Executive Summary:
Harvest Effects on Riparian Function And Structure Under Current Oregon Forest Practice Rules

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INTRODUCTION

The purpose of this study was to evaluate the effectiveness of the 1994 Oregon Department of Forestry's Forest Practices Stream Rules. The particular focus was on rules designed to address riparian forest stands along fish-bearing streams. The purpose of the vegetation retention rules is to maintain and promote *desired future riparian stand conditions* that will provide ample shade, an abundance of large wood to the channel, bank stability, snags, nutrient input and nutrient uptake. Under the 1994 stream rules, riparian stands can be managed to the extent that these goals can be met.

The 1994 Oregon Department of Forestry Forest Practice Water Protection Rules require the establishment of riparian management areas (RMAs) on most streams that are within or adjacent to a harvest unit. The RMA width requirements vary depending on the stream classification (OAR 629-635-300). Oregon Department of Forestry (ODF) classifies streams by "Type" and by stream size. The "Type" designations include Type F for fish-bearing streams, Type N for non-fish-bearing streams, and Type D for domestic water sources without fish presence. Stream sizes are based on average annual stream flow and are classifications as small, medium, or large. A landowner has multiple options for managing RMAs. For example, one option is to harvest conifer trees within riparian management areas that are in "excess" of standard basal area targets, while maintaining a 20-foot no-cut buffer zone as measured from the average annual high water mark.

Much of the available research on the effects of harvesting on riparian function and structure is derived from study sites that were harvested prior to the *current* forest practice rules. The harvest practices on these sites typically involved clearcut harvesting down to the stream's edge followed with intense burning. Such studies document dramatic losses in shade and cover, associated increases in stream temperature, and losses in large wood recruitment and loading in the stream channel. Studies on these practices conducted throughout Oregon demonstrate that the impaired functions are typically shown to recover within 5 to 15 years for shade and temperature, depending on the stream size (Brown et al. 1971, Feller 1981, Andrus and Froehlich 1987, Beschta et al 1987, Johnson and Jones 2000). Recovery of both large wood recruitment and instream large wood is expected to take much longer (Beechie et al. 2000).

Fewer studies assess the effects of *current* harvest practices on riparian structure and function. Those that do have demonstrated increased protection of shade and LWR above that provided under previous regulations in Oregon (Brazier and Brown 1973, Hairston-Strang and Adams 1997, Hairston-Strang and Adams 2000) and Southeast Alaska (Koski et al. 1984). Hairston-Strang and Adams (2000) concluded that Oregon Forest Practices Act's current water protection rules adopted in 1994 strengthen protection for riparian forest resources over that provided by the previous rule set.

OBJECTIVES AND MONITORING QUESTIONS

The objectives of this monitoring project were to determine if the forest practice riparian rules promote riparian conditions that are consistent with levels observed in mature riparian forests and if

the rules are effective at maintaining structure that will promote the desired future conditions for large wood recruitment and shade. The specific monitoring questions to be addressed include:

1. *Do estimates of average basal area that were used to craft the standard targets for basal area accurately represent mature riparian forests?*

2. *Do hardwoods dominate the near-stream area on all stream sizes?*

3. *How does the available basal area in riparian management areas compare to standard targets?*

4. *Are the 1994 forest practices riparian rules effective in maintaining potential sources of large wood recruitment for in-stream habitat as compared with pre-harvest condition?*

5. *Are the 1994 stream protection rules effective in maintaining stream shade as compared with pre-harvest condition?*

6. *What are the trends in conifer regeneration within riparian areas?*

The estimates of conifer basal area for unmanaged mature riparian forests are evaluated by comparing the targets to data from mature riparian forests. The attainability of the targets is evaluated by comparing the pre-harvest basal area to the targets themselves. In light of a lack of agreed-upon numerical standards for shade and large wood recruitment, this study uses before and after harvest comparisons and evaluates effectiveness by the degree to which potential large wood recruitment and shade are retained.

STUDY DESIGN

This study was conducted at volunteered sites distributed throughout the state of Oregon (Figure 1). Fourteen sites were in the Coastal georegion, 12 in the Interior, four in the West Cascades, two in the East Cascades, two in the Siskiyou, and six in the Blue Mountain georegion. Data were collected before harvesting on 40 sites. Twenty-five of those 40 sites were revisited one year later after harvesting and the measurements were repeated.

