Exempt 20-Acre Parcel Riparian Management Zones: An Assessment of Riparian Function

Purpose and Need

The purpose of this paper is to characterize ecological functions provided by riparian management zones (RMZ) adjacent to Type S and F waters on exempt 20-acre parcels as defined by Washington's forest practices rules (WAC 222-30-023). The rule requirements were evaluated in light of available scientific literature to quantify the level of large wood recruitment and shade provided by RMZs adjacent to Type S and F waters on exempt 20-acre parcels. Large wood recruitment and shade were evaluated because they play an important role in maintaining the ecological health of aquatic systems and they are also sensitive to forest practices effects. This information will be incorporated into an Environmental Impact Statement currently being developed to support the Forests and Fish Habitat Conservation Plan.

Introduction

The degree of riparian influence on the aquatic environment decreases with increasing distance from the water (FEMAT 1993). Therefore, in forests where trees are of similar height, trees closer to the water generally provide greater ecological benefit compared with those farther away. This relationship can be illustrated as a curve where the cumulative effectiveness of a given riparian function is related to distance from the stream or wetland edge (Figure 1). The relationship is function-specific and is often expressed as a proportion of tree height. Since species, age, and site productivity all affect tree height, the generalized function-distance relationships in Figure 1 change somewhat as forest stand characteristics vary across time and space.

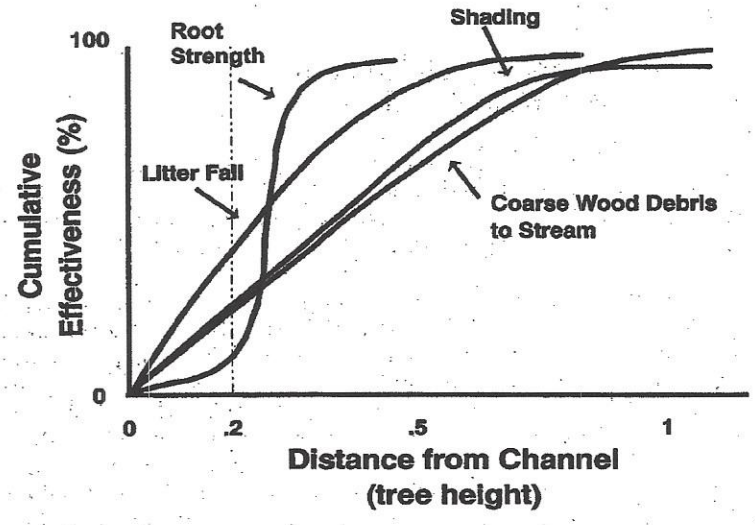

Figure 1. Relationship between cumulative effectiveness of various riparian functions and distance from the stream channel. Distance from channel is expressed as a proportion of tree height. From FEMAT (1993).

Part 1 - Large Wood Recruitment

Background

Recent research into woody debris recruitment has helped shape the generalized recruitment-distance relationship illustrated in Figure 1. In a study of first- through third-order streams in western Oregon and Washington, McDade et al. (1990) found that 70 percent of in-stream debris pieces recruited from mature conifer forests originated from within 50 feet of the streambank (Figure 2). Source distances of 66 and 100 feet corresponded with 80 and 90 percent total recruitment, respectively for debris from mature conifer forests (McDade et al. 1990). In cases where mature hardwoods dominated the riparian forest, McDade et al. (1990) found that 75 and 90 percent of in-stream debris pieces were recruited from 30 and 50 feet, respectively. In a similar study, Murphy and Koski (1989) found that 90 percent of in-stream debris recruited from old-growth forests in southeast Alaska had source distances of 50 feet or less from the stream edge (Figure 3).

