Economic Costs of Different Riparian Management Regulations in the Pacific Northwest

Kevin W. Zobrist and Bruce R. Lippke

ABSTRACT

Riparian management is an important consideration for sustainable wood production in the Pacific Northwest. Western Washington and Oregon have similar riparian management issues but different regulatory prescriptions. Application of these prescriptions to a sample of 10 small private ownerships illustrate some of the economic differences of each state's approach. Economic costs tend to be higher in Washington but can be significant in both states. Lower cost strategies through alternate plans may be important for protecting riparian habitat while ensuring the long-term economic viability of forestry in the region.

Keywords: regulations, forest economics, riparian buffers, nonindustrial private forest landowners

Riparian management is an important consideration for sustainable wood production in the Pacific Northwest. Riparian areas are a significant component of the forest landscape in the region. They are areas of high biodiversity (Naiman et al. 1993, 1998), and they improve water quality and provide salmon habitat and other resources of importance to the region. Wood production in these areas is important economically for private landowners. Maintaining favorable economics for forestry is vital for keeping private land in forestry use (Murphy et al. 2005). Riparian forest habitat is already frequently lost to competing land uses such as real estate development (Chan et al. 2004), which ultimately is less compatible with fish and water resources. The challenge for the sustainable management of riparian forests is to protect key ecological functions while also providing favorable long-term economic returns for wood production.

Western Washington and western Oregon have similar riparian management conditions, challenges, and goals. Both states have forest practices regulations that call for restricted timber harvest within riparian buffers to protect aquatic resources. However, there are significant differences between the buffer prescriptions in each state. These differences can have economic implications for the long-term sustainability and competitiveness of private forest ownerships, especially small ownerships. To further explore the economic implications of different regulatory approaches, the economic costs of the regulations of each state were compared for a sample of 10 small, private forest ownerships. Although the sample was not large, it incorporated a wide range of stand and stream conditions and offered useful insights about how different regulations play out on actual ownerships. This comparison also illustrates some of the cost trends between the two states, demonstrates the highly variable nature of economic costs for small owners, and provides insights about the types of mitigation strategies that may be needed to keep forestry economically viable while also protecting important aquatic resources.

Current Regulatory Approach

The riparian regulations of Washington, known as the Forests and Fish Rules (FFRs), were adopted in 2001. The riparian regulations of Oregon were adopted in 1994, with additional voluntary measures outlined in the 1997 Oregon Plan for Salmon and Watersheds. The rules for both western Washington and western Oregon cite a similar goal, which is to put riparian stand development on a trajectory toward a desired future condition (DFC) of mature forest structure.[1,2]

Although the DFC goals are similar, the regulatory prescriptions for achieving those goals are significantly different between the two states. In western Washington, the FFRs require a three-zone riparian management buffer for any fish-bearing stream. The total buffer width is 1 site-potential tree height (SPTH), which ranges from 90 to 200 ft depending on site class. The first zone is a 50-ft no-harvest core zone. This is followed by an inner zone, which extends to two-thirds and three-quarters of the SPTH for small and large streams, respectively. There are two partial harvest options for the inner zone. Option 1 allows thinning from below to a minimum density of 57 conifers/ac. Option 2 allows the harvest of the trees furthest from the stream up to a minimum distance of 80 ft and subject to the retention of 20 conifers/ac that are at least 12 in. dbh. Partial harvesting can only be done in the inner zone if the remaining conifers in the core and inner zones are projected to meet DFC basal area targets. The remainder of the buffer is the outer zone, in which harvesting is allowed subject to the retention of 20 conifers/ac. In addition to fish-bearing streams, a 50-ft no-harvest buffer is required around portions of nonfish-bearing streams and sensitive features.[3]

The riparian rules for western Oregon call for 50-, 70-, and 100-ft wide riparian management buffers on each side of small, medium, and large fish-bearing streams respectively. No harvest is allowed within the first 20 ft of the buffer. For medium and large streams, additional conifers must be retained in the remainder of the buffer such that the total conifer number and basal area within the buffer meet minimum targets. For small streams, only basal area targets apply. The targets are determined by stream size and geographic location. For nonfish-bearing streams, 50- and 70-ft-wide buffers are required for medium and large streams, respectively. No

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Table 1. Comparison of western Washington and Oregon riparian buffer requirements for a site class II riparian stand along a small, fish-bearing stream.

