RTI FACT SHEET **#25**

Rural forest community issues *August 2003*

Alternate Planning for small forest landowners in eastern Washington under the Forest and Fish Rules

The stated intent of Washington State's "Forest and Fish Rules" (FFR) for eastern Washington is to provide restoration of riparian function while allowing activities that can ameliorate risks associated with fire, disease, and insects within riparian zones. In addition, the FFR anticipated the need for alternate plans in situations where risks to aquatic resources are low and mitigation of economic impacts to small landowners is desired. Alternate plans must provide equivalent protection to aquatic resources, yet be simple to implement, economically desirable, and avoid unintended consequences associated with eastside disturbance vectors such as bark beetles and fire. An alternate plan approach was developed using stand density index (SDI) to integrate the economic, riparian function, and biological criteria necessary to reduce riparian stand susceptibility to infestation by Mountain Pine Beetle (Dendroctonus ponderosae, Hopkins). This approach suggests one possible template for eastside alternate plans on at-risk stands. Refinement of the approach that is derived to avoid negative consequences may be a precursor to developing a desired future condition (DFC) model for the eastside which integrates variability in habitats and disturbance regimes to arrive at a dynamic range of optimal riparian conditions. The eastside dynamic range (EDR) model would reflect the integration of disturbance variables, such that stands would be placed on a trajectory toward long-term sustainability rather than away from risk avoidance.

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Analysis of the potential economic impacts of increasing riparian protection under the FFR was completed using a case study approach. Under the FFR there is considerable variability in economic impact among landowners in eastern Washington (see Factsheet 20) with owners losing up to 49% of the economic value of their holdings. This outcome is particularly apparent in drier and poorer ecosystems where basal area increase takes a substantial time period or where stands have high tree densities, but few trees exceeding 10" dbh.

Given the negative economic outcomes under the FFR and the funding uncertainties under the FREP (see Factsheet 2), pursuing an alternate plan is an option landowners can choose to provide habitat value in a more cost effective manner. Alternate plans (AP) are permitted in specific situations, such as disproportionate levels of impact, or on a small harvest unit, but they must provide 'protection to public resources at least equal in overall effectiveness as provided by the act and rules' (WAC 222-12-040). In effect AP must consider economic viability, and riparian stand biological condition. In the absence of an eastside DFC model, AP for eastern Washington have been developed to place riparian stands on a growth trajectory to reduce their susceptibility to loss from disturbance vectors. As an example, the biological conditions that precipitate Mountain Pine Beetle (MPB) infestations are explored for a low site class riparian zone in Okanogan County to determine the most appropriate approach for alternate planning under such circumstances. In the long term, an eastside dynamic range (EDR) model that is based on inherent disturbance regimes (Everett et al. 2000) might be preferable.

Literature on MPB risk and susceptibility indicates that stands move into the range of susceptibility to insect infestations at approximately 80-100 ft^2/ac of basal area (Cochran 1988, Larsson et al.1983, Schmid and Mata 1992). When examining the potential for insect attack, the literature indicates that variability in site quality also drives insect infestation with drier and poorer ecosystems experiencing mortality at lower stocking levels (Cochran et al. 1994). Vigor indices indicate that for low site classes, the lower limit of susceptibility is approximately 85 ft^2/acre (Cochran 1988). These susceptibility ranges and vigor indices suggest that the threshold of bark beetle susceptibility is between the upper and lower basal entry limits for inner riparian zone management under the FFR. Post harvest outcomes that meet FFR requirements for basal area and trees/acre are given in Figure 1 for all low elevation case study sites in the original analysis. Figure 1 demonstrates that 75% of managed riparian stands will remain very close to the MPB threshold or in many cases exceed it under the FFR. Stands will exceed this limit, even at completion of harvest, when the combination of minimum tree count and 21 largest tree requirement result in basal area retention exceeding 85 ft^2/acre of basal area. Basal area growth between harvest entries will always exceed this limit of susceptibility because re-entry is not permitted until the upper basal area limit established under FFR is reached.