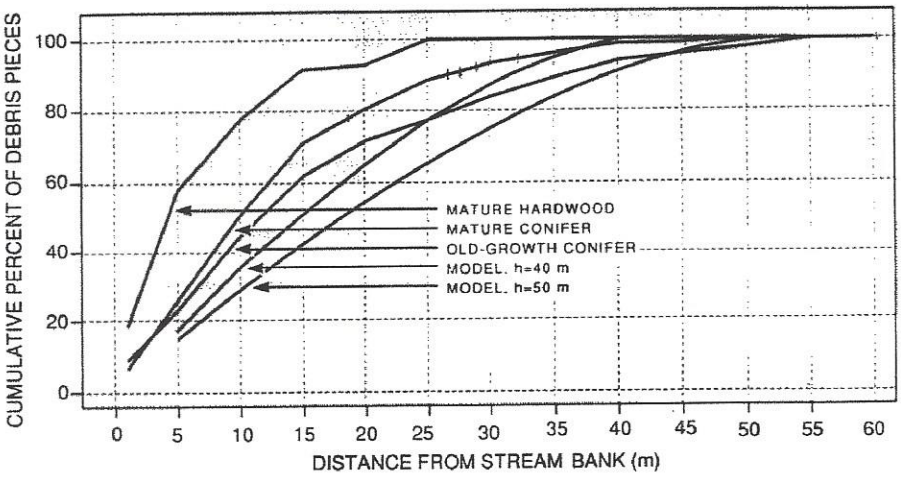

Figure 2. Distribution of source distances from origin to streambank for conifer large woody debris in old-growth stands and hardwood and conifer large woody debris in mature stands (as based on field observations) and for trees 40 and 50 m tall (as calculated from a trigonometric model of debris delivery). From McDade et al. (1990).

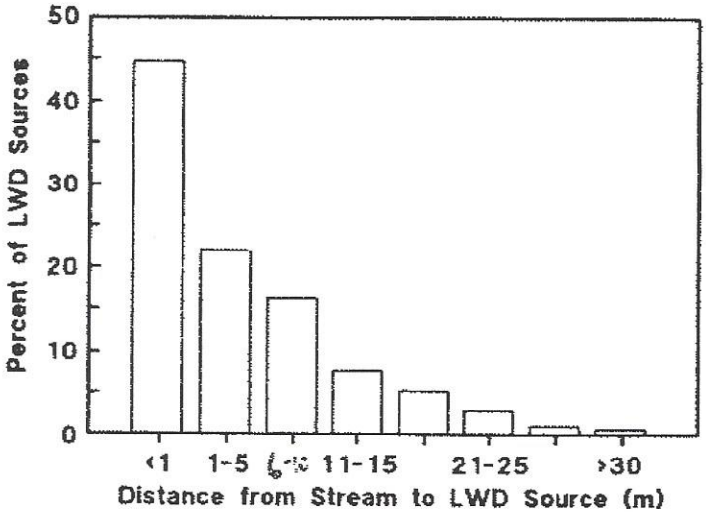

Figure 3. Distances from the stream to sources of large woody debris. Histogram bars show the percentage of all identified large woody debris sources (N = 861) at given distances from the stream for 32 stream reaches in old-growth forest in southeast Alaska. From Murphy and Koski (1989).

Variations in the source distance relationships in the aforementioned studies are largely attributable to differences in tree height and recruitment process. Younger second-growth forests or forests growing on less productive sites have shorter trees as compared to older forests or forests growing on highly productive sites. Riparian forests with shorter trees supply a larger proportion of the total in-stream wood load from a given source distance relative to riparian forests with taller trees (Robison and Beschta, 1990; Van Sickle and Gregory, 1990). The relative importance of recruitment processes such as bank erosion, chronic mortality, and mass wasting also affect the shape of source distance relationships. Source distance curves for channels dominated by bank erosion tend to be shifted upward and to the left (i.e., a larger proportion of the wood is recruited from close to the channel) relative to channels where wood is recruited via chronic mortality or mass wasting (Benda et al. 2003).