	Washington	Oregon
Total riparian buffer width (ft)	170	50
Width of no-harvest area (ft)	80	20
Retention in the remainder of the buffer	26 conifers (20.4 ft^2 minimum basal area) per 1,000 ft of stream	As needed for total basal area of 40 ft^2 per 1,000 ft of stream

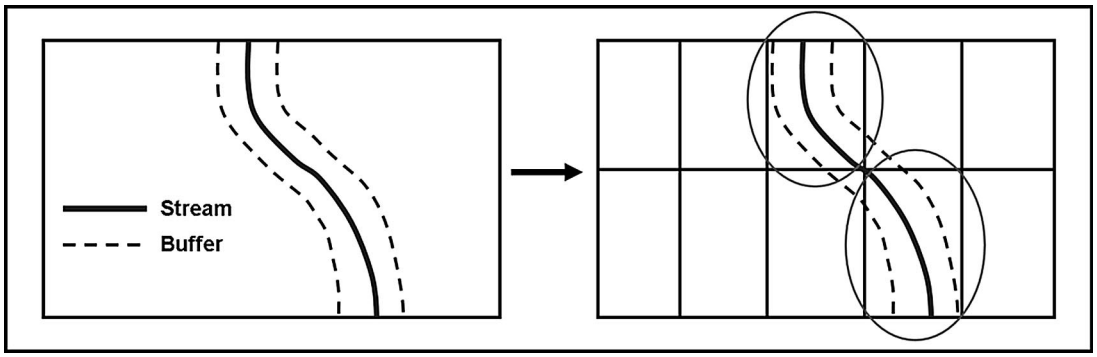

Figure 1. Unlike large ownerships, for which buffer impacts, can be averaged over a large area, with small ownerships, the impacts are more concentrated, often resulting in most or all of a parcel being designated a riparian buffer.

harvest is allowed within 20 ft of the stream, and minimum conifer number and basal area targets must be met. Retaining merchantable trees in a riparian buffer is not required for small, nonfish-bearing streams.[4] Oregon has a third stream classification for domestic water use, but this classification was not applicable to our sample.

In addition to these minimum requirements under the forest practices rules, the Oregon Plan for Salmon and Watersheds outlines voluntary options for retaining additional conifers in the riparian area. One option is to not harvest more than 25% of the excess basal area above the regulatory target. Another option is to simply treat the entire riparian management buffer as a no-harvest zone (full width buffer option).[5]

The differences between the Oregon and Washington riparian regulations are particularly apparent for small streams. Table 1 compares the buffer requirements for a site class II riparian stand along a small, fish-bearing stream. In Washington, the total buffer width would be 170 ft. Assuming inner zone harvest option 2, no harvest would be allowed within the first 80 ft. For the remainder of the buffer, an additional 20 conifers/ac greater than 12 in. dbh would be retained. This amounts to 26 trees and a minimum basal area of 20.4 ft^2 per 1,000 ft of stream. In Oregon, the total buffer width would be 50 ft. No harvest would be allowed within the first 20 ft. Additional conifers would only have to be retained as needed to meet the total basal area target, which is often already met within the 20-ft no-harvest area.

Concerns about Economic Viability

The rules in both states express a desire to protect riparian habitat in a context of maintaining the economic viability of private forest ownerships. The Oregon rules express this in general terms, citing the importance of riparian management rules for achieving the policy objectives of the Forest Practices Act, "including encouraging economically efficient forest practices."[6] The Washington rules express this more directly, stating that the goals of the FFRs include "maintaining commercial forest management as an economically viable land use."[7]

The economic impacts of riparian buffers on small, private forest ownerships are of particular concern, especially in Washington, where the buffers tend to be more restrictive. A Small Business Economic Impact Statement (SBEIS) found that the FFRs results in disproportionate economic costs for small ownerships (Perez-Garcia et al. 2001). Small ownerships in Washington also tend to be located in lowland areas in proximity to streams (Rogers 2004). Unlike with larger, industrial ownerships that can average buffer costs over a large area, with small ownerships, the impacts are concentrated on the individual ownerships where streams are present. A fish-bearing stream running through the middle of a small parcel can result in most or all of that parcel being designated a riparian buffer zone (Figure 1). Those ownerships that have significant portions of riparian habitat are particularly important for conservation, but they also have the highest economic costs from riparian harvest restrictions.