A detailed field protocol is available on the ODF website (http://www.odf.state.or.us/internal.htm) and/or upon request. Riparian sample sites were 500 ft long by 100 ft wide, established parallel to the stream. The plot location was placed at a randomized distance from the bottom of the unit. All trees with a diameter at breast height (dbh) greater than or equal to six inches (") were measured within 20 feet of the stream and a 20% sample of trees were measured between 20 and 100 feet from the stream. Measurements included: dbh, distance from the stream, degree of lean to the stream, percent slope, and species. In addition, tree height and age were measured for one tree of each species in each diameter class. Diameter classes were 6-10", 11-15", 16-20", and 21"+. Trees smaller than 6" dbh were counted and identified by species. Shade and cover were measured along five evenly spaced transects (one every 100 feet) starting at one end of the plot. Regeneration sampling was done only on those sites that had been replanted prior to the post-

harvest survey (n = 10, Interior and Coastal georegions). Seedlings and saplings were counted and identified by species in 20-ft. diameter circular plots.

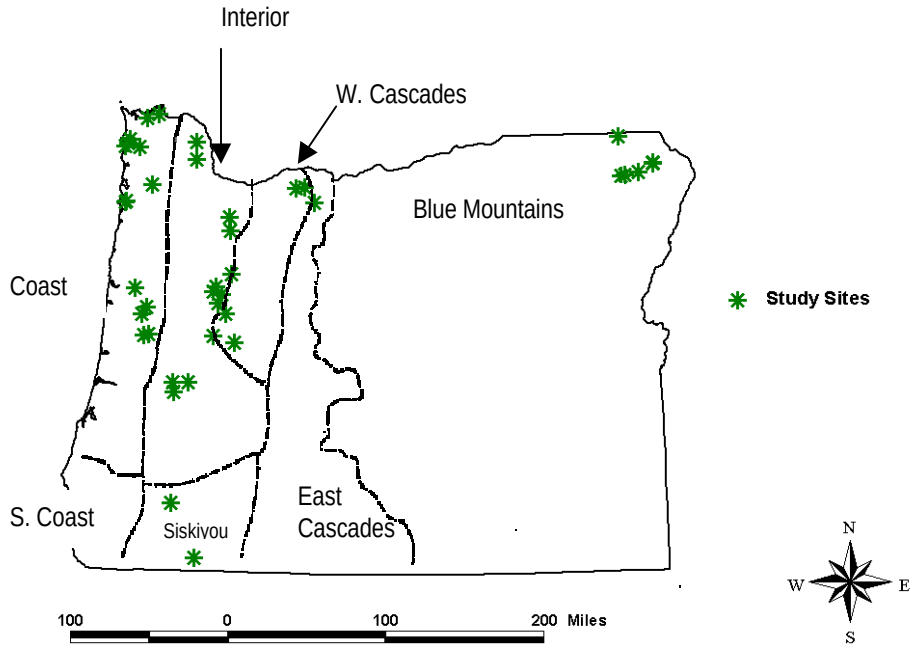

Figure 1. Study Sites and Georegion Boundaries.

LIMITATIONS AND STRENGTHS OF THE STUDY

One limitation of this study is the use of volunteered sites. Implications of a volunteered sample include a potential bias in the type of sites that were volunteered and the way in which the sites were ultimately managed. One way to evaluate this bias is to compare the percent of sites managed with a standard target prescription in this study to the percent in another ODF monitoring project that relied on a randomly selected sample. Preliminary results from the random selection indicate that 22% of sites (42 out of 182 sites) were managed with a standard target (Josh Robben, ODF, personal communication) compared with 44% (11 of 25) in this study. In general, sites managed with a standard target would have greater coniferous basal area prior to harvest and, potentially, a greater impact on large wood recruitment and shade as a result of harvesting. In addition to the non-random selection, the relatively small sample size is another limitation. A small sample increases the potential that the monitored sites do not represent the range of riparian characteristics across the landscape. Finally, conclusions about rule effectiveness are tempered by the lack of agreed-upon measures of effectiveness.