Forest Practices Rule Requirements

Forest practices rules for exempt 20-acre parcels in western Washington require the retention of RMZs that are 29, 58 or 86 feet wide along Type F waters and 86 or 115 feet along Type S waters (bankfull width determines the RMZ width). In eastern Washington, exempt 20-acre parcel RMZ widths are 35 or 58 feet along Type S and F waters where the adjacent harvest unit is partial-cut (again, bankfull width determines the RMZ width). Where harvest units are clearcut in eastern Washington, exempt 20-acre parcel RMZs along Type S and F waters must average 58 feet in width with a minimum width of 35 feet and a maximum width of 345 feet.

Harvest within exempt 20-acre parcel Type S and F RMZs is allowed if shade requirements are met[1]. In western Washington, harvesting within RMZs must retain between 29 and 115 trees per 1,000 feet of stream length on each side of the stream. The bankfull width and channel substrate type determines the exact number of trees that must be retained (WAC 222-30-023). In eastern Washington, tree retention within RMZs is determined by the size and species composition of the riparian stand (WAC 222-30-023).

While harvesting to established minimums is allowed if shade requirements can be met, data from the DNR-Forest Practices Division indicate harvesting within the RMZ is uncommon. In a statewide sample of 37 RMZs established on exempt 20-acre parcels during 2003, 32 (or 86 percent) were treated as no-harvest areas and only two had 15 percent or more of the trees removed from the RMZ (Table 1; DNR-Forest Practices Division, unpublished data, 2003). While these data comprise a relatively small sample, anecdotal information from the DNR suggests they are representative of RMZ harvest practices since adoption of the Emergency Salmonid Rule (ESR) in 1998 (S. Casey, pers. comm.; B. Anderson, pers. comm..). The ESR was implemented to address federal listings of several species of salmonids under the federal Endangered Species Act.

The low frequency of RMZ harvest is likely attributable to two factors. First, it is likely that many sites do not meet minimum shade requirements, eliminating RMZ harvest options. Many exempt 20-acre parcels are located at low elevations where minimum shade levels must equal or exceed 80 percent. Such high shade levels are difficult to attain, particularly for larger streams that have natural canopy openings over the channel. Legacy effects from past forest practices such as increased sediment deposition and resulting channel widening also restrict the capacity of some sites in attaining minimum shade requirements.

The second factor that affects the frequency of RMZ harvest is the required shade analysis. A landowner planning to harvest within an RMZ must measure and document existing shade levels and compare those levels to required minimums. If "surplus" shade exists, the landowner must then identify (or mark) trees eligible for harvest under the shade rule. If "surplus" shade does not exist (i.e., existing shade is below the required minimum) no harvest is allowed. The cost (in time and/or money) associated with conducting the shade analysis often deters many landowners from pursing RMZ harvest, particularly when there is no guarantee of surplus shade.

Estimated Recruitment from RMZs

Multiple factors affect wood recruitment potential from exempt 20-acre parcel RMZs. As noted earlier, recruitment under natural conditions is affected by tree height (which is a function of species and age) and the relative importance of various recruitment processes (i.e., bank erosion vs. chronic morality vs. mass wasting). Under managed conditions, RMZ width (which varies with region, water type and bankfull width) and the level of tree retention within the RMZ affect wood recruitment. Given the many factors that influence wood delivery to streams, recruitment potential from exempt 20-acre parcel RMZs is likely to vary widely.

---

[1] Minimum shade requirements are based on elevation and waterbody classification (established by the Department of Ecology) and are designed to ensure water temperature standards are achieved.

Table 1. Distribution of riparian management zones by tree retention level for exempt 20-acre parcels in Washington (n = 37); data from forest practices approved in 2003.