There is concern that significant economic costs from riparian regulations will increase the motivation to pursue a more economically competitive land use such as development, which would likely cause a greater detriment to riparian habitat. Development is not subject to the same riparian buffer requirements as forestry and may result in a greater and permanent loss of forested riparian habitat as well as the loss of forested upland habitat. This concern was expressed in the Forests and Fish legislation, which noted that riparian harvest restrictions would "further erode small landowners' economic viability and willingness or ability to keep the lands in forestry use and, therefore, reduce the amount of habitat available for salmon recovery."[8] Conversion of forestland has already occurred at a rapid rate in recent decades (MacLean and Bolsinger 1997, Washington Department of Natural Resources 1998). Although this trend is likely to continue regardless of riparian regulations as urban areas continue to expand and the economic value of land for real estate development is often an order of magnitude higher than for forestry use, maintaining the economic viability of commercial forestry is important for not further discouraging forestry use and exacerbating this trend.

Examining Economic Costs

To better understand the economic costs of different riparian regulations, it is useful to see how they apply to actual ownerships with stream holdings. Broad studies, such as the SBEIS in Washington, are important for capturing overall or average costs. However, these studies are not based on stand-specific inventory data and the relative location of streams, and they do not differentiate between different management options within the riparian buffer. A more complete picture can be established by going beyond the average costs and examining some of the individual owner variability. As Figure 1 illustrates, with small ownerships, the economic costs can be highly variable, ranging from 0% to 100% depending on the configuration of the property and the location of the stream. The long-term economic sustainability of forestry is of particular concern for those individual properties with significant stream costs. A study was done in Washington to examine the impacts of the FFRs on a sample of 10 such ownerships (Zobrist 2003). This sample was small and exploratory, as it would be cost-prohibitive to collect inventory data for enough owners to characterize the full range of costs. The sample does include many different stand ages, stand conditions, and relative stream locations, and the variability across the sample captures real, on-the-ground applications of the rules with situations that are observed frequently in western Washington and Oregon. This same sample of ownerships was reevaluated to see how the impacts would have been different under the Oregon rules, allowing a unique comparison of how the rules of each state are applied and the resulting economic costs.

The 10 small ownerships represented a range of westside conditions. Six of the ownerships are located in southwest Washington, and the other four are in the coast region. The sample ownerships ranged in size from 33 to 310 ac. Each ownership had different proportions of riparian and upland area and included a mix of timber types, age classes, and site classes, as well as a mix of small and large streams. Most of the ownerships were medium to high site (site class I or II), and it was assumed after consulting with owners that the existing inventory would be harvested at age 50 followed by planting Douglas-fir (*Pseudotsuga menziesii*) at 435 trees/ac (10-ft spacing) for subsequent 50-year rotations. For several stands that had a lower site quality, this rotation was extended to 55 years. For the ownerships in southwest Washington, it was assumed that an early commercial thin from below to 180 trees/ac would be done at age 20 instead of a precommercial thin (PCT), which is a growing trend in the region (Talbert and Marshall 2005). For the ownerships in the coast region, natural regeneration of approximately 600 western hemlock (*Tsuga heterophylla*)/ac was assumed in addition to the planted Douglas-fir. To manage this natural regeneration, it was assumed that a PCT would be done at age 15, leaving 200 Douglas-fir/ac and 70 western hemlock/ac, followed by a commercial thin from below at age 35 to remove half of the stems.

For each sample ownership, GIS software was used to identify the required buffer zones under the rules of each state. Management was then simulated in each zone according to the rule requirements (no harvest, partial harvest, or full harvest). Management simulations were done using the Landscape Management System (LMS), which brings together growth, treatment, and visualization models under a single interface that allows for integrated analysis of forest management alternatives (McCarter et al. 1998). LMS outputs include stand structure metrics, financial analysis, habitat evaluation, and others. Management was first simulated with no riparian harvest restrictions to establish a baseline. Five different riparian buffer scenarios were then analyzed:

1. Minimum retention requirements under the Oregon forest practices rules (OR Rules).
2. Oregon Plan option to not harvest more than 25 percent of the excess basal area above the regulatory targets (OR Plan).
3. No harvest at all within the Oregon buffer zone (OR Full Buffer).
4. Minimum retention requirements under the Washington FFRs, assuming Option 2 (WA Rules).
5. No harvest at all within the Washington buffer zone (WA Full Buffer).