The strengths of the study are based, in part, on the use of riparian data collected before and after harvesting. Pre- and post-harvest data allow for accurate evaluation of changes that result from harvesting, unencumbered with assumptions about what conditions might have been like before

harvesting. Another strength of the study is the use of data collected on sites managed under the current set of forest practice rules on private industrial forestland. There is a great deal of debate about the role that forestry currently plays in the efforts for salmon recovery. While there has been ample research on the role of historic forest management practices, fewer studies rely on data that reflect current practices.

RESULTS AND CONCLUSIONS

1. *Do estimates of average basal area that were used to craft the standard targets for basal area accurately represent mature riparian forests?*

The desired future condition for streamside areas along fish-bearing streams is to grow and retain vegetation so that, over time, average conditions across the landscape become similar to those of mature streamside stands. A comparison of mature forest conditions to the assumed basal area for 120-year-old managed stands indicates that the standard targets often underestimate average conifer stocking for West Cascade and Interior streams, and approximate average conifer stocking for Coastal, Northeast Oregon and Central Oregon areas (Figure 2).

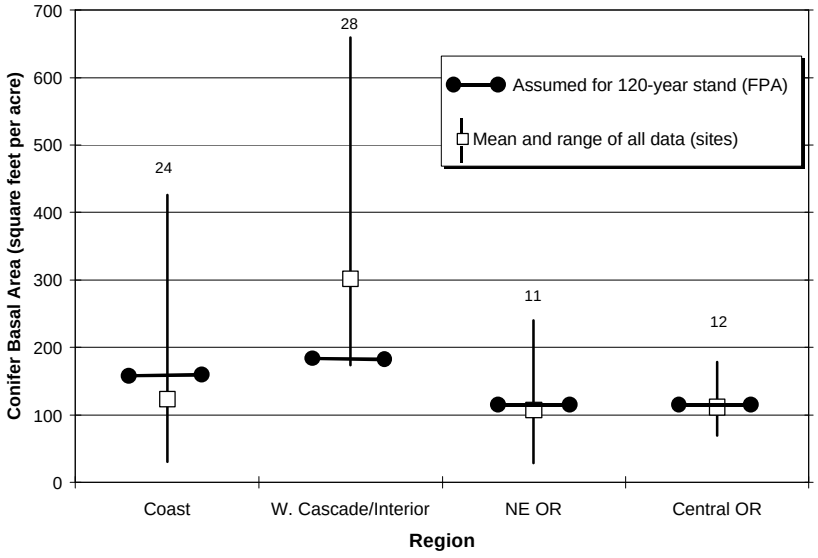

Figure 2. Basal area in unmanaged riparian areas and current basal area standard targets. Numbers above each line represent sample size.

2. *Do hardwoods dominate the near-stream area on all stream sizes?*

When crafting the basal area standard targets, an assumption was made that small and medium streams would have lower coniferous stocking in the first 20 feet from the stream due to presence of hardwoods. Hardwood domination was a good assumption for large and small coastal streams.

In the cases of other georegions and for medium coastal streams, reducing the standard target to account for hardwood domination was not supported by these data. In addition, while hardwoods dominated the first 20 feet, conifer stocking was still greater than expected on small streams.

3. *How does the available basal area in riparian management areas compare to standard targets?*

Results indicate substantial variability in conifer stocking within and between georegions and stream sizes. However, targets were commonly met within 20 feet of the stream on small (72% of sites) and medium streams (81%) (Figure 3). Results also indicate that, in most instances, landowners are not exercising the option to clearcut harvest to within 20 feet of the stream.

These data indicate that portions of RMAs managed with an RCR prescription were actually well stocked with conifers (3 out of 4 sites met the basal area target prior to harvest). The RCR prescription should be evaluated on a larger scale and in greater detail to determine if the application adequately maintains existing patches of potential LWR.

