*Pinus ponderosa*), dry mixed conifer, and wet mixed conifer, were included in the study. The ponderosa pine sites represent the driest sites in the study and fire as a whole, followed by dry mixed conifer and wet mixed conifer. As in site selection for the Biscuit Fire, a stratified random sampling design was used to select points in each plant association that represented a range of broad fire severity classes, forest size classes, and stream sizes. The fire severity map used for the B&B Complex Fire was created in the same way as that for the Biscuit Fire, using pre- and post-fire color infra-red satellite images of the fire area and determining fire severity from the amount of change in reflected infrared light. The forest size class map was also comparable to that in the Biscuit. One point for each fire severity class/stream class/forest size class combination was selected and sampled in each plant association. Approximately 18 points were sampled in each plant association, as not all combinations for each plant association were present in the landscape.

Sampling methodology

Biscuit Fire

Sampling was conducted in the summer of 2004, two years after the Biscuit Fire. At each randomly selected point, one 10- x 25-m plot was established in the riparian area. Half of the plot (5- x 25-m) was in the riparian area with one side of the plot on one stream edge, and the other half of the plot (5- x 25-m) abutting the stream on the other side of the stream. In addition to the riparian plots, one 10- x 25-m upland plot was placed 25 m in elevation above the riparian area on each side of the stream. This elevation change ensured that the upland plot would not be as directly influenced by elevated soil moisture as the riparian plot.

In each plot, an assessment of fire severity was done that included measurements of scorch height, percent crown scorch, percent exposed mineral soil, and percent basal area mortality. Scorch height was measured as the height of char on the three tallest trees in each plot. Crown scorch was measured with a hypsometer as the percent of the pre-fire live crown that was scorched by the fire. Percent exposed mineral soil was visually estimated to the nearest 5% in each plot. This assessment was conducted by the same two individuals throughout data collection, and an average of the estimates for each individual was used for each plot in order to reduce bias.

Basal area mortality and live basal area were approximated in each plot by measuring the diameter at breast height (DBH) of all trees greater than 5 cm DBH and recording the species and live/dead status of each tree. All individual trees less than 5 cm DBH were counted by species. Dead shrub stems were also counted by species, and the percent cover of all live shrub species was visually assessed to approximate former shrub cover by species.

In riparian plots, further measurements were taken, including stream gradient, or slope of the stream, within the plots, percent slope to each of the upland plots, bank-full width, and valley floor width. Information such as plant association and forest size class for each sampling point were extracted from GIS layers created by the Forest Service.

For the purposes of assessing recovery of riparian vegetation, all live and dead trees in the plot measured within 2 m of the stream (a 2X25 m plot on each side of the stream) were recorded separately. In addition, all regeneration of trees and shrubs was recorded in the 2-m band. It was noted whether regeneration was by seed or sprout. All riparian plot centers were permanently marked with rebar, and GPS coordinates of the markers were taken for future measurement purposes.

B&B Complex Fire

Sampling in the B&B Complex Fire was conducted in the summer of 2005, two years after the fire. The sampling strategy in the B&B Complex Fire was the same as that in the Biscuit Fire, with some exceptions. In the B&B Complex Fire, instead of placing upland plots 25 m in elevation above the riparian area, upland plots were placed 150 m in horizontal distance from the riparian area. Horizontal distance was used in the B&B Complex Fire because there is little elevation change between riparian areas and uplands. As in the Biscuit Fire, placing the upland plot 150 m away from the riparian plot ensured that the upland plot would not be as directly influenced by the presence of a stream as the riparian plot.

As in the Biscuit Fire methodology, an assessment of fire severity was done in each plot in the B&B Complex Fire that included measurements of scorch height, percent crown scorch, percent exposed mineral soil, and percent basal area mortality. However, scorch height and crown scorch were measured on both the three tallest conifers and the three tallest hardwoods in each riparian plot in the B&B Complex fire, instead of just the three tallest trees. Riparian recovery was again assessed by measuring all regeneration of trees and shrubs in a 2-m band along streams. An assessment of stream cover was added, which involved estimating percent cover over the stream along six evenly spaced transects that crossed the stream. All other measurements taken in plots in the B&B Complex Fire were similar to those taken in the Biscuit Fire plots.