The total costs of each buffer scenario on the economic performance of the property as a whole (riparian and upland) were assessed for each sample ownership. Economic analysis was done using Economatic, a financial analysis companion program integrated with LMS. Economatic uses harvest output data from LMS and can compute several economic performance metrics based on user-provided cost and price assumptions (Zobrist et al. 2006). Two economic performance metrics were used to assess costs: total forest value and soil expectation value (SEV). Forest value is the net economic value of both the land and existing timber given the expected management costs and revenues. SEV is the economic value of land by itself for the purpose of managing timber under given assumptions starting with bare ground. SEV represents the economic performance of beginning a new forest rotation after the existing timber is harvested. Thus, SEV is an important measure of the long-term economic viability to sustain the land in forestry (Zobrist 2005).

Cost, price, and management assumptions were kept consistent with the previous study of the Washington FFRs (Zobrist 2003) and were kept consistent across all five scenarios. These assumptions included a real time discount rate of 5%. Planting costs of $239/ac (435 seedlings/ac at $0.55/seedling) were used, and annual overhead costs of $40/ac were applied.[9] Average year 2000 delivered log prices for western Washington (from Log Lines Reporting Service) were used. Combined logging and hauling costs were applied based on the average cut diameter for a harvest operation and typically ranged between $115 and $150/thousand board feet (mbf) for clearcut harvests. Higher costs were applied for thinning operations, ranging from $200 to $250/mbf. Under these assumptions the baseline SEV for each ownership ranged from $82/ac (lowest quality site) to $1,420/ac (highest quality site), with an average SEV of approximately $750/ac. All values were computed before taxes.

The range and distribution of the effects of riparian buffers on forest value for the 10 sample ownerships are plotted for each riparian buffer scenario in Figure 2 as a percent change relative to the no-buffer baseline. These results reflect the total economic costs of riparian harvest constraints, including both lost timber harvest revenue and lost future returns to land. For each riparian buffer scenario, there is a wide range and disparity of costs across the 10 sample ownerships. Properties with higher proportions of riparian acreage had greater economic losses. Properties with lower economic values to begin with also tended to have greater losses, as the costs of riparian buffers represented a higher proportion of the economic value for lower value properties.

The range and magnitude of costs across the 10 sample ownerships were significantly different between the different riparian buffer scenarios. The costs were lowest under the OR Rules scenario, which called for the narrowest buffers and the lowest leave tree