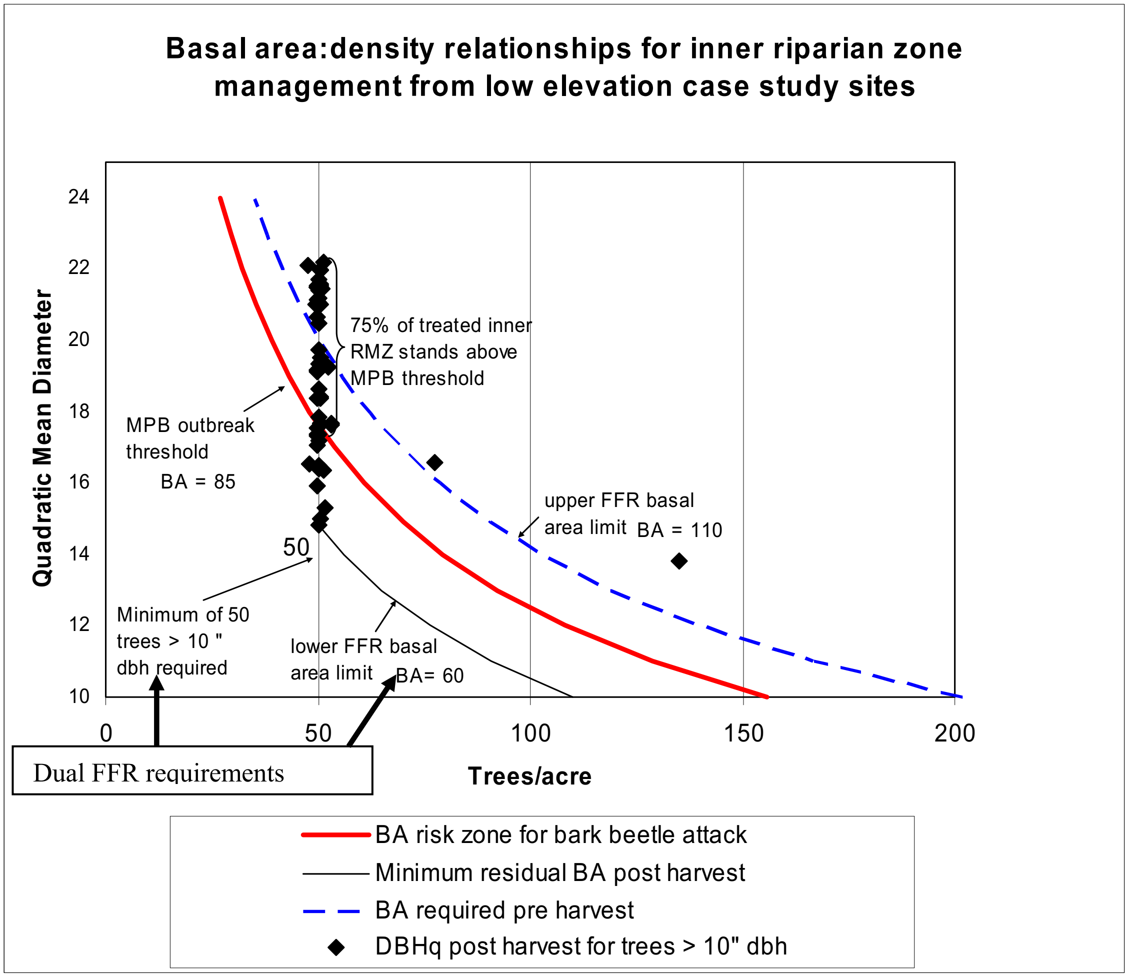

Figure 1: BA distribution post harvest for riparian inner zones in low elevation case study sites under the FFR.

Outcomes depicted in Figure 1 suggest that AP that alter stand density and thus mitigate insect dynamics while still meeting economic and riparian functional requirements are needed. In determining appropriate thresholds, AP to address MPB risk must consider "stockability". Stockability refers to the inherent biological carrying capacity of the site which can be inferred from the plant association or habitat type (Cochran et al. 1994, Fiedler et al. 1988). Stockability measures are derived relative to 'normal' or full stocking using site index (SI), maximum SDI, and growth basal area (GBA) (Cochran et al. 1994). The types of relationships between inherent carrying capacity of low productivity sites and insect attack identified in the figures and literature would indicate that AP on low productivity sites should look at maintaining lower basal areas than those that occur under the FFR criteria, given current stand conditions. In addition, linking harvest timing to mortality indices and basal area increment decline rather than FFR upper basal area limits, could reduce the stand stress that is a precursor to MPB infestation. Under the FFR, riparian function is maintained using 5 key leave tree requirements: minimum BA, TPA and DBH, upper BA limit, and largest tree requirements. Collectively, these variables can be described using stand density index or SDI, which forms a baseline metric for comparison of disparate stand conditions to the riparian functional requirement.