DNR Region	100% Retention	99% Retention	95% Retention	90% Retention	85% Retention	50% Retention
Central	5	0	0	0	0	1
South Puget	9	0	0	0	0	0
Olympic	1	0	1	1	0	0
Northwest	5	0	0	0	0	0
Southwest	7	1	0	0	0	0
Northeast	1	0	0	0	1	0
Southeast	4	0	0	0	0	0
TOTAL	32	1	1	1	1	1

Wood recruitment potential from exempt 20-acre parcel RMZs is estimated to range from 45 to 95 percent and from 75 to 100 percent for mature conifer and mature hardwood forests, respectively. Where in the range a particular RMZ falls depends on the RMZ width. These conclusions are based primarily on the scientific literature described earlier (Murphy and Koski 1989; McDade et al. 1990) and are further supported by the DNR data related to exempt 20-acre parcel RMZs that indicates the vast majority of RMZs are left unharvested. Harvesting within RMZs will reduce these estimates; the degree of reduction will depend largely on the number of trees harvested and the location of the harvested trees with respect to the water.

Part 2 – Shade

Background

Forest practices rules rely on shade, expressed as percent canopy cover, to ensure forest practices activities meet water temperature standards (WAC 222-30-040). The degree of shade provided by streamside buffers varies with the species, age, and density of riparian vegetation. Buffer strip width is also important, but by itself may not be a good predictor of stream shading (Sullivan et al. 1990). Studies of the relationship between buffer strip width and shade (expressed as angular canopy density or ACD) show a high degree of variability, particularly for buffers less than about 75 feet in width (Brazier and Brown 1973; Steinblums et al. 1984) (Figure 4). Nonetheless, ACD is positively correlated with buffer width; as buffer width increases, the level of riparian shade also increases. In the Oregon Coast Range, Brazier and Brown (1973) found buffers approximately 70 feet wide had ACDs similar to that of old-growth stands (Figure 4). Steinblums et al. (1984) found that buffers approximately 120 feet wide in the Oregon Cascades were necessary to achieve ACDs representative of old-growth (Figure 4).

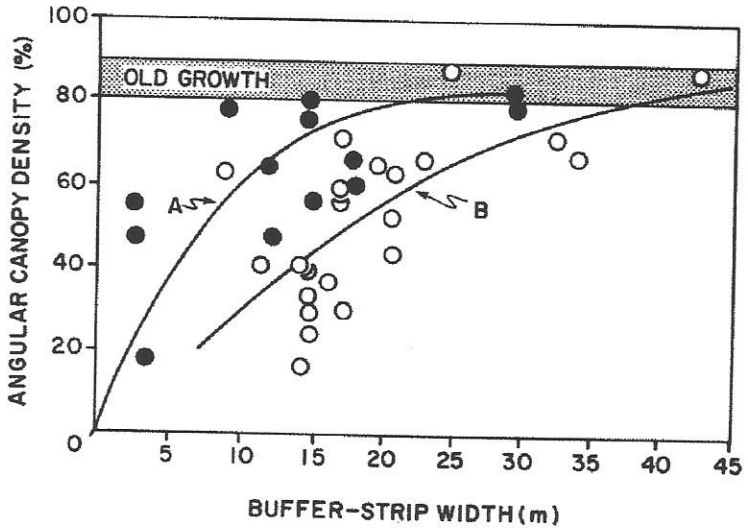

Figure 4. Relationship of angular canopy density (ACD) to buffer strip width in western Oregon. Data for (A) from Brazier and Brown (1973); data for (B) from Steinblums et al. (1984). From Beschta et al. (1987).

Forest Practices Rule Requirements

Forest practices rules for exempt 20-acre parcels in western Washington require the retention of RMZs that are 29, 58 or 86 feet wide along Type F waters and 86 or 115 feet along Type S waters (bankfull width determines the RMZ width). In eastern Washington, exempt 20-acre parcel RMZ widths are 35 or 58 feet along Type S and F waters where the adjacent harvest unit is partial-cut (again, bankfull width determines the RMZ width). Where harvest units are clearcut in eastern Washington, exempt 20-acre parcel RMZs along Type S and F waters must average 58 feet in width with a minimum width of 35 feet and a maximum width of 345 feet.

As noted earlier, forest practices rules allow for harvest within RMZs only if existing shade levels exceed minimum requirements. Only trees that provide "surplus" shade can be removed. In cases where existing shade does not meet minimum requirements, no RMZ harvest can occur.