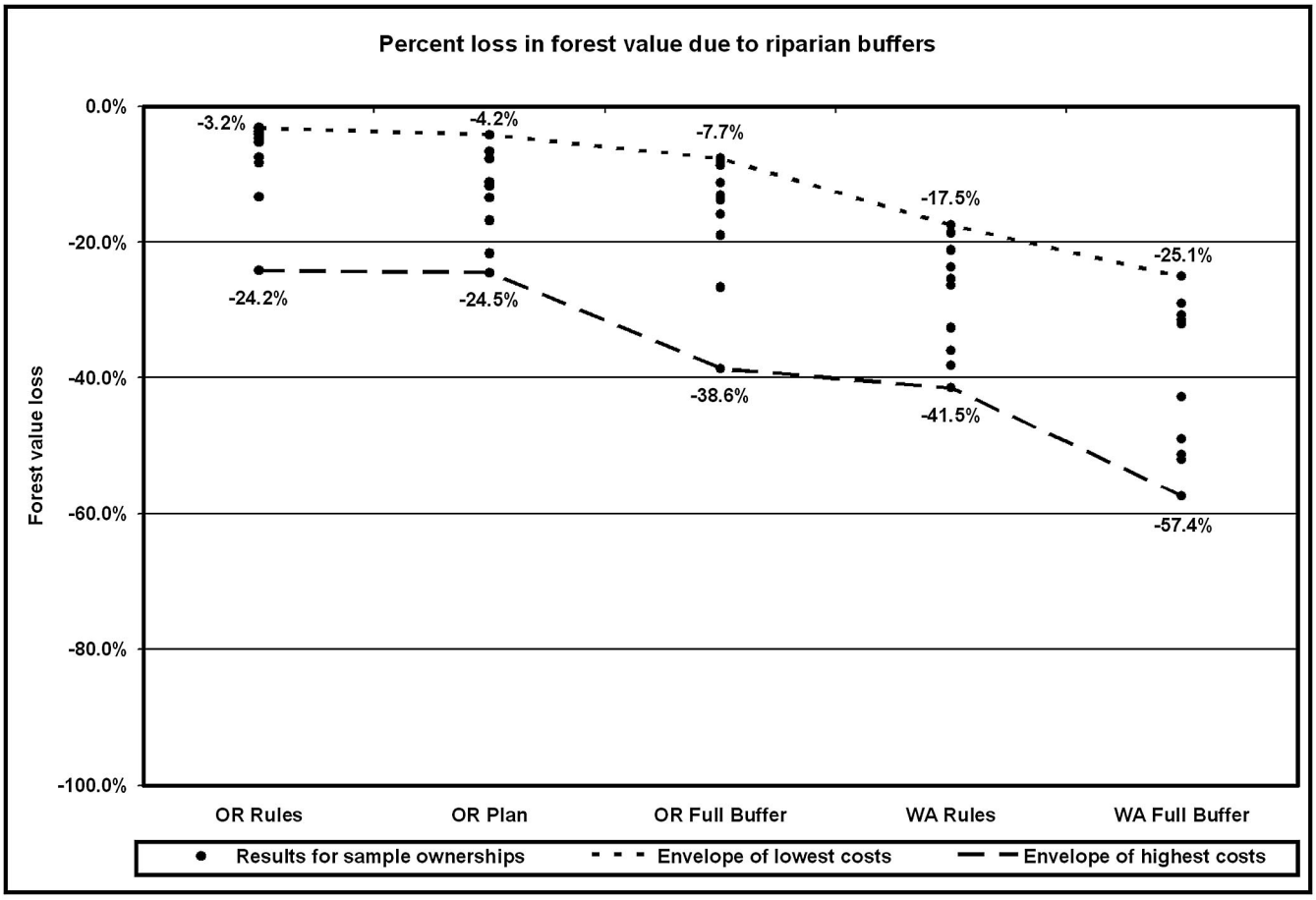

Figure 2. The percent loss in forest value by buffer scenario for 10 sample westside ownerships. These results represent the total economic costs of riparian harvest constraints.

retention requirements, especially for small streams. The costs for this scenario ranged from 3.2 to 24.2% of forest value relative to the no-buffer baseline. The ownerships at the higher end of this range were those with large streams that required wider buffers and greater retention. The OR Plan scenario, which called for the same buffer width but additional retention within the buffer, resulted in slightly higher costs, ranging from 4.2 to 24.5% of forest value. The OR Full Buffer scenario also called for the same buffer width, but it assumed no harvest at all within the buffer. The costs for this scenario were significantly higher, ranging from 7.7 to 38.6% of forest value. The costs were highest under the Washington buffer scenarios, which called for wider buffers and greater no-harvest areas. For the WA Rules scenario, which assumed the maximum allowable harvest, the costs ranged from 17.5 to 41.5% of forest value. For the WA Full Buffer scenario, which assumed no harvest at all within the buffer, the costs ranged from 25.1 to 57.4% of forest value.

Although the forest value losses represent the total lost economic asset value, they may not adequately reflect the longer-term effects on economic viability. The reason is that forest value largely reflects the value of existing timber for which the production costs are not fully considered as many of these costs occurred in the past (i.e., they are sunk). Riparian harvest restrictions can have a greater effect on the economic viability of using the land for future forest rotations, which is measured by SEV and considers all production costs from establishment to final harvest. For the no-harvest areas of riparian buffers, the land cannot be harvested and used to cultivate subsequent rotations, and thus its economic value for timber production is lost. The economic value of the land is also diminished in partial harvest areas of riparian buffers, as the increased shade from the leave trees can be expected to slow the growth rates of subsequent rotations. Depending on the percentage of land restricted by riparian buffers for a given property, the overall per-acre value can be substantially diminished. The overall loss in land value can be expected to be disproportionately larger than the acres affected, as fixed overhead and administrative costs become concentrated on fewer productive acres.

The range and distribution of the effects of riparian buffers on SEV for the 10 sample ownerships are plotted for each scenario in Figure 3. As with the forest value results, there is a wide range of costs both across different ownerships and across different buffer scenarios. As expected, the range and magnitude of costs are considerably greater for SEV than they were for forest value. Comparing the different buffer scenarios, the costs were again lowest under the OR Rules scenario, ranging from 3.7 to 43.3% of SEV relative to the no-buffer baseline. The costs were higher for the OR Plan scenario, ranging from 8.7 to 61.6% of SEV. These results were the same as the OR Full Buffer scenario, as the majority of the timber in the riparian buffer is left standing under the OR Plan scenario. Thus, both scenarios preclude the cultivation of future timber rotations within the full width of the buffer. The costs were again highest under the Washington