Stand density index (SDI), as given by the equation SDI = $TPA(DBHq/10)^{1.6}$, gives a relative density measure of the number of 10" trees/acre of land (Reineke 1933). Calculating a SDI for the FFR riparian requirements of 50 TPA> 10" and a basal area of 60 square feet/acre gives a SDI value of 95. For low elevation stands, the minimum acceptable target SDI is 95 with only trees >10" dbh considered acceptable in meeting riparian functional requirements. With alternate planning, the options for meeting the SDI requirements can be expanded by considering the dual metrics of stand density (TPA) and quadratic mean diameter (DBHq). Table 1 outlines the relationship between these metrics in meeting the SDI goal of 95. It should be noted that in all cases the basal area for a SDI of 95 is below the threshold for MPB infestation for either ponderosa or lodgepole pine. If we use the SDI of 95 as an acceptable measure of riparian functionality and treat the riparian zone in case study 7, a site in Okanogan County that continues to experience mortality from mountain pine beetle, the metrics are given in Table 2. If riparian function is given by a SDI of 95, then these riparian stands largely meet or exceed that goal. The stands also maintain a basal area below that of the susceptibility level for MPB. Table 3 compares the economic outcomes relative to the baseline under FFR and the AP developed to address riparian functional requirements while addressing bark beetle risk for Case 7.

Table 1: Options for meeting a Stand Density Index goal of 95.

	SDI	TPA	DBHq	BA
	95	95	10	52
	95	82	11	54
	95	71	12	56
	95	62	13	58
	95	55	14	59
FFR	**95**	**50**	**14.9**	**60**
	95	50	15	61
	95	45	16	63
	95	41	17	64
	95	37	18	66
	95	34	19	67
	95	31	20	68
	95	29	21	70
	95	27	22	71
	95	25	23	72
	95	23	24	74

Table 2: Range of riparian stand metrics over a 90 year simulation period for Case 7

metric	DBHq >6" dbh	TPA >6" dbh	TBA	SDI
average	11.9	75	58.2	116
max	14.0	117	66.5	141
min	9.8	49	51.0	97

Table 3: Percentage change of NPV (as compared to the baseline) over 90 years between FFR and an AP for Case 7 that addresses MPB risk.

Scenario	% change
No Riparian Harvest	-9%
Inner Zone Single Entry	-10%
Alternate Plan	10%

Mortality and stand basal area growth rate declines were apparent in the simulation results for Case 7 once the stands exceed 80-90 square feet of basal area/acre. This decline is consistent with the literature which indicates that growth rates, as determined by basal area increment, decline at these stocking levels (Fiedler et al.1988, Larsson et al. 1983). Alternate plan strategies for Case 7 used the simulated growth rate decline as an indicator for riparian stand entry which meant that stand entry occurred prior to meeting the required upper basal area limit. At entry, a SDI of approximately 95 with approximately 50-60 square feet of basal area and 50 trees > 10" dbh were retained. Limits on leaving the 21 largest trees were ignored to effect basal area reduction without excessive loss of tree cover necessary to meet shade requirements. A comparison of the outcomes for FFR and the AP are given in Figure 2. Figure 2 indicates that the average stand condition over 90 years under the FFR scenario is on the isoline where mortality from MPB can be expected. Under a no management scenario, as would occur in the core zone, stands fall below the MPB risk zone in only 1 of 9 decades. In contrast, the AP scenario maintains an average basal area below the MPB risk level in all decades. For case study 7, the alternate plan is much more likely to address a currently existing MPB infestation than the FFR. The alternate planning approach used in this example could be applied for many situations where stocking control is desirable to avoid the unintended consequences of MPB infestation within riparian zones. Given the range of options in the look-up table (Table 1) for low elevation sites, optimal solutions regarding the number and size of leave trees can be varied to address specific LWD or shade requirements on a specific stream reach.

Conclusions

The stated intent of the rules in eastern Washington is to provide for restoration of riparian function while allowing activities that can ameliorate risks associated with disturbance agents within riparian zones. The development of AP that address susceptibility factors associated with MPB infestation while meeting riparian habitat requirements provide a potential solution. Adoption of a multi-metric approach that considers the equivalency of SDI across acceptable tree diameter classes can provide a mechanism to achieve risk reduction for multiple resource values, while improving economic consequences. Sensitivity analysis indicated that the growth models used in this analysis responded to site and habitat type parameters; this information can be used to tailor AP by habitat type to better reflect biological limits and stressors. In the long term, an eastside dynamic range model (EDR) might be a more comprehensive approach than risk avoidance approaches.