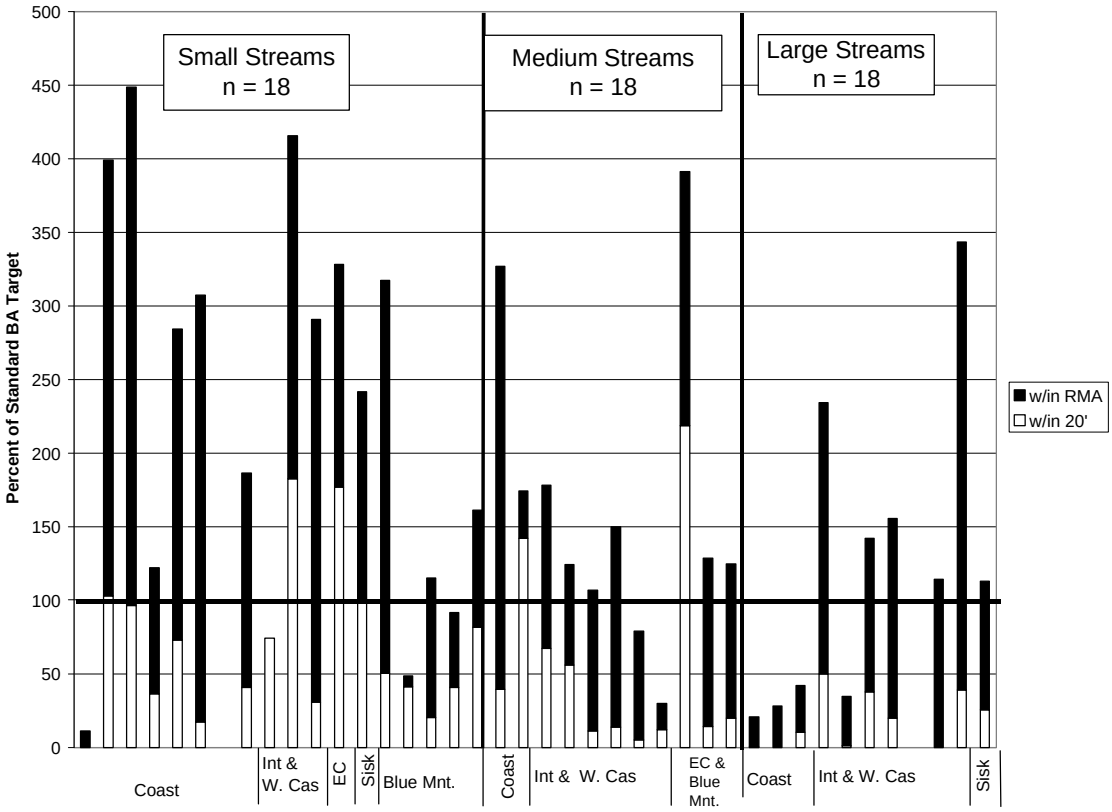

Figure 3. Percent of the standard target for basal area, available prior to harvest, within 20 feet and within the RMA. Georegions are labeled as Coast = Coastal, Int&W.Cas = Interior and West Cascades, EC = East Cascades, Sisk = Siskiyou, Blue Mnt. = Blue Mountain.

4. *Are the 1994 forest practices riparian rules effective in maintaining potential sources of large wood recruitment for in-stream habitat as compared with pre-harvest condition?*

Reductions in the predicted potential large wood recruitment (LWR) were 59%, 32% and 18% on small, medium and large streams, respectively. However, these reductions were only statistically significant on small streams. Observed reductions in potential LWR on medium streams, while substantial in some cases, were not statistically significant on average. While, the sample size is small, results also indicate a notable decrease in LWR potential with the application of the RCR rule.

The intention of the RCR rule is to provide for long term sources of large wood, even though there may be a short-term impact on stream temperature. The possibility that the application of RCRs may be contributing to a reduction in potential LWR is an unintended consequence of that alternative. This potential consequence needs to be evaluated in greater detail on both a larger scale and on a site-by-site basis as the rule is applied. If the findings from this study do accurately represent the larger population, it is clear that the success of the prescription heavily relies on achieving regeneration and retention goals in *both* "conversion" and "retention" blocks. If achieved, then the long-term LWR of such sites would be improved through this management strategy.

5. *Are the 1994 stream protection rules effective in maintaining stream shade?*

The average reduction in cover was 12%, 7%, and 1% for small, medium, and large streams respectively (Figure 4). The only statistically significant change in average cover was associated with small streams (p-value = 0.03). Although cover reductions were greatest for small streams, the average cover was still relatively high (78%) and is expected to recover over a relatively short period of time (2-3 years). Cover in small streams before harvesting ranged from 83 to 95%, and after harvesting, ranged from 60 to 95%. The two greatest reductions in cover (-36 and 34%) were observed on two out of four of the RCR sites (one medium stream and one small stream).

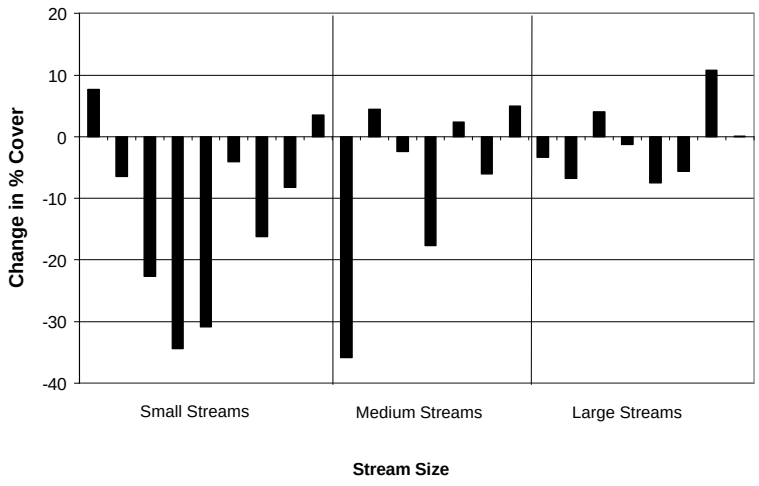

Figure 4. Change in cover after harvesting.

6. What are the trends in conifer regeneration within riparian areas?

Regeneration in both the Coast and Interior georegions was highly variable. However, when compared with data from unmanaged riparian forests, these data indicate relatively high conifer stocking in the Coast georegion. The most commonly observed conifer seedling and sapling species in the Coast georegion were western hemlock and Sitka spruce. Hardwood seedlings and saplings dominated regeneration in the Interior georegion. In the Interior georegion, Douglas-fir accounted for the most commonly observed conifer species, with the exception of one site that had substantial grand fir regeneration. The higher incidence of conifer regeneration on these sites as compared with studies on unmanaged stands is most likely a result of reforestation efforts that follow harvesting. Further monitoring is needed to evaluate this trend with a statistically reliable study.

SUMMARY AND RECOMMENDATIONS

The great amount of variability observed in existing basal areas indicates that a single basal area target is problematic. In general, the rules are adequate at maintaining structure that is predicted to protect large wood recruitment and shade on large streams. The degree to which and the frequency with which pre-harvest basal area exceeded the standard target on small and medium streams indicates the existing targets are likely to be too low to achieve the desired future condition as described in OAR 629-640-110. This conclusion is supported by the findings of substantial reductions in LWR and cover on small streams and for riparian areas managed with an RCR prescription. Moderate reductions were also observed on medium streams but high variability precluded statistical significance of these findings. This conclusion is further supported by the finding that the standard targets underestimated average basal area for mature riparian forests in Interior and West Cascade streams.

The following recommendations are made:

> *The Board of Forestry should re-evaluate the standard targets for basal area to better address the range of conditions and better reflect the capabilities of riparian areas on medium and small streams, particularly in the Interior and West Cascade georegions.*
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> *The Board of Forestry should consider changes to vegetation retention rules to increase the maintenance and promotion of shade and potential LWR on small and medium streams.*
>
> *The Board of Forestry should investigate the advantages and disadvantages of the RCR prescription with greater detail and on a larger scale. In the interim, riparian areas that are going to be managed under this prescription should undergo a detailed assessment to ensure that existing sources of future large wood are adequately maintained and that regeneration stocking standards are achieved.*

The Board of Forestry should evaluate on a larger scale the trends in both conifer and hardwood regeneration within riparian areas. The goal should be to determine if the results from this study are reliable and if there are management strategies that will continue to improve regeneration within 100 feet of the stream.