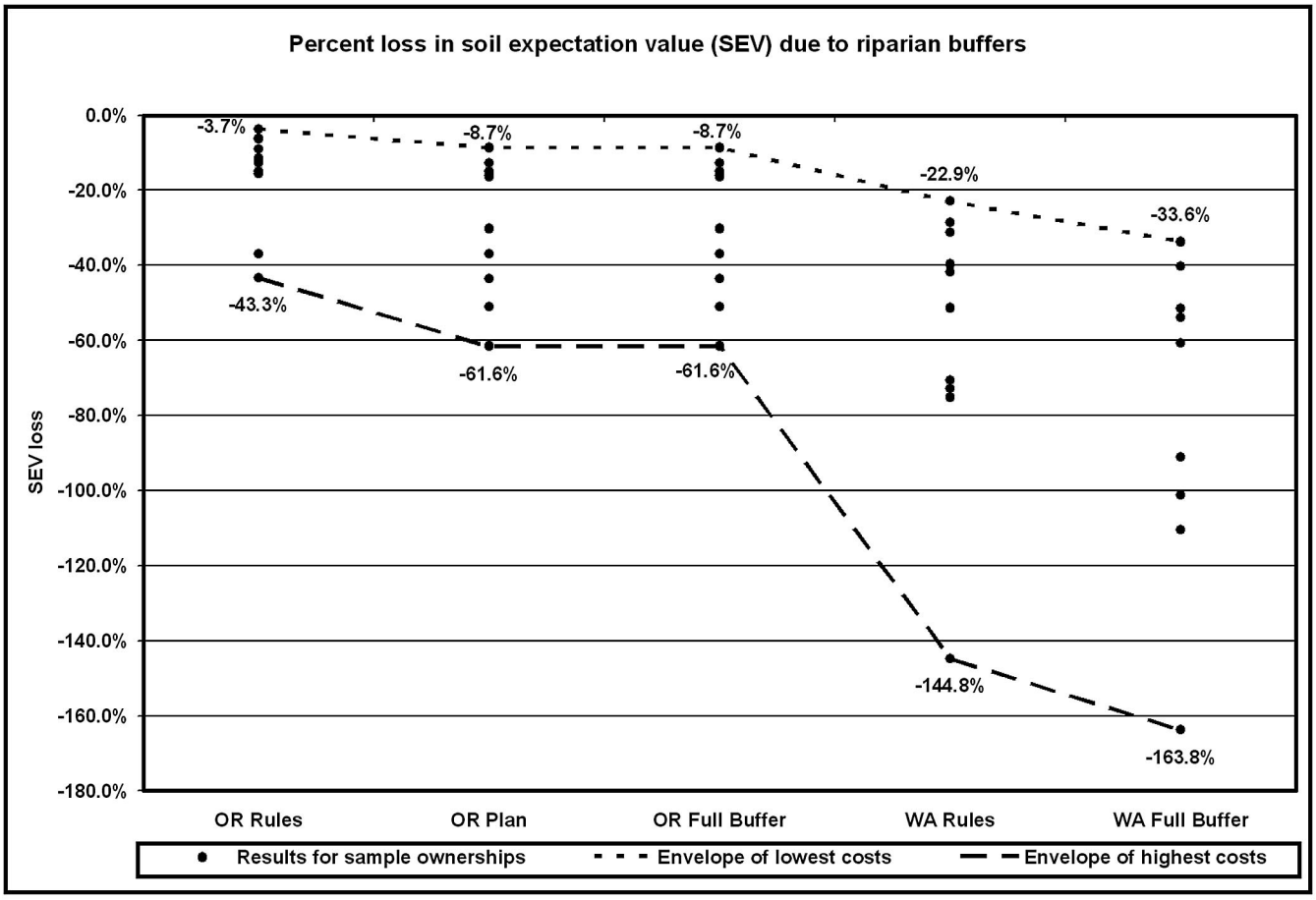

Figure 3. The percent loss in soil expectation value by buffer scenario for 10 sample westside ownerships. These results represent the cost of riparian harvest constraints on the long-term economic motivation for continued forest management.

buffer scenarios. For the WA Rules scenario that assumed maximum allowable harvest, the costs ranged from 22.9 to 144.8% of SEV. For the WA Full Buffer scenario, the costs ranged from 33.6% to 163.8% of SEV.

Overall, the economic costs of riparian buffers were significant for most of the sample ownerships. The range and magnitude of costs were higher for the Washington rules than for the Oregon rules, due to the wider buffers and greater retention requirements, especially for small streams. There was also less differentiation in cost between small and large streams under the Washington rules, whereas that was a key difference in the level of cost under the Oregon rules. The costs of riparian buffers were particular high for SEV. This suggests that riparian buffers will have the greatest economic effect on future rotations, causing much lower economic returns when starting a new rotation with bare land. Although any decrease in SEV reflects a lower economic competitiveness relative to other land uses, SEV losses of over 100% are of particular concern. Such losses mean that, assuming a 5% cost of money, timber revenues can no longer cover the production costs, and thus, forest management is no longer economically viable.