Data analysis

T-tests were used to determine whether there were significant differences in fire severity measures between riparian areas and adjacent uplands in both the Biscuit Fire and B&B Complex Fire. Model selection based on Akaike's Information Criteria (AICc) was used to identify site and vegetation factors that were strongly associated with riparian fire severity in both fires (analyzed separately). *A priori* hypotheses were generated and used to develop a set of biologically reasonable one-, two-, and three-factor regression models for each of two fire severity response variables, including percent exposed mineral soil (a measure of soil damage) and percent basal area mortality (a measure of damage to vegetation) for each fire. Explanatory variables included in the candidate models were upland fire severity (upland basal area mortality), measures of local topography (stream gradient, valley floor width, bank-full width, and slope to uplands), and measures of riparian fuels (hardwood composition, number of small stems, plant association, forest size class). The models developed for each fire severity response variable for each fire were compared using AIC, and the set of models with the lowest AIC values were considered to be the models with the most explanatory power.

Nonmetric multidimensional scaling (NMS) ordination was utilized to determine factors influencing the species composition of regenerating vegetation in riparian zones of the Biscuit Fire (B&B Fire analysis is in progress). Stem count data of all regenerating species were used in the analysis. Explanatory variables included in the analysis were watershed, stream class, forest size class, stream gradient, valley floor width, bank-full width, scorch height, crown scorch, percent exposed mineral soil, basal area mortality, conifer basal area, and alder basal area. Multi-response permutation procedure (MRPP) was also used to test for differences between regenerating plant communities in plots along different stream classes and in different watersheds.

PRELIMINARY RESEARCH RESULTS AND MANAGEMENT IMPLICATIONS

Upland versus riparian fire severity

Both percent exposed mineral soil in riparian areas and scorch height on trees in riparian areas were significantly lower than that of the adjacent uplands in both the Biscuit and B&B Complex Fires (Figures 2 and 3). However, there were no significant differences between percent crown scorch and dead basal area mortality in the riparian and adjacent upland plots in either fire (Figures 2 and 3). These results indicate that the intensity of fires (scorch height) in riparian areas was generally lower than that of uplands in the two fires. Despite lower fire intensity in riparian areas, fire damage in riparian areas (tree crown scorch and mortality) was not significantly different from that in the uplands in either fire. The level of damage in riparian areas may be explained by the shorter stature, lower height to live crown, thinner bark and thus greater sensitivity to fire of many species, particularly the hardwoods, found in riparian areas in both fire areas.

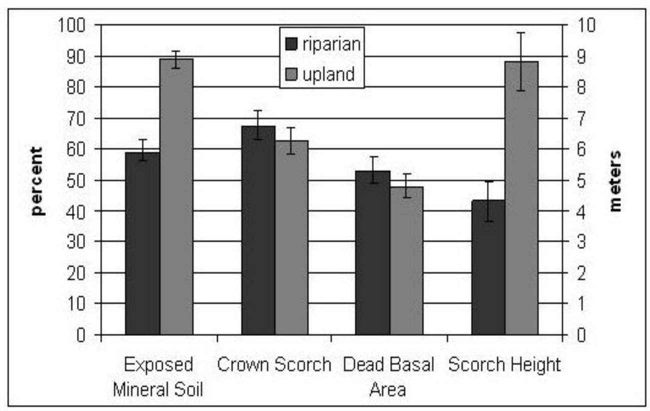

Figure 2. Fire severity measures in riparian areas versus adjacent uplands in the Biscuit Fire.