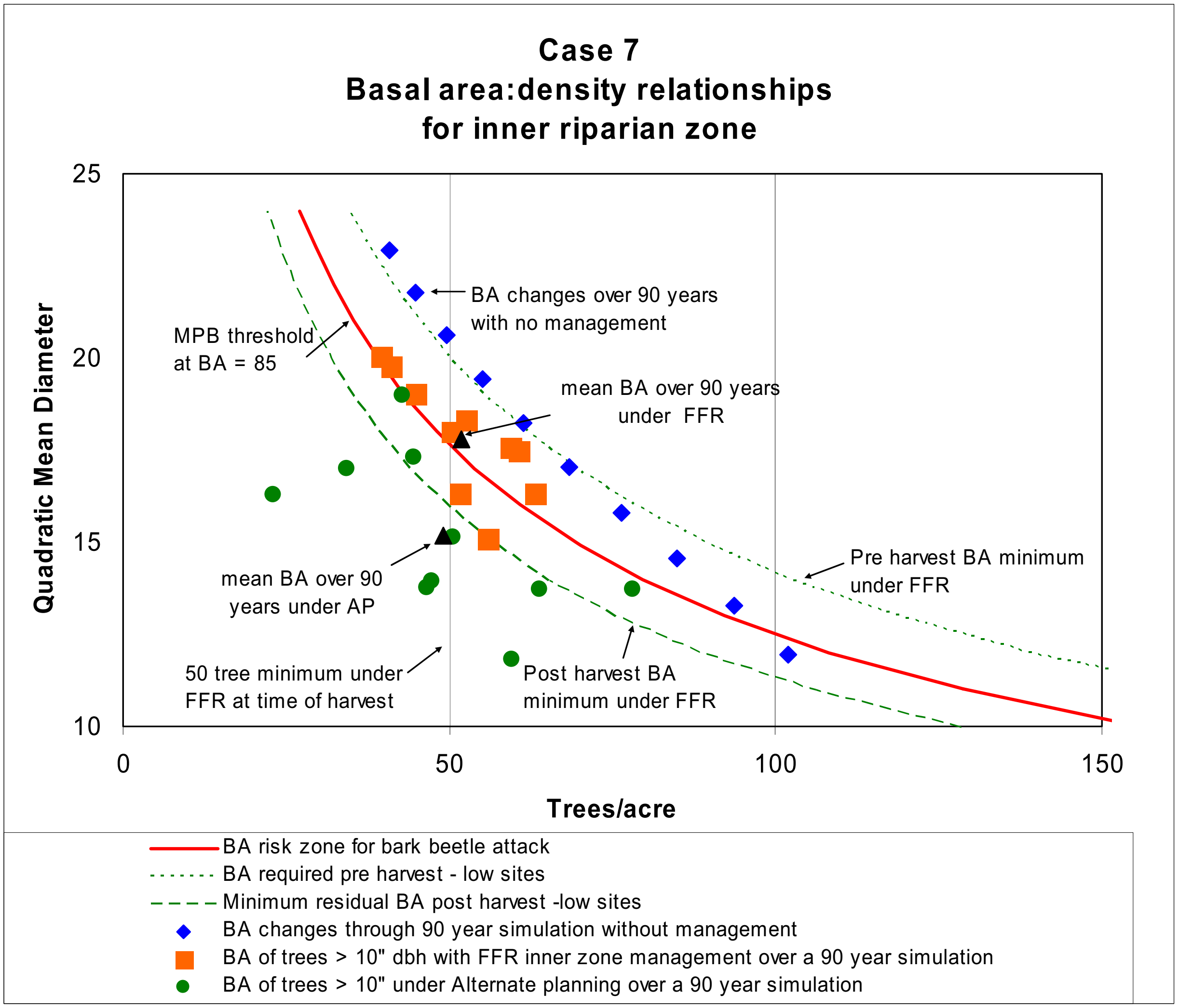

Figure 2: Basal area relationships under AP and FFR scenarios for Case 7 riparian zones.

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Everett, R.H., J. Townsley, and D. Baumgartner, 2000, *Chapter 11: Inherent Disturbance Regimes: A Reference for Evaluating the Longterm Maintenance of Ecosystems* in Journal of Sustainable Forestry, 11(1/2):265-288.

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Schmid, J.M. and S.A. Mata, 1992, Stand Density and Mountain Pine Beetle caused Tree Mortality in Ponderosa Pine Stands, USDA Forest Service, Rocky Mountain Forest and Range Experimental Station, Research Note #515.. (RN-RM-515, Mar 1992).

WAC 222-12-040, 2001, Washington Administrative Code § 222-12-040 Alternate Plans - Policy.

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