There have been several efforts in Washington to help mitigate the economic costs of the FFRs. The Washington Forest Excise Tax was reduced from 5.0 to 4.2% of stumpage value for landowners affected by riparian buffer requirements. However, in most cases, the cost of the riparian buffers is many times greater than the value of this tax credit, especially for small landowners (Reeves 2004). Washington has also implemented a unique cost-sharing effort specifically for small landowners called the Forestry Riparian Easement Program (FREP). The FREP pays landowners 50% of the value of timber that must be left in riparian buffers. If the value of riparian leave trees exceed a high cost threshold of 19.1%, the value in excess of this threshold is compensated at 100%. When potential FREP payments are factored in, the economic costs of the Washington rules assuming maximum allowable harvest (Option 2) range from 6.5 to 22.6% of forest value relative to a no-buffer baseline. These costs are significantly lower than without the FREP and are more on par with the costs of the Oregon rules.

Although the FREP can potentially offer significant economic relief to landowners affected by riparian buffers, the funding for this program is limited such that only a small percentage of eligible landowners will likely benefit. Another critical issue with the FREP is that it only compensates for the value of the standing timber and not the lost value of the land. Thus, although landowners can recover much of the value of existing riparian timber, the economic viability of managing for future rotations on the property may still be significantly diminished (SEV losses remain unchanged), and the motivation for land conversion is not reduced.

Given the limited funding available for programs such as the FREP and the importance of maintaining the long-term economic viability of the land for forestry use, it may be useful to identify management strategies for protecting riparian habitat at a lower cost. The rules in both states include provisions for landowners to

deviate from the regulatory buffer prescriptions using approved alternate plans. The Washington rules recognize alternate plans as a potential mechanism for reducing compliance costs for landowners, stating that alternate plans can be used to "meet riparian functions while requiring less costly regulatory prescriptions."[10] The Washington rules further suggest that templates be used to streamline alternate plan preparation and approval.[11] Templates would outline specific strategies to serve as management models for achieving ecological and economic goals in riparian areas. Several example alternate plan templates have been developed that hold promise for significantly reducing both forest value and SEV losses while still achieving the regulatory goal of developing the DFC in the riparian area (Zobrist et al. 2004, 2005). Such templates could play an important role in a regional strategy for sustainable riparian management.

Conclusions

Washington and Oregon have similar circumstances and policy objectives when it comes to westside riparian management. However, each state has a different regulatory approach for achieving these objectives, which result in different economic costs for landowners. Small ownerships are uniquely affected by riparian harvest restrictions, as costs are not evenly distributed but rather concentrated on individual ownerships with high proportions of riparian area. An examination of a sample of 10 such ownerships illustrates what the different regulatory approaches can cost for individual ownerships. For these sample ownerships, the costs were higher under the Washington rules than under the Oregon rules, which was to be expected given Washington's wider buffer widths and greater leave tree requirements. Most of the economic costs were based on lost timber harvest revenue in riparian areas. However, another significant cost was the reduced productive land base, which may make future forest rotations no longer economically viable. This can add further economic incentive to pursue more profitable land uses such as development, which can ultimately be more detrimental to fish and other aquatic resources.

The differences in economic costs have significant implications for the long-term economic sustainability and relative competitiveness of private forest ownerships in Washington and Oregon. There are implications, as well, for other states, which are taking still different approaches to riparian management or which may be faced with riparian management decisions in the future. Although this initial sample of 10 ownerships is useful for illustrating key principles and issues, it also suggests that additional research that includes a broader sample of landowners, incorporates an eastside perspective, and delves further into individual owner objectives is needed to further understand the comparative economic costs of riparian management regulations. Additional research is also needed to further develop alternative management approaches that can work to meet both environmental and economic objectives.