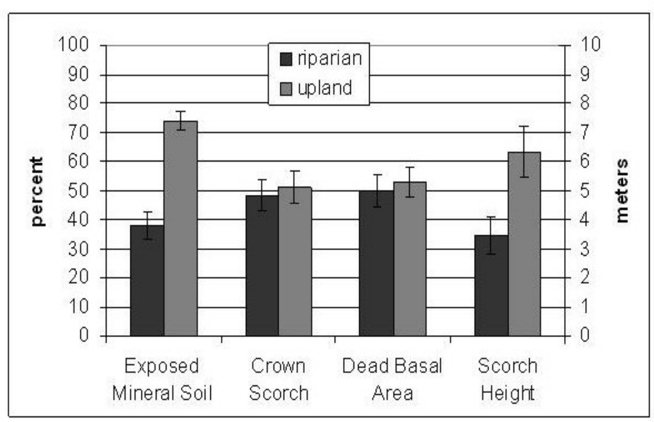

Figure 3. Fire severity measures in riparian areas versus adjacent uplands in the B&B Complex Fire.

The level of tree mortality caused by fire in riparian areas of the Biscuit and B&B Complex Fires indicates that fire plays a role in riparian vegetation dynamics similar to that in uplands in these fire-prone regions of Oregon.

The four different measures of fire severity, including basal area mortality, crown scorch, scorch height, and exposed mineral soil, were not all highly correlated with each other in either fire. Surprisingly, the fire severity measures that are most easily assessed aerially and most often used, crown scorch and basal area mortality, were not strong predictors of exposed mineral soil, a measure of damage to soil, in either fire (Pearson correlation coefficients between exposed mineral soil and the other aerially assessed fire severity measures were less than 0.48 in both fires). Exposed mineral soil is an ecologically important measure of fire severity in both riparian areas and uplands. The lack of correlation between aerial measures of fire severity and measures of soil damage suggests that one should not be used to predict the other and that both should be measured in fire severity assessments.

Factors associated with riparian fire severity

Upland fire severity (basal area mortality) was found to be a strong predictor of both measures of riparian fire severity (exposed mineral soil and basal area mortality) in both the Biscuit and B&B Complex Fires, after accounting for other variables (Table 1). This result suggests that when fire is severe in the uplands, it will also be severe in riparian areas (or vice versa), but when fire is of moderate or low severity in the uplands, the fire will be of moderate or low severity in the riparian zone (or vice versa).

Riparian basal area mortality (damage to vegetation) was strongly associated with an aspect of riparian fuels in both fires (riparian stem number in the Biscuit Fire and plant association in the B&B Complex Fire), after accounting for upland fire severity (Table 1). In the Biscuit Fire, damage to riparian vegetation was higher in riparian areas with a greater number of small stems. Smaller stems are fine fuels that can increase fire intensity and severity. In the B&B Complex Fire, damage to riparian vegetation was significantly higher in the ponderosa pine plant association than it was in the wet mixed conifer plant association. Increased damage to riparian vegetation in ponderosa pine forests compared to wet mixed conifer forests could be due to lower moisture and thus lower fuel moisture in ponderosa pine forests compared to wet mixed conifer forests.

There was weak evidence that riparian basal area mortality was negatively associated with bank-full width in both fires (Table 1), after accounting for upland fire severity and a measure of riparian fuels, indicating that damage to vegetation is lower along larger streams. Larger streams have more influence on fire severity than smaller streams because they have higher flow, thus serving as a larger fuel break. Larger streams have a greater effect on adjacent vegetation, and riparian areas along larger streams are often dominated by hardwoods associated with riparian areas in the Siskiyou region, such as *Salix* (willow species), *Alnus rubra* (red alder), *Amelanchier alnifolia* (Pacific serviceberry), *Corylus cornuta var. californica* (western hazelnut), and *Holodiscus discolor* (ocean spray). Riparian hardwoods are generally a less flammable vegetation type than conifer-dominated types. Larger streams also generally have a lower gradient than smaller streams. Higher gradient streams could burn more severely than lower gradient streams because fire tends to burn in an uphill direction with increased slope steepness resulting in