Data presented earlier indicate a majority of exempt 20-acre parcel RMZs is left unharvested, primarily due to shade rule requirements (see page 4). Therefore, even though one set of forest practices rules allow for harvesting within RMZs (WAC 222-30-023), in most cases shade requirements (WAC 222-30-040) eliminate harvest opportunities.

Estimated Shade From RMZs

Shade provided by exempt 20-acre parcel RMZs varies with RMZ width and the species, age, and density of riparian vegetation. Retention of RMZs that are 29 to 115 feet (9 to 35 meters) wide will likely provide between 25 and 85 percent shade or canopy cover. This conclusion is based on data from Brazier and Brown (1973) and Steinblums et al. (1984) (Figure 4) and is further supported by the DNR data related to exempt 20-acre parcel RMZs that indicates the vast majority of RMZs are left unharvested. Wider RMZs likely fall into the upper end of this range while narrower RMZs typically fall into the lower end.

Generally, narrow RMZs are typically associated with smaller channels where shade requirements can be more easily met, while wide RMZs are typically associated with larger channels where shade requirements are more difficult to meet.

Literature Cited

Anderson, R., DNR-Northeast Region, Forest Practices District Manager, Colville, WA. Personal communication. February 6, 2004.

Benda, L., D. Miller, J. Sias, D. Martin, R. Bilby, C. Veldhuisen, and T. Dunne. 2003. Wood recruitment processes and wood budgeting. Pages 49-74 in S.V. Gregory, K.L. Boyer, and A.M Gurnell, editors: The ecology and management of wood in world rivers. Am. Fish. Soc., Symposium 37, Bethesda, MD.

Beschta, R.L., R.E. Bilby, G.W. Brown, L.B. Holtby, and T.D. Hofstra. 1987. Stream temperature and aquatic habitat: fisheries and forestry interactions. In: Streamside Management: Forestry and Fisheries Interactions, E.O. Salo and T.W. Cundy (eds.), College of Forest Resources, University of Washington, Seattle WA. Contribution No. 57.

Brazier, J.R. and G.W. Brown. 1973. Buffer strips for stream temperature control. Res. Pap. 15. Forest Research Laboratory, Oregon State University, College of Forestry, Corvallis, OR. 9 p.

Casey, S., DNR-Forest Practices Division, Olympia, WA. Personal communication. February 6, 2004.

Forest Ecosystem Management Assessment Team (FEMAT). 1993. Forest ecosystem management: an ecological, economic, and social assessment. US Government Printing Office, Washington, D.C.

McDade, M.H., F.J. Swanson, W.A. McKee, J.F. Franklin, and J. Van Sickle. 1990. Source distances for coarse woody debris entering small streams in western Oregon and Washington. Can. J. For. Res. 20:326-330.

Murphy, M.L. and K.V. Koski. 1989. Input and depletion of woody debris in Alaska streams and implications for streamside management. N. Am. J. Fish. Mngmnt. 9: 427-436.

Robison, G.E. and R.L. Beschta. 1990. Identifying trees in riparian areas that can provide coarse woody debris to streams. For. Sci. 36(3):790-801.

Steinblums, I.J., H.A. Froehlich, and J.K. Lyons. 1984. Designing stable buffer strips for stream protection. J. For. 82(1):49-52.

Sullivan, K., J. Tooley, K. Doughty, J.E. Caldwell, and P. Knudsen. 1990. Evaluation of prediction models and characterization of stream temperature regimes in Washington.

Timber/Fish/Widlife Rep. No. TFW-WQ3-90-006. Washington Dept. Nat. Resources, Forest Practices Division, Olympia, WA. 224 p.

Summers, R.P. 1983. Trends in riparian vegetation regrowth following timber harvesting in western Oregon watersheds. M.S. thesis, Oregon State University, College of Forestry, Corvallis, OR. 151 p.

Van Sickle, J. and S.V. Gregory. 1990. Modeling inputs of large woody debris to streams from falling trees. Can. J. For. Res. 20:1593-1601.