Endnotes

[1] Washington Administrative Code (WAC) 222-16-010.
[2] Oregon Administrative Rules (OAR) 629-640-000.
[3] For a complete description of the riparian management zones for western Washington, see WAC 222-30-021.
[4] For a complete description of riparian management areas and vegetation retention requirements for western Oregon, see OAR 629-635 and 629-640.
[5] For additional information about Oregon Plan options for forest landowners, see the Oregon Department of Forestry and State and Private Forestry Community Oregon Plan Statewide Work Program (June 7, 2000).
[6] OAR 629-635-0100.
[7] Revised Code of Washington (RCW) 77.85.180.
[8] RCW 76.13.100.
[9] This figure was based on input from local landowners and is significantly higher than typical industrial costs because of the lack of economies of scale for small ownerships.
[10] RCW 76.13.110.
[11] WAC 222-12-0403.

Literature Cited

CHAN, S., P. ANDERSON, J. CISSEL, L. LARSEN, AND C. THOMPSON. 2004. Variable density management in riparian reserves: Lessons learned from an operational study in managed forests of western Oregon, USA. *For. Snow Landsc. Res.* 78(1/2):151–172.

MACLEAN, C.D., AND C.L. BOLSINGER. 1997. *Urban expansion in the forests of the Puget Sound region*. Resource Bulletin PNW-RB-225. USDA Forest Service, Pacific Northwest Research Station, Portland, OR. 17 p.

MCCARTER, J.B., J.S. WILSON, P.J. BAKER, J.L. MOFFETT, AND C.D. OLIVER. 1998. Landscape management through integration of existing tools and emerging technologies. *J. For.* 96(6):17–23.

MURPHY, G.E., W.R.J. SUTTON, D. HILL, C. CHAMBERS, D. CREEL, C. BINKLEY, AND D. NEW. 2005. Economics of intensively managed forest plantations in the Pacific *Northwest. J. For.* 103(2):78–82.

NAIMAN, R.J., H. DECAMPS, AND M. POLLOCK. 1993. The role of riparian corridors in maintaining regional biodiversity. *Ecol. Applic.* 3:209–212.

NAIMAN, R.J., K.L. FETHERSTON, S.J. MCKAY, AND J. CHEN. 1998. Riparian forests. P. 289–323 in *River ecology and management: Lessons from the Pacific coastal ecoregion*, Naiman, R.J., and R.E. Bilby (eds.). Springer-Verlag, New York.

PEREZ-GARCIA, J.M., J. EDELSON, AND K. ZOBRIST. 2001. *New proposed forest practices rules small business economic cost statement.* Washington State Department of Natural Resources, Olympia, WA.

REEVES, L.H. 2004. Comparing the value of leave tree buffers with a forest excise tax credit in Washington state. *West. J. Appl. For.* 19(3):165–170.

ROGERS, L. 2004. *Map of known Washington state non-industrial private forestland parcels by elevation ranges.* Rural Technology Initiative, College of Forest Resources, University of Washington, Seattle, WA. Available online at www.ruraltech.org/gis/sflowria/maps/ sflodb/NIPF_by_Elevation_Bands_Version_3.jpg; last accessed June 2006.

TALBERT, C., AND D. MARSHALL. 2005. Plantation productivity in the Douglas-fir region under intensive silvicultural practices: Results from research and operations. *J. For.* 103(2):65–70.

WASHINGTON DEPARTMENT OF NATURAL RESOURCES. 1998. *Our changing nature: Natural resource trends in Washington state*. Washington Department of Natural Resources, Olympia, WA. 75 p.

ZOBRIST, K. 2003. *Economic costs of the forests and fish rules on small, NIPF landowners: Ten Western Washington case studies*. RTI Working Paper 1, Revised Edition. Rural Technology Initiative, College of Forest Resources, University of Washington, Seattle, WA. 23 p.

ZOBRIST, K.W. 2005. *Economically sustainable working forests: Financial analysis principles and applications*. Northwest Environmental Forum Topic Paper 2. Northwest Environmental Forum, College of Forest Resources, University of Washington, Seattle, WA. 16 p.

ZOBRIST, K.W., J.M. COMNICK, AND J.B. MCCARTER. 2006. Economatic: A new tool that integrates financial analysis with forest management simulations. *West. J. Appl. For.* 21(3):134–141.

ZOBRIST, K.W., K.R. GEHRINGER, AND B.R. LIPPKE. 2004. Templates for sustainable riparian management on family forest ownerships. *J. For.* 102(7):19–25.

ZOBRIST, K.W., K.R. GEHRINGER, AND B.R. LIPPKE. 2005. A sustainable solution for riparian management. P. 54–62 in *Understanding key issues of sustainable wood production in the Pacific Northwest*, Deal, R.L., and S.M. White (eds.). USDA For. Serv. Gen. Tech. Rep. PNW-GTR-626.