	Response Variable	
	Riparian Basal Area Mortality	**Riparian Exposed Mineral Soil**
Biscuit Fire	**1)** Riparian stem number + Upland fire severity **2)** Riparian stem number - Bank-full width + Upland fire severity	**1)** Stream gradient - Riparian hardwood basal area **2)** Riparian stem number + Stream gradient **3)** - Riparian hardwood basal area - Bank-full width **4)** Stream gradient + Upland fire severity
B&B Complex Fire	**1)** Plant association + Upland fire severity **2)** Plant association - Bank-full width + Upland fire severity	**1)** Slope to uplands + Upland fire severity **2)** Slope to uplands - Riparian stem number

Table 1. Set of top models explaining riparian basal area mortality and riparian exposed mineral soil in both the Biscuit and B&B Complex Fires.

increased flame length and surface fire rate of spread.

Riparian exposed mineral soil (damage to soil) was strongly associated with an aspect of riparian fuels and/or local topography in both fires (Table 1). In the Biscuit Fire, riparian exposed mineral soil was strongly associated with stream gradient and an aspect of riparian fuels (riparian hardwood basal area or riparian stem number). A model including stream gradient and upland fire severity was also found to have high explanatory power.

Stream gradient was strongly positively associated with riparian exposed mineral soil in the Biscuit Fire. This result indicates that streams with high gradients (slopes) burn more severely than those with lower gradients. Higher gradient streams could burn more severely because fire tends to burn in an uphill direction with increased slope steepness resulting in increased flame length and surface fire rate of spread. In addition, in the landscape of the Siskiyou Mountains where the Biscuit Fire occurred, smaller streams generally have higher stream gradients than the larger streams. Thus, it is possible that streams with higher gradients burned more severely because they are generally smaller and have less influence on fire behavior than larger streams.

Riparian hardwood basal area was strongly negatively associated with riparian exposed mineral soil in the Biscuit Fire, suggesting that riparian fire severity was lower with greater riparian hardwood basal area. Hardwoods serve as a microsite indicator in that their presence indicates generally wet conditions. The wet conditions in which hardwoods grow would lead to lower riparian fire severity. It is also possible that the presence of hardwoods, such as alder, that have relatively high foliar moisture leads to lower riparian fire severity. However, the number of small stems in riparian areas was positively associated with riparian exposed mineral soil. Again, smaller stems are fine fuels that can increase fire intensity and severity.

In the B&B Complex Fire, riparian exposed mineral soil was strongly positively associated with slope to uplands, after accounting for upland fire severity. A model with riparian stem number and slope to uplands was also found to be a strong model. Slope to uplands, or percent slope from the riparian plot to the upland plots, was found to be strongly positively associated with riparian exposed mineral soil, indicating that riparian locations in steeper valleys experience higher fire severity. Several researchers have reported cases where steep narrow valleys have acted as chutes or chimneys by channeling fire in the direction of the wind. It is possible that steep narrow valleys in the B&B Complex Fire acted as chimneys and led to greater soil damage in riparian areas located in the valleys.

Riparian exposed mineral soil was negatively associated with riparian small stem number in the B&B Complex Fire. This is opposite from the relationship between both riparian fire severity response variables and riparian small stem number in the Biscuit Fire. In the B&B Complex Fire, many of the hardwoods in riparian areas have a shrub form. Thus, it is possible that a higher number of small stems is an indicator of a moist riparian environment in the B&B Complex Fire area. The moist conditions in these locations may reduce fire severity, particularly soil damage.

Overall, these results suggest that upland fire severity and riparian fuels influence the amount of fire damage to riparian vegetation but that all three factors (upland fire severity, local topography and riparian fuels) influence the amount of fire damage to riparian soils. As upland fire severity is most consistently associated with riparian fire severity, this variable may be the most useful indicator of riparian fire severity from a management perspective. Thus, fire models that predict upland fire severity could be useful in determining riparian locations that may be targeted for pre-fire fuels reductions and post-fire rehabilitation.

Riparian Recovery in the Biscuit Fire: Preliminary results

Riparian vegetation composition in the Siskiyou Mountains varies predictably with stream size. Riparian areas along larger streams are generally dominated by riparian associated hardwood species, such as *Alnus rubra* (red alder), *Salix* spp. (willow), *Amelanchier alnifolia* (Pacific serviceberry), *Corylus cornuta var. californica* (western hazelnut), and *Holodiscus discolor* (ocean spray). Riparian areas along mid-sized streams (Class 2) also have a strong hardwood component, with species such as *Alnus rubra* (red alder), *Acer macrophyllum* (big-leaf maple), *Acer circinatum* (vine maple), *Umbellularia californica* (California-laurel), *Cornus nuttallii* (Pacific dogwood), and *Fraxinus latifolia* (Oregon ash). Riparian areas along mid-sized streams are also characterized by conifer species such as *Chamaecyparis lawsoniana* (Port-Orford-cedar), *Taxus brevifolia* (Pacific yew), and *Thuja plicata* (western redcedar). Vegetation along small streams (Class 1) is generally not distinct from that of the surrounding forest. Upland associated species, such as *Lithocarpus densiflorus* (tanoak), *Chrysolepis chrysophylla* (golden chinquapin), *Arbutus menziesii* (Pacific madrone), *Abies concolor* (white fir), and *Pinus lambertiana* (sugar pine), dominate riparian areas along smaller streams.

Vegetative cover in post-fire riparian plant communities in the study area ranged from two to 35% (average = 11%). Sprouting was the most common form of regeneration, with an average of 75 sprouted individuals in a 25 m^2 area, compared to an average of 11 seeded individuals in a 25 m^2 area. Common sprouting species included *Alnus rubra* (red alder), *Acer circinatum* (vine maple), *Rhododendron macrophyllum* (Pacific rhododendron), and *Gaultheria shallon* (salal). Common seeded species included *Salix* (willow spp.) and *Alnus rubra* (red alder).

Post-fire regenerating plant community composition in riparian zones of the Biscuit Fire was dependent on fire severity and stream size (bank-full width and stream class).

Regeneration communities were significantly different among stream classes (MRPP yielded $p < 0.0001$ and $A = 0.06$), but there were only small differences between watersheds (MRPP yielded $p = 0.0014$ and $A = 0.02$). Greater regeneration of riparian associates, such as *Alnus rubra* (red alder), *Holodiscus discolor* (ocean spray), *Salix* spp. (willow species), and *Amelanchier alnifolia* (Saskatoon serviceberry), occurred along larger streams and in locations that had lower fire severity. Lower fire severity and greater water availability appear to combine to result in greater regeneration of riparian associates along larger streams after fire. Regeneration of riparian species such as *Acer macrophyllum* (big-leaf maple), *Acer circinatum* (vine maple), *Rubus leucodermis* (western raspberry), and *Ribes bracteosum* (stink currant) was positively associated with pre-fire basal area of red alder, although oddly, regeneration of red alder (mostly sprouts) was not associated with pre-fire red alder basal area.

Information on the factors that influence post-fire riparian vegetation recovery can again help managers predict locations where riparian areas may be most in need of post-fire rehabilitation treatments. Results suggest that post-fire rehabilitation activities should be concentrated on small streams, because fire severity is generally highest and cover of new vegetation is generally lowest along small streams compared to large streams.

STUDY TIMELINE

Data analysis will be completed in the winter of 2007. A dissertation and manuscripts on these studies will be completed by the summer of 2007.

The Cooperative Forest Ecosystem Research (CFER) program was developed to facilitate sound management of forest ecosystems, with emphasis on meeting priority research information needs of the Bureau of Land Management (BLM) and the Oregon Department of Forestry (ODF) in Western Oregon.

The information contained in this document is preliminary in nature and has not been peer-reviewed. The data are not guaranteed to be correct or complete. Users are cautioned to consider carefully the provisional nature of the information.

The CFER program cooperators provide financial support, faculty and staff to conduct research and information exchange, study sites, assistance with project installations, and in-kind support as needed.

Program cooperators include: