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CHARACTERIZATION OF RIPARIAN MANAGEMENT ZONES AND UPLAND MANAGEMENT AREAS WITH RESPECT TO WILDLIFE HABITAT

1988-90 CUMULATIVE REPORT

By

Washington Department of Wildlife
Habitat Management Division

October 1991

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CHARACTERIZATION OF

RIPARIAN MANAGEMENT ZONES

&

UPLAND MANAGEMENT AREAS

WITH RESPECT TO WILDLIFE HABITAT

Submitted to:
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Division of Forest Regulations and Assistance
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Submitted by:
TFW Wildlife Steering Committee
under the direction of the
Cooperative Monitoring, Evaluation, and Research Committee

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This report summarizes the 1988, 1989, and 1990 field seasons of the Cooperative, Monitoring, Evaluation, and Research Committee monitoring project titled: "Characterization of Riparian Management Zones and Upland Management Areas with Respect to Wildlife Habitat." The Wildlife Steering Committee determined that the project has accumulated enough data to accomplish project objectives. This summary is the final cumulative report on the data collected.

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ABSTRACT

This report summarizes the 1988, 1989, and 1990 field seasons of the Cooperative, Monitoring, Evaluation, and Research Committee monitoring project titled: "Characterization of Riparian Management Zones and Upland Management Areas with Respect to Wildlife Habitat." The objective of the project was to quantify the physical and botanical characteristics of Riparian Management Zones (RMZs) and Upland Management Areas (UMAs) with respect to wildlife habitat. Although originally planned for six years, monitoring was discontinued after three years by the Wildlife Steering Committee because the Committee felt enough data had been collected to accomplish project goals and objectives. During the three field seasons 226 sites were sampled, 184 RMZs (71 miles and 516 acres) and 42 UMAs (175 acres). A total of 155 RMZs and 37 UMAs were sampled on the westside of the state. On the eastside of the state 29 RMZs and 5 UMAs were sampled. The study was confined to RMZs along water type 1, 2, and 3 streams. UMAs, which are left voluntarily by the landowner, were categorized as bogs, forested wetlands, and upland forests. The 1988 field season lasted three months (August through October). 'the 1989 and 1990 field seasons lasted six months apiece from May through October.

INTRODUCTION

The Timber/Fish/Wildlife (TFW) Agreement (1987) requires the development of a monitoring, evaluation, and research program with cooperative decisions on priorities and associated costs. Results from research and monitoring are now used to make incremental changes in the forest practices regulations. This process is known as adaptive management and is a policy of the Forest Practices Board.

This project, Characterization of the Physical and Botanical Characteristics of Riparian Management Zones (RMZs) and Upland Management Areas (UMAs) with Respect to Wildlife Habitat, was designed to provide detailed information on RMZs and UMAs. The project provides a "snapshot" view of RMZs and UMAs as they occur throughout the state of Washington.

Technical support was provided by the Wildlife Steering Committee. Although originally not the intent of the project, data were (at the request of the Wildlife Steering Committee) interpreted where possible to determine the value of habitat provided for wildlife in RMZs and UMAs, and compared to the Washington Forest Practices Rules and Regulations where possible. Although originally planned for six years, monitoring was discontinued after three years by the Wildlife Steering Committee because the Committee felt enough data had been collected to accomplish project goals and objectives.

RMZs are defined in the Washington State Forest Practices Regulations, WAC 222 (1988) as a specified area along Type 1, 2, or 3 waters where specific measures are taken to protect water quality and fish and wildlife habitat. Riparian zones are among the most heavily used wildlife habitats in the forests of Washington (Thomas et al., 1979). They occur along rivers, streams, intermittent drainages, ponds, lakes, reservoirs, springs, and wetlands.

UMAs are areas of naturally occurring trees and vegetation where specific silvicultural activities have been designed to provide wildlife habitat (Forest Practices Board Manual, 1988). UMAs are voluntary under the TFW agreement. They are intended to increase habitat diversity by providing vegetative conditions that would not normally occur in harvested areas. The TFW intent was for UMAs to provide increased diversity through irregular scattering or dispersion of habitats for a broad spectrum of wildlife species. This project provides an information base for more detailed studies on the value and use of RMZs and UMAs for wildlife.

METHODS

Study Area

This study was limited to commercial state and private forests of Washington. Most western Washington forests are located in the Sitka spruce (Picea sitchensis) and western hemlock Tsuga heterophylla) zones (Franklin and Dyrness, 1973). East of the Cascade crest, the forests are located in the Douglas-fir (Pseudotsuga menziesii), Pacific silver fir (Abies amabilis), and subalpine fir (Abies lasiocarpa) zones.

Site Selection

Because sites were sampled following harvest, complete random sampling was not possible. Sample sites were limited to harvested areas that were under state or private ownership. An attempt was made to distribute the sampling effort equally throughout the state of Washington. In order to sample sites throughout the state, the Wildlife Steering Committee decided to give preference to those sites that would require one or two days to sample.

Data Collection

RMZs and UMAs were sampled systematically with line transects. Transects were 250 feet apart and data were collected from 5x10 foot subplots located along these transects. Trees and snags were sampled in macro plots established 25 feet off both sides of the transect. In RMZs, transects were established perpendicular to the stream course, from the ordinary high water mark to the harvest unit boundary. Transects in UMAs bisected the sites to allow the majority of each UMA to be sampled. The WDW Field Procedures Handbook, Second Edition (1990), provides a detailed description of project methods. To provide a genera[understanding of field techniques, the variables and their measurements are briefly described below.

RMZs

RMZ and Vegetative Riparian Zone Width: Riparian Management Zone strip width was recorded as the,, length of a transect from the ordinary highwater mark: to the edge of the harvest unit. Average Riparian]Management Zone site width was calculated by averaging the transects within the site. Average Riparian Management Zone width was calculated for the westside and the eastside of the state. All references to riparian zone widths refer to a single side of the stream. The width of the vegetative riparian zone was also recorded (Figure 1). The vegetative riparian zone width was defined as the distance between the ordinary high water mark and the point where the vegetation changes from a wetland to an upland plant community.

Midstream Canopy Closure: Midstream canopy closure was measured with a densiometer from the center of the stream between the ordinary high water marks. Canopy was measured to determine the amount of shade provided to the stream by the RMZ.

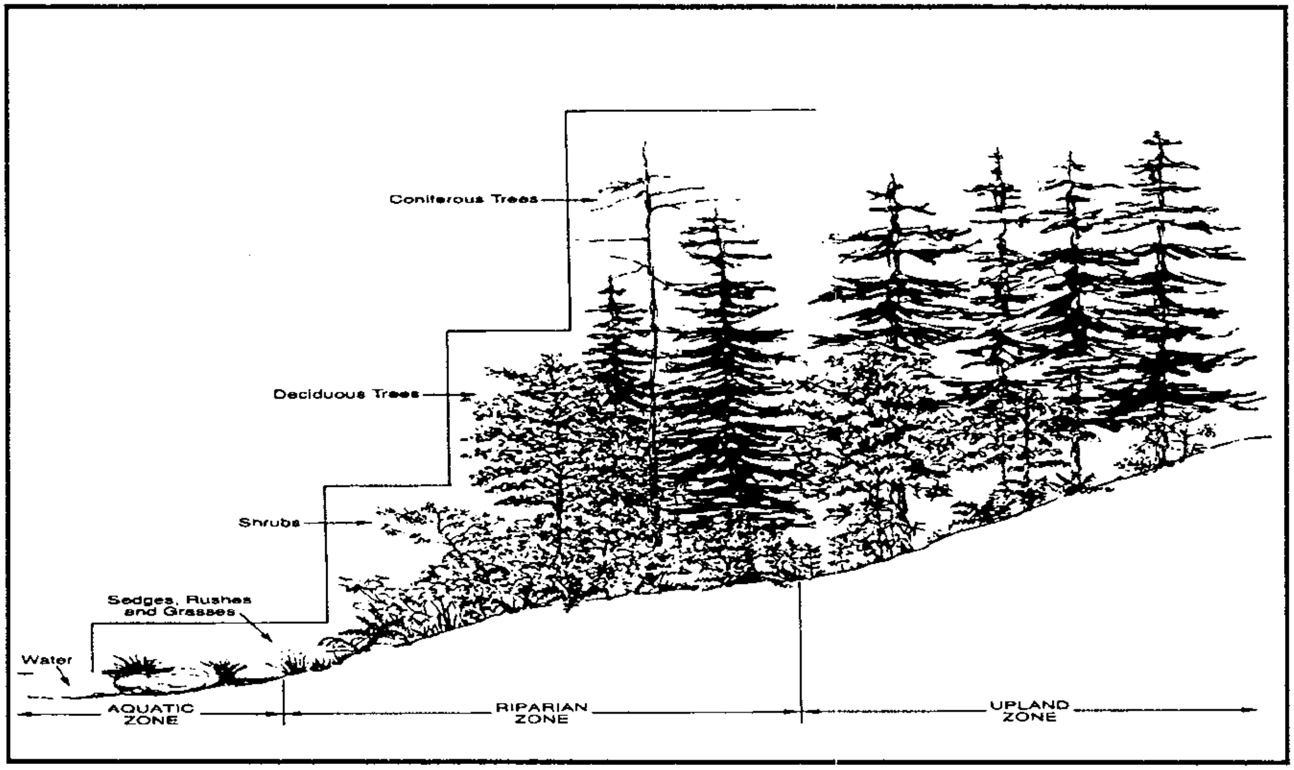

Figure 1. Vegetative Riparian Zone *(Riparian Zone).*

Large Organic Debris: Logs were recorded as large organic debris (LOD) when they were at least ten feet in length, within the ordinary-high-water-mark, and the diameter was at least four inches at the small end. LOD measurements include: length of LOD within ordinary highwater marks, length outside ordinary high water marks, diameter, and whether the LOD was conifer, hardwood, or of unknown origin.

Shrubs and Herbs: The dominant and co-dominant shrub and herb species were recorded within subplots. Plants were identified to species when possible and by the percentage of ground they covered within the subplot, in addition, the total ground coverage of all shrubs, forbs, and grasses were recorded separately.

Subplot Overstory Canopy and Ground Cover: Overstory canopy closure above the subplot was measured with a densiometer. Ground cover was recorded for: shrubs, forbs, grasses, downed wood, water, rock, soil, and organic matter. Forbs were defined as herbaceous plants, excluding grasses and shrubs. Downed wood was measured in three classes: DW1 = recent downed, bark intact, branches intact; DW2 = older down, bark loose, twigs and branches mostly gone, decay beginning on outer few inches of log; DW3 = old down, trace amounts of bark, branches absent, decay mostly to completely through the log. Organic matter consists of litter, duff, mosses, lichens, and fungi.

Trees and Snags: Within the macro-plot, trees and snags were recorded by species, diameter, condition of health for trees, and decay condition for snags. Diameters were recorded in size classes of four-inch increments, i.e., 0-3.9, 4-7.9, etc., up to 24 inches or greater. Hardwood species were recorded as maple, cherry, cottonwood, oak, dogwood, madrone, aspen, larch, and willow, or "other hardwoods" (hardwoods not mentioned above). Live trees include healthy, undamaged trees, live trees with dead tops, and live trees with broken tops. Snags were classified as recently dead trees (i.e., still possessing dead needles or leaves), snags with fight bark, and snags with loose bark. Note: Snags were defined to include those dead trees less than four inches in diameter at breast height. Figures 7 and 8 should be used to determine the average number of snags per acre, by diameter, in RMZs and UMAs.

Blowdown: To determine the percentage of blowdown, data were collected on the total count, tree species, tree type (conifer or hardwood), and the DBH of trees that appeared to have blown over since harvest. Blown-down trees were also recorded as downed wood (class 1). The original study plan did not require the measurement of blowdown. Measurement of blowdown began after the 1989 field season, therefore was recorded only for one year.

UMAs

UMAs were classified as: upland forests, forested wetlands, or bogs. All variables described above for RMZs were measured similarly in UMAs, except LOD. Some UMAs were isolated from other forested areas by the harvest unit and others were attached to RMZs (I.e., the UMA was the area beyond the required 25 foot RMZ). When sampling an RMZ with an attatched UMA, the area within 25 feet of the stream’s ordinary highwater mark was sampled as an RMZ, and the area beyond 25 feet was sampled as a UMA.

Resampled RMZs and UMAs

Project design required that 20% of all sites sampled each year be resampled after two years. Of 39 sites sampled in 1988, eight were resampled in 1990. Because no eastside UMAs were sampled in 1988, only westside UMAs were resampled. Resample sites were randomly selected.

Data Analysis

Data are stored in PARADOX (Borland, Version 3.5) and are available in ASCII format. Data in report form are also stored in a PARADOX RUN-TIME package allowing the user to view and print the data in PARADOX without owning PARADOX. Data structure, information, and installation instructions are contained in WDW’s Data Documentation (1991).

Data summaries were created with Quattro Pro (Borland, Version 2.0). The following basic summary statistics were calculated for habitat parameters: means, standard deviations, variance, and constancy. All data tables and summaries are conmined in the 1988-90 Data Appendix. (WDW, 1991).

Sample site locations are recorded on 7.5-minute USGS quadrant maps or on 15-minute maps if 7.5-minute maps were not available. Maps and files are stored at the Department of Wildlife, Habitat Management Division, 600 Capitol Way N., Olympia, Washington, 98501-1091, (206) 753-3318. Copies of this report and project data may be requested from the Department of Natural Resources, Forest Regulations and Assistance Division (206) 753-5315. All discussions within this report pertain to data collected from sites sampled during the 1988, 1989, and 1990 field seasons.

RESULTS

RMZ/UMA Site Summary

Total Sites and Distribution: A total of 226 sites were sampled between 1988 and 1990 (Figure 2). Of these, 184 were RMZs and 42 were UMAs. Appendix A lists the total number of sites, strips within sites, and the number of subplots within sites. Eight sites sampled in 1988 were resampled in 1990 as follows: four westside RMZs, two westside UMAs, and two eastside RMZs. See WAC 222-30-020(4) for the distinction between the westside and eastside sites. Site specific in:formation is summarized in Appendix B. A tabular listing of the westside and eastside RMZ/UMA site variables discussed on page seven can be found in Appendix C.

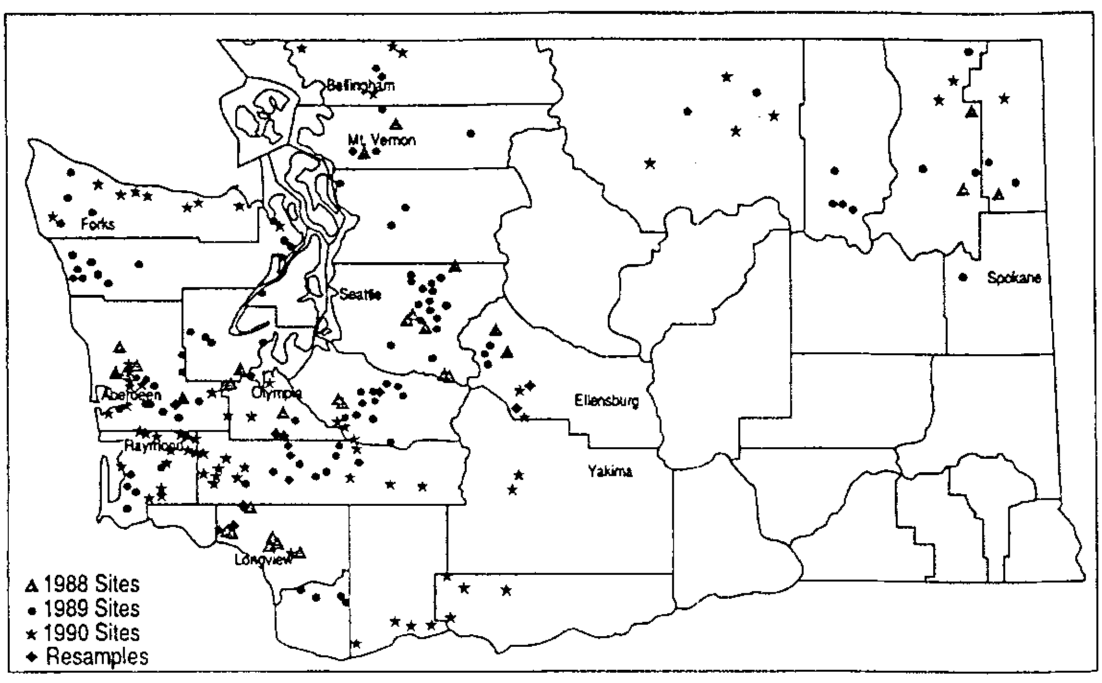

Figure 2. Map of RMZ and UMA sample sites.

Total Length and Area Sampled: Seventy-one miles and 516 acres of RMZs were sampled between 1988 and 1990, 58 miles covering 446 acres on the westside, and 13 miles covering 70 acres on the eastside, RMZ size in acres ranged from .2 to 13.4 with an average of 2.8 acres. UMAs sampled between 1988 and 1990 totaled 175 acres, 136 acres on the westside and 39 acres on the eastside. UMAs ranged from .01 to 13.5 acres with an average of 4.2 acres. The .01 acre UMA (2 subplots) was attached to an RMZ. Again, it must be recognized that in order to sample sites throughout the state, the Wildlife Steering Committee requested we visit only those sites that could be sampled in one or two days.

RMZ to Harvest Unit Ratio for Sampled Sites: Harvest unit size associated with westside RMZs averaged 109 acres, and totaled 16,862 acres. Harvest unit size associated with eastside RMZs averaged 210 acres, and totaled 5,875 acres. The ratio of acres harvested to acres of RMZs was 38:1 and 84:1 for westside and eastside sites, respectively.

UMA to Harvest Unit Ratio for Sampled Sites: Harvest unit size associated with westside UMAs averaged 114 acres, for a total of 4,119 acres. Harvest unit size associated with eastside UMAs averaged 289 acres, for a total of 1,445 acres. The ratio of acres harvested to acres of UMAs was 30:1 and 37:1 for westside and eastside sites, respectively.

Site Elevation: Westside RMZs averaged 700 feet above sea-level and ranged from sea-level to 3,600 feet. Eastside RMZ elevation averaged 2,800 feet above sea-level, and ranged from 500 to 4,800 feet. Westside UMAs averaged 900 feet, and ranged from sea-level to 3,300 feet. Eastside UMAs averaged 3,000 feet above sea-level and ranged from 1200 to 5,300 feet.

Slope: Average slope of sampled RMZs along water type 1, 2, and 3 streams was 30 %, 21%, and 25 %, respectively. Average slope of sampled UMAs in bogs, forested wetlands, and upland forests was 5 %, 3 %, and 35%, respectively.

RMZs

One hundred fifty-five RMZs were sampled on the westside of the state. They were located on streams, lakes, Puget Sound, and Willapa Bay. Fifty-two sites were along type 1 waters (154 total acres), 19 sites were along type 2 waters (55 total acres), and 84 sites were along type 3 waters (237 total acres).

Twenty-nine RMZs were sampled on the eastside of the state. They were located along streams and lakes. Four sites were along type I waters (8 total acres), 6 sites were along type 2 waters (12 total acres), and 19 sites were along type 3 waters (50 total acres). A tabular comparison of RMZ variables for the westside and eastside can be found in Appendix D. A complete description of water types and their definitions can be found in the Washington Forest Practices Rules and Regulations.

RMZ Width: Average RMZ widths are displayed in Figure 3. RMZ widths along type 1, 2, and 3 streams on the westside averaged 68, 59, and 53 feet per side, respectively. Average RMZ site width on the westside ranged from 20 to 176 feet, per side. Westside individual transect length ranged from 0 to 330 feet.

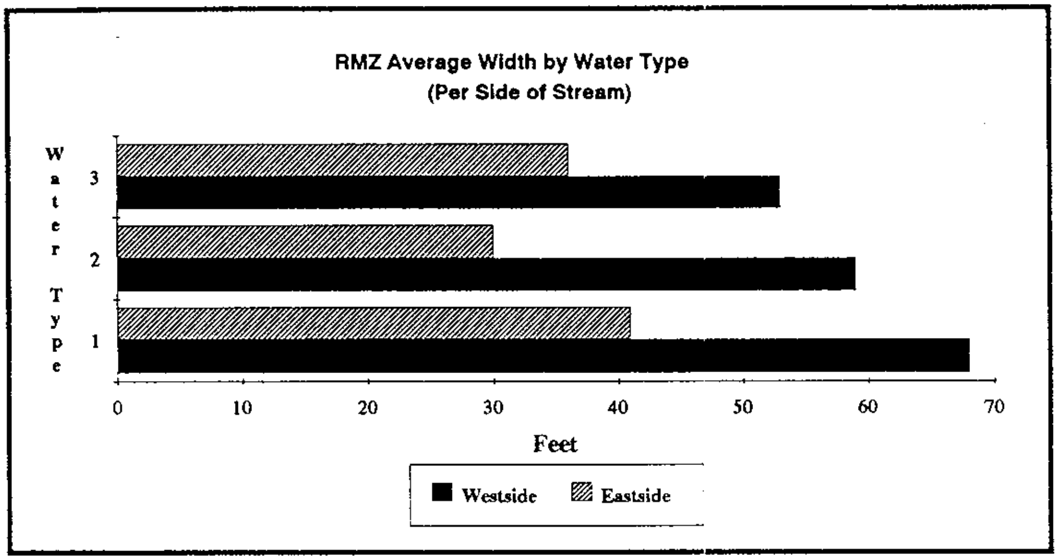

Figure 3. RMZ Average Widths in sampled RMZs by Water Type

Defining RMZ boundaries adjacent to partial cut harvest units on the eastside proved difficult when there was no clear distinction between the partial cut harvest unit and the partially cut RMZ. When harvest boundaries were not easily identified, we concluded the sampling effort at 30 feet.

RMZ widths for eastside water type 1, 2, and 3 streams adjacent to all harvest types averaged 41, 30, and 36 feet, respectively. Average RMZ site width on the eastside ranged from 16 to 86 feet. Eastside individual transect length ranged from 0 to 190 feet.

RMZ And Vegetative Riparian Zone Width Comparison: Figures 4 and 5 display the width of the Riparian Management Zone to the vegetative riparian zone. The vegetative riparian zone width in westside RMZs averaged 32, 26, and 27 feet, respectively for type 1, 2, and 3 waters. Eastside riparian zone width averaged 13, 6, and 13 feet respectively for type 1, 2, and 3 waters.

Midstream Canopy Closure: Canopy closure over the stream center averaged 76% and 65 % on the westside and eastside of the state, respectively. Average midstream canopy cover for westside streams was 69%, 71%, and 79% for water types 1, 2, and 3, respectively. Eastside average midstream canopy cover was 41%, 49%, and 72% for water types 1, 2, and 3, respectively.

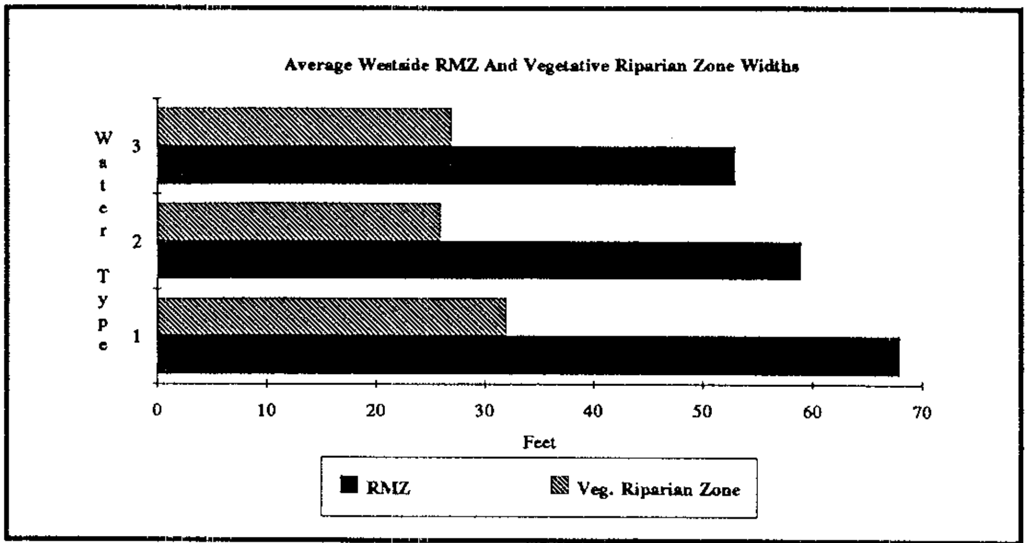

Figure 4. Average westside RMZ and RZ width

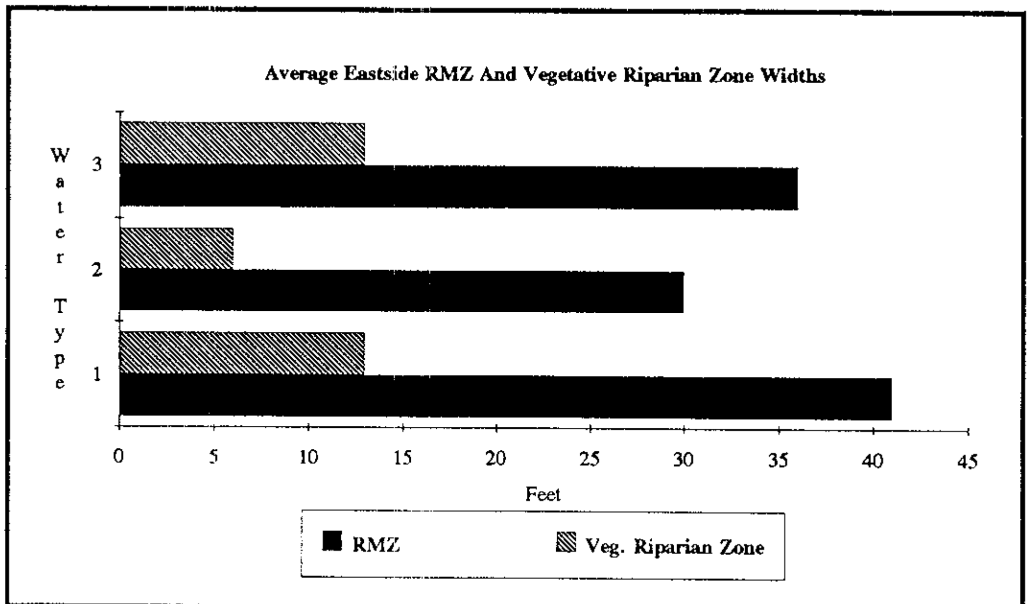

Figure 5. Average eastside RMZ and RZ widths

Large Organic Debris: Conifers comprised 60% of the large organic debris (LOD) in streams on both sides of the state. Hardwood LOD comprised 23%, and pieces which were not recognizable as either conifer or hardwood made up the remaining 17%. There were 4.2 pieces of LOD per 100 feet in westside streams with an average diameter of 15 inches. Type 1, 2, and 3 westside streams had 2.9, 5.6, and 4.8 pieces of LOD per 100 feet, respectively. There were 3.3 pieces of LOD per 100 feet in eastside streams with an average diameter of 10 inches. Type 1, 2, and 3 eastside streams had .9, 3.6, and 3.6 pieces of LOD per 100 feet, respectively. Average length of the LOD within the ordinary high water mark was 12 feet and 9 feet on the westside and eastside of the state, respectively.

Shrubs and Herbs: A total of 8,968 subplots were sampled in westside RMZs with 87 shrub and 133 herb species identified. Salmonberry was the most frequently encountered shrub in these RMZs with a coverage of 57%, but vine maple had the highest coverage (70 %, Appendix E). The most frequently occurring herb in westside RMZs was swordfern, covering 44%. Oregon oxalis covered the most ground in these sites (60%).

Fourteen hundred and twenty-six subplots were sampled in eastside RMZs with 77 shrub and 124 herb species identified. Snowberry was the most frequently encountered shrub in these RMZs, with a coverage of 49%. Again, vine maple, had the highest coverage (64%). The most common herbs, and also the herbs with the highest coverage, in eastside RMZs were unknown grass species. These grasses covered 52% of the area. (Note: when possible grasses were identified to species, if not possible they were recorded as unknown grass species.)

Subplot Overstory Canopy and Ground Cover: Overstory canopy closure in RMZs averaged 84% on the westside and 77% on the eastside. Total shrub, forb, and grass coverage in westside RMZs averaged 57 %, 53 %, and 12 % respectively. Eastside shrub, forb, and grass coverage was 57%, 33 %, and 22 %, respectively.

Downed wood classes 1, 2, and 3, covered 1%, 2%, and 5% of the ground respectively on both sides of the state. Total water, rock, soil, and organic ground cover in westside RMZs averaged 1%, 3%, 3%, and 88% respectively. Eastside sites had coverages of 1%, 2%, 2%, and 90% for water, rock, soil, and organic ground cover.

Trees and Snags: Data were collected on the species and diameter for trees and snags. For reporting purposes trees and snags were grouped as either conifers or hardwoods and by their diameter per acre.

Figures 6 and 7 display the average number of trees and snags per acre in sampled RMZs throughout the state of Washington. Appendix F displays the five most commonly encountered tree and snag species found in these RMZs.

More than 65 % of the trees in westside RMZs were less than eight inches DBH. Average DBH was in the size range of 8 to 12 inches. Over 72% of the trees and snags in RMZs had diameters of less than eight inches.

Westside RMZs contained an average of 276 trees per acre. Forty-five percent of the trees were conifers, 55 % hardwoods. The most commonly found tree in these RMZs was red alder (39% of the total tree count). There was an average of 33 snags per acre in westside RMZs. Average snag DBH was between 4 and 8 inches. Fifty-four percent of the snags were conifer, and 46% were hardwoods. The most common snag in westside RMZs was red alder (41% of the total snag count).

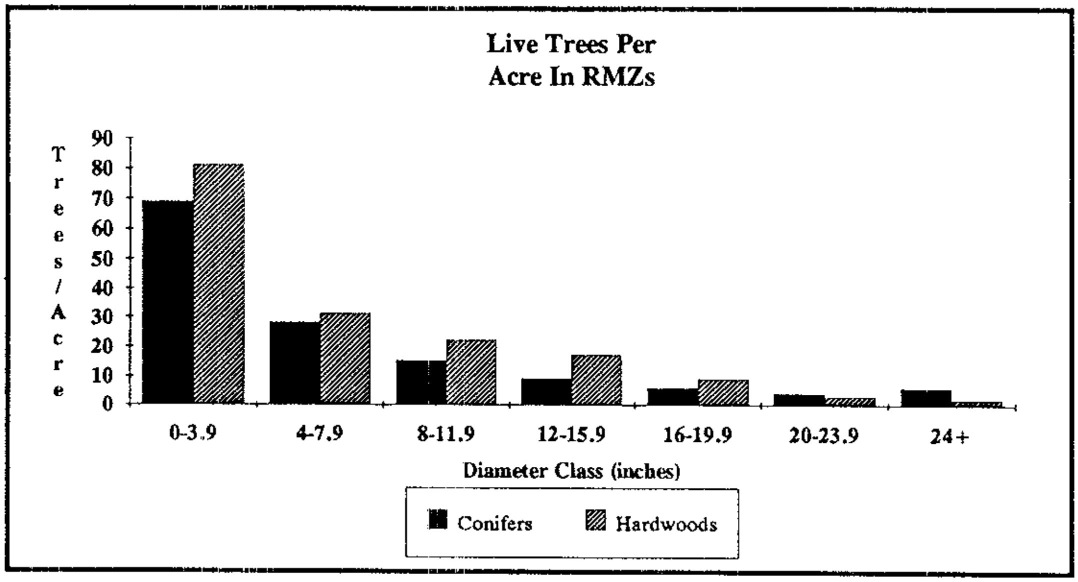

Figure 6. Average number of live trees per acre in sampled RMZs

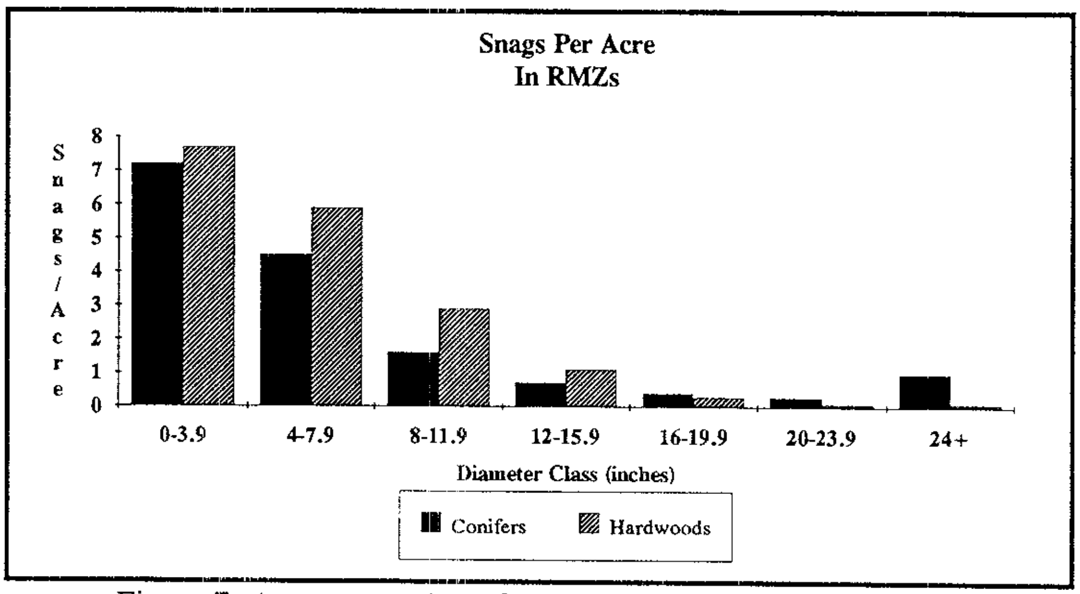

Figure 7. Average number of snags per acre in sampled RMZs

Eastside RMZs had an average of 458 trees per acre. Average eastside tree DBH in RMZs was between 4 and 8 inches. Forty-six percent of the trees were conifers and 54% were hardwoods. "Other hardwoods" were the most frequently found trees in these RMZs (29% of the total tree count). Eastside RMZs contained on average 45 snags per acre. Average snag DBH in eastside RMZs was between 4 and 8 inches. The conifer to hardwood ratio was 1:1. Eastside RMZ snags were most frequently "other hardwoods" (22% of the total snag count).

Blowdown: RMZ blowdown, on both the westside and eastside of the state, accounted for 2% of the total tree count in sampled sites. Trees 4 to 12 inches DBH comprised 47% of the blowdown. Of these, 56% were conifer and 44% hardwood. Blowdown in all size classes averaged 58% conifers and 42% hardwoods. Average blowdown DBH in westside and eastside sites were in the size range of 8 to 12 inches. Seventy-two percent of the blowdown occurred along type 3 waters.

Blowdown occurred within 28 of the sampled westside RMZs; 43% of the total blowdown was within 2 sites. The most commonly blown down tree species in westside RMZs was western hemlock. Western hemlock accounted for 43% of the total blowdown in westside sites. Blowdown occurred within 11 of the sampled eastside RMZs. Again, 43 % of the blowdown was within 2 sites. The most common tree species to blow over were "other hardwoods". These "other hardwoods" accounted for 38% of the blowdown in eastside sites.

UMAs

Forty-two UMAs were sampled, 37 on the westside, five on the eastside. Of the westside sites two were classified as bogs (12.5 total acres), nine sites were forested wetlands (34.6 total acres), and 26 sites were upland forests (88.9 total acres). On the eastside one site was classified as a forested wetland (8.6 total acres) and four sites were upland forests (30.6 total acres). A tabular comparison of UMA variables for the westside and eastside can be found in Appendix G.

Shrubs and Herbs: A total of 3,051 subplots were sampled in westside UMAs. Seventy-two shrubs and 95 herbs were identified in these UMAs. In westside UMAs the most frequently encountered shrub, and also the shrub with the most ground cover, was vine maple with a cover of 72% (Appendix E). Swordfern was the most common herb in westside UMAs with a cover of 45 %. Unknown Carex species accounted for the greatest herb cover in westside UMAs (67%). The high cover and frequency of Carex species, and grass species in westside UMAs, was due primarily to the sampling of two bog UMAs along the Pacific Coast.

A total of 825 subplots were sampled in eastside UMAs. Forty-six shrub and 72 herb species were identified in these UMAs. Lack of a shrub species was the most frequently encountered situation in eastside UMAs. When a shrub was present it was most frequently shiny leaf spirea, with a cover of 10%. Mallow ninebark covered the most ground in eastside UMAs (71%). Pine grass was the most common herb in eastside UMAs, with a cover of 50%. Herbs with the highest cover were unknown grasses (55 %).

Subplot Overstory Canopy and Ground Cover: UMA overstory canopy closure averaged 87% on the westside and 82% on the eastside. Total shrub, forb, and grass ground coverage in westside UMAs averaged 55%, 39%, and I2%, respectively. Eastside sites had shrub, forb, and grass coverages of 29%, 24%, and 24%.

Westside UMAs had downed wood coverages of 1%, 2%, and 5% for decay class 1, 2, and 3, respectively. Downed wood in decay classes I, 2, and 3, averaged 1%, 1%, and 4%, respectively in eastside UMAs. Water, rock, soil, and organic ground coverages were 1%, 3 %, 2 %, and 91% in westside UMAs. Eastside UMA water, rock, soil, and organic ground coverages were 1%, 5 %, 3 %, and 88 percent.

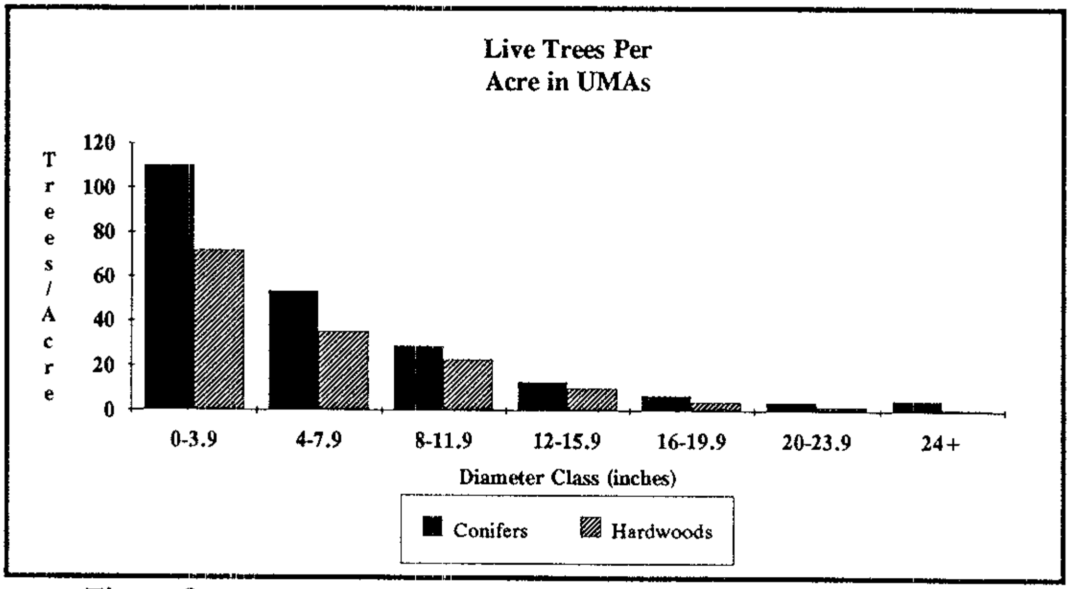

Figure 8. Average number of live trees per acre in sampled UMAs

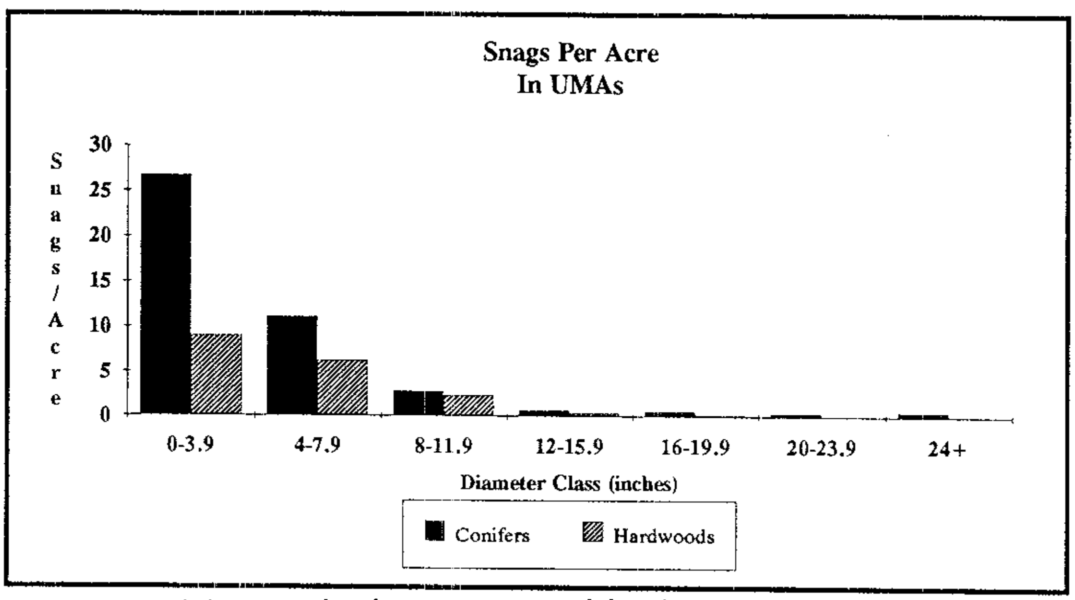

Figure 9. Average number of snags per acre in sampled UMAs

Trees and Snags: Figures 8 and 9 display the average number of trees and snags per acre in UMAs sampled throughout the state of Washington. Appendix F displays the five most frequently encountered tree and snag species found in these UMAs.

Over 70% of the trees in westside and eastside UMAs were less than eight inches DBH. Average DBH of trees in westside and eastside UMAs were in the size ranges of 8 to 12 inches and 4 to 8 inches, respectively. Eighty-seven percent of the snags in westside and eastside sites combined were less than eight inches in diameter. Average DBH of snags in westside and eastside UMAs were in the size ranges of 4 to 8 inches and 1 to 4 inches, respectively.

Westside UMAs, on the average, contained 346 trees per acre. Conifer to hardwood tree ratio was 1:1. Red alder was the most common tree species found in these UMAs (27% of the total tree count). Forty-four snags per acre were found in westside UMAs. Snag conifer to hardwood ratio was 1:1. Red alder was the most common snag in these UMAs (25 % of the total snag count).

Eastside UMAs contained an average of 441 trees per acre. Eastside UMAs were dominated by conifer trees 9:1. The tree species most frequently found in these UMAs was Douglas-fir (38% of the total tree count). Snag density in Eastside UMAs averaged 137 per acre. Snag ratio (conifers to hardwoods) was 9:1 in eastside UMAs. Douglas-fir was the most common snag in these UMAs (45% of the total snag count).

Blowdown: Blowdown was 1% of the total tree count in sampled UMAs. Of the UMA blowdown 61% occurred in upland forests, 39% in forested wetlands, with no blowdown recorded in westside bogs or eastside forested wetlands.

Seventy-nine percent of statewide blowdown in sampled UMAs was conifer and 21% hardwood. Average DBH of blowdown was between 8 to 12 inches on the westside and between 4 to 8 inches on the eastside. The majority of blowdown (43 %) was found in trees four to twelve inches DBH.

Blowdown was found within six of the westside UMAs sampled; 67% of the blowdown was within two sites. The most commonly blown over tree species in westside UMAs was Douglas-fir, accounting for 72% of the blowdown. Blowdown was 1% of the total tree count in sampled upland forest UMAs on the westside. Westside forested wetlands had 4% blowdown; 74% was in one site.

Blowdown was found within two of the eastside upland :Forest UMAs sampled; 92 % was in one site. Eastside blowdown in upland forests was 2% of the total tree count. Blowdown was recorded most frequently for Douglas-fir. Douglas-fir accounted for 86% of the recorded blowdown in sampled eastside UMAs.

Resampled RMZs and UMAs

A summary of the resampled sites can be found in Appendix H. The eight resampled sites total 27 acres. Westside RMZs and UMAs totaled 13 and 8 acres, respectively. All westside RMZs were along water type 3 streams and both UMAs were upland forests. The two eastside RMZs totaled 6 acres, 4 acres along a water type 2 stream, and 2 acres along a water type 3 stream. Permanent plots were not established at any of the sites. Wooden laths marking strip origins, and flagging marking strip and subplot boundaries established by the 1988 field crew was visible in most resampled sites. Because permanent plots were not established, a small portion of the change in variable data between 1988 and 1990 may be attributed to human error.

Midstream Canopy Closure: Average midstream overstory canopy coverage on westside streams measured 77% in 1988 and 91% in 1990. Eastside midstream canopy cover remained relatively constant at 42% and 43% for 1988 and I990 respectively.

Large Organic Debris; LOD density averaged 5.1 and 3.6 pieces per 100 feet for westside sites in 1988 and 1990, respectively. Average westside diameter was 14 and 13 inches in 1988 and 1990, respectively. LOD density averaged 3.5 and 3.6 pieces per 100 feet for eastside sites in 1988 and 1990, respectively. Average diameter in eastside streams was 14 inches in 1988 and 12 inches in 1990.

RMZ Shrub, Forb and Grass Coverage: Total shrub cover in westside RMZs measured 55% in 1988 and 68% in 1990. Total forb cover was 54% in 1988 and 70% in 1990. Total grass coverage was 9% in 1988 and 8% in 1990. Eastside shrub cover measured 35% in 1988 and 56% in 1990. Forb and grass cover averaged 21% and 18%, respectively in 1988 and 40% and 20%, respectively in 1990 on the eastside.

RMZ Subplot Overstory Canopy: Westside RMZ average overstory canopy closure was 79% and 88% in 1988 and 1990, respectively. Eastside RMZ average overstory canopy closure was 60% and 64% in 1988 and 1990, respectively.

RMZ Live Trees: Live tree count in westside RMZs increased by 40% per acre. The increase in live trees per acre was primarily due to an increase in hardwoods less than four inches in diameter at breast height (DBH). These trees increased by more than one and a half times in westside RMZs. Live tree count of trees larger than four inches DBH, was reduced by 8% between 1988 and 1990. Following the 1988 field season, a change was made in how eastside live trees 1 to 8 inches DBH were sampled. Thus, tree count within this diameter range is not compared. Total trees per acre, larger than eight inches DBH, decreased by 12% in eastside RMZs.

RMZ Snags: In westside RMZs total snag count per acre increased by 48% between 1988 and 1990. Snags less than four inches DBH increased by more than two and a half times. Westside RMZ snag count of snags larger than four inches in diameter decreased by 11%. In eastside RMZs total snag count per acre increased by 122%. Again, the largest increase in snags were those less than four inches in diameter. These snags increased by 'almost six times, while snags larger than four inches increased by 22%.

RMZ BIowdown: Blowdown occurred in five of the six resampled RMZs. Westside blowdown was 9 % of the total tree count. The species most frequently blown over was western hemlock which accounted for 66% of the blowdown. Trees less than 12 inches DBH comprised 74% of the blowdown.

Eastside blowdown was 2% of the total tree count. The species most frequently blown over were "other hardwoods", accounting for 42 % of the blowdown. Trees less than 8 inches DBH comprised 42% of the blowdown in resampled RMZs.

LIMA Shrub, Forb and Grass Coverage: Total shrub cover in westside UMAs was 78% in 1988 and 84% in 1990. Total forb cover was 38% in 1989 and 49% in 1990. Total grass cover was 1% in 1988 and 2% in 1990.

UMA Subplot Overstory Canopy and Ground Cover: Average overstory canopy closure remained nearly constant between 1988 and 1990 at 95% and 96%, respectively in westside UMAs.

LIMA Live Trees: Live tree count in westside UMAs increased by 8% per acre. Live conifers less than four inches DBH increased by 57%. Trees larger than four inches DBH in westside UMAs decreased by 5 %.

UMA Snags: Snags per acre in westside UMAs increased 93%. Snags less than four inches in diameter increased by 235 %. Snags over four inches in diameter increased by 12%.

UMA Blowdown: Westside blowdown occurred in both resampled UMAs. Blowdown accounted for 2% of the tree count. Douglas-fir was the most frequently recorded species to blow down in these UMAs, Douglas-fir accounted for 53% of the blowdown. Trees less than 12 inches DBH comprised 87% of the blowdown in resampled westside UMAs.

DISCUSSION

Wildlife Habitat Value in RMZs and UMAs

Riparian zones are defined by Franklin and Dryness (1973) as areas identified by the presence of vegetation which requires free or unbound water, or conditions more moist than others found in the same area. Wildlife use of riparian zones is disproportionately greater than use of other habitats (Odum, 1979). Of 414 known wildlife species in western Oregon and Washington, 359 (87%) use riparian zones or wetlands during some season or part of their life cycle (Brown, 1985). Brown also states that riparian zones provide more niches than any other type of habitat. Riparian zones provide fish and wildlife with: water, cover, food, plant community diversity, increased humidity, high edge-to-area ratios, migration routes, and serve as a recruitment source of large organic debris to streams (Brown, i985). Many of the habitat values provided to wildlife in RMZs were measured in this study. The following discussion relates habitat variables measured during this project to potential wildlife use.

Vegetative Riparian Zone Width and LOD: Along westside streams the vegetative riparian zone was within the Riparian Management Zone 72% of the time. The vegetative riparian zone along eastside streams was within the Riparian Management Zone 87% of the time. Vegetative riparian zones on the westside were almost three times as wide as those on the eastside. Differences in the vegetative riparian zone width between sides of the state may be due primarily to the way the vegetative riparian zone receives moisture. Westside riparian zones receive water from both streams and precipitation, whereas eastside riparian zones are largely dependent on a permanent water source, such as streams or groundwater.

Large organic debris (LOD) provides and creates habitat for fish (Swanson 1978 and Grette 1985). It has been shown that individual fish species prefer specific habitats created by LOD, during different life stages (Bisson et al, 1982). Salmonids use the slack waters created by woody debris during high discharge periods as cover and resting areas 03ustard and Narver, 1975; Tschlapinski and Hartman, 1983). Jeff Cedarholm (1989) found that LOD returns nutrients to the stream by retaining salmon carcasses after spawning.

Cedarholm (1985) reported 29.4 pieces of LOD per 100 meters in small streams adjacent to harvested land on the Olympic Mountains. Studies in streams adjacent to unlogged land found the average density of LOD to be 59.9 pieces per 100 meters (Grette, 1985). Conversion of our data to pieces per 100 meters finds 15.8 pieces, about half the LOD found in logged areas (Cedarholm, 1985), and about a quarter of that found in unlogged areas (Grette, 1985).

In resampled RMZs LOD averaged] .5 fewer pieces per 100 feet on the westside. Average diameter of LOD decreased by 1 inch on the westside and 2 inches on the eastside. Consistent with Swanson's (1978) findings, LOD was found in greater amounts in the smaller water type 3 streams than in the larger water type I streams.

Shrubs, Herbs, Overstory Canopy, and Downed Wood: Shrub and herb species diversity were greater in RMZs than UMAs. Herb species were more diverse than shrub species on both sides of the state, in RMZs and UMAs. Higher westside diversity may be attributed to higher quantities of effective precipitation.

Average overstory canopy in RMZs .anti UMAs exceeded the 70 % and 75 % coverage identified as optimal thermal cover for elk and deer, respectively, by Thomas (1979). Although sufficient canopy coverage was present, the total area required (30 to 60 acres) for optimal elk thermal cover was not present in the sites sampled. Deer require a smaller area (2 to 5 acres) than elk to meet the definition of optimal thermal cover. Some UMAs sampled may provide thermal cover for deer, RMZs on the average probably do not.

Downed wood provides wildlife with cover and sites for feeding, reproducing, and resting (Maser et al, 1979). Within western Oregon and Washington 150 species are known to use dead and downed wood (Brown, 1985). Twenty-five percent of all amphibians in western Oregon and Washington use downed logs as breeding habitat

(Bunnell and Kremsater, 1990). Downed wood also provides travel corridors for small mammals such as shrews and voles. Downed wood returns nutrients such as phosphorous and nitrogen back to the soil (Zinke et al., 1979). Of the downed wood measured in our project, most was in the older decay class. Older downed wood provides habitat for many species of wildlife including: salamanders, snakes, common poorwills, shrews, marten, and voles (Brown, 1985).

Snags: Nearly 100 species of wildlife use snags in western Oregon and Washington; more than 53 of these species are cavity dependent (Brown, 1985). Snags provide essential nesting, foraging, and cover habitat. The most common tree species in both RMZs and UMAs were also the most common snag species.

Roughly three quarters of the snags provided in RMZs and UMAs were snags less than 12 inches DBH. Numerous birds can use these snags for foraging, but only a few can use them for nesting. These snags may provide nesting habitat for smaller birds such as chickadees and downy woodpeckers (Brown, 1985).

Brown (1985) compiled a table displaying snag densities required by cavity nesters in westside habitats to maintain various population densities of cavity-dependent species. Snags greater than 16 inches in diameter occur at densities of 241 and 215 per 100 acres in westside sampled RMZs and UMAs, respectively. If these densities occurred throughout home ranges, red-breasted sapsuckers, downy woodpeckers, hairy woodpeckers, and northern flickers could theoretically be supported at 100% of their maximum populations.

Westside RMZs and UMAs contained snags greater than 24 inches DBH at 109 and 89 per 100 acres, respectively. These snag densities could theoretically support the nesting requirements of pileated woodpeckers at 100% of their maximum populations (Brown, 1985) if this snag density is available throughout their home range.

Sixty-two species of mammals and birds are known to use snags for nesting or shelter in the Blue Mountains (Thomas, 1979). The most common tree species in both RMZs and UMAs on the eastside of the state was also the most common snag species. Over 80% of the snags in eastside RMZs were less than 8 inches DBH. Ninety-one percent of the snags in eastside UMAs were less than 8 inches DBH. As mentioned previously, theses snags may be utilized for foraging, but few species can use them for nesting.

Thomas (1979) compiled a table that displays snag densities required by cavity nesters in eastside habitats to maintain various population densities of cavity-dependent species. Snags greater than 12 inches in diameter occur at densities of 419 and 298 per 100 acres in eastside sampled RMZs and UMAs, respectively. If these densities were present throughout home ranges, northern flickers and hairy woodpeckers could theoreticaily be supported at 100 % of their maximum populations in eastside RMZs and UMAs. Snags larger than 20 inches in diameter occur at densities of 181 and 74 per I00 acres in eastside RMZs and UMAs, respectively. These densities could theoretically support pileated woodpeckers at 100% of their maximum populations in eastside RMZs and UMAs.

Note: This project did not compare snag habitat found in sampled sites to that found in the surrounding landscape. Therefore it is unknown if the snag density found in sampled sites is similar to that found throughout the home ranges of the species discussed above.

Blowdown: Blowdown of live trees within RMZs was minor, with the majority occurring on type 3 waters. Higher incidence of blowdown on type 3 waters may result from the fact that average RMZ width was narrowest on these streams. Trees in UMAs were less likely to blow down than trees in RMZs. The highest percent of blown-down trees in UMAs was in westside forested wetlands. Increased blowdown in forested wetlands is most likely due to an increased moisture content in the ground.

Compliance

The intent of this project was to assess the physical and botanical characteristics of RMZs and UMAs with respect to wildlife habitat. As stated earlier, this project was not designed to monitor compliance with the Forest Practices Act. Data were collected, however, such that they may be compared to the regulations in the Forest Practices Act. The Wildlife Steering Committee has requested that the data be compared to the regulations when possible. A summary of the compliance section is provided in Appendix I.

Westside: RMZ widths for type 1, 2, and 3 waters averaged 68, 59, and 53 feet (per side of the stream), respectively. Refer to Figure 3 (Page 8). Seven RMZs (5%) averaged below the required minimum width of 25 feet.

Along all water type I RMZs sampled, the minimum tree count required was exceeded. Along water type 1, gravel/cobble streams, with channel widths over 75 feet, there was an average of 297 trees per 1000 feet, 247 more than required. Along water type 1, boulder/bedrock streams, with channel widths over 75 feet there was an average of 577 trees per 1000 feet, 552 more than required.

Along water type 1, gravel/cobble streams, with channel widths under 75 feet, there was an average of 468 trees per 1000 feet, 368 more than required. Along water type 1, boulder/bedrock streams, with channel widths under 75 feet, there was an average of 485 trees per 1000 feet, 435 more than required.

Channel width on all water type 2 streams sampled, averaged less than 75 feet. Along gravel/cobble streams, there was an average of 305 trees per 1000 feet, 205 trees more than the minimum. Along boulder/bedrock streams there was an average of 490 trees per 1000 feet, 440 more than required

All water type 3 stream channel widths averaged more than 5 feet. Along gravel/cobble streams there was an average of 296 trees per 1000 feet, 221 more than required. Along boulder/bedrock streams there was an average of 232 trees per 1000 feet, 207 more than required.

Eastside: The ability to compare data collected in eastside RMZs to the regulations is limited. The primary reason for this was the inability to accurately locate the RMZ boundaries in partial cuts, as previously discussed on page 8. When RMZ boundaries were not readily identified, sampling concluded at 30 feet. Comparisons between eastside sites and the regulations were made under the following assumptions:

- sampling ended at 30 feet when RMZ boundaries could not be defined.
- width comparisons were made relative to the harvest type listed on the forest practice application.
- partial cuts include the following harvest types (as listed on the forest practice application): partial cut, selection system, selective cut, overstory removal, and overwood removal.
- harvest methods other than partial cuts include 'thinning and clearcutting.

Twenty-two RMZs were located next to partial cut harvest units· They averaged 41, 29, and 36 feet wide (per side of the stream), for water types 1, 2, and 3 streams, respectively. Refer to Figure 3 (Page 8).

Seven RMZs were located next to harvest units other than partial cuts. They averaged 35 and 36 feet wide (per side of the stream), for water types 2 and 3, respectively. All four water type 1 sites were located adjacent to partial cuts. Four non-partial cut sites (44%) averaged less than the minimum required width of 30 feet.

Nineteen live conifers were found per acre between 12 and 20 inches DBH, three above the minimum requirement of 16 per acre. On the average there were four hardwoods per acre between 12 and 16 inches DBH in RMZs, one above the minimum requirement of three per acre.

Tree count per acre of trees larger than four inches DBH in RMZs was 171, 52, and 147 for eastside lakes, boulder/bedrock streams, and gravel/cobble streams, respectively. Lakes and gravel/cobble tree density per acre was above the minimum number per acre of 75. Tree count per acre along boulder/bedrock streams was below the minimum by 23 trees per acre.

RECOMMENDATIONS

Three years of experience on this project has provided insight on how to make data collection efforts more efficient and useful. The following recommendations are offered to those individuals contemplating comparable data collection efforts or starting new projects designed to evaluate the effect of forest management on wildlife habitat.

Site Selection

If another statewide project is conducted within Washington that requires the use of Forest Practices Applications (FPAs) I suggest contacting the Department of Natural Resources, Forest Regulation and Assistance Division (206-753-5315). The DNR maintains a tabular database of all FPAs. Regional projects requiring application information from a specific DNR region can be found at the DNR regional offices. For locations and phone numbers of regional offices contact DNR information at (206) 753-5327.

Plant Community Classification System

Forest Service Plant Association Keys currently are used to characterize habitat types in forested environments. The majority of these keys are written for upland areas with little emphasis given to riparian areas. Similar keys should be created for riparian areas.

Study Design

Pre-harvest data were not collected by this project. Future study design could include pre-harvest sampling to monitor changes in the vegetation characteristics of RMZs and UMAs resulting from the harvest of adjacent vegetation. From this, determinations could be made on whether the value to various wildlife species in these areas increases or decreases with management over time. In addition to vegetation sampling, the recording of wildlife sightings or sign could be incorporated for an idea of wildlife usage of these areas. A total count of trees, snags, downed wood, and LOD within each site measured would be useful.

Originally this project was designed to resample a percentage of the sample sites every year. The project lasted three years, with only one season of resamples. Since there is currently no mechanism to assess the wildlife habitat value provided in these areas over time, sites sampled by this project could be revisited in five year intervals. King (1982) states that in order to get a reasonable indication of plant succession trends, at least five years of data are required. Resampling these sights may provide data on snag creation and decay rate,;. Information provided from resampling may prove valuable in managing habitat for wildlife with forest practices.

Data Analysis

Specific attention should be given to the needs of data storage, analysis, and retrieval for all projects. Fifteen months (over 90 man-months) of data collection resuited in over 12 megabytes of data and tables. To handle data sets this large adequate equipment and time should be allocated for data analysis.

Future Research - Continuation of this Project

The original intent of the RMZ/UMA monitoring project was to monitor 10% of all the FPAs with identified RMZs or UMAs. Due to manpower limitations only about 4 % of the FPAs were sampled. Similar studies in the fature that are designed to monitor RMZs and UMAs for a "snapshot view" might be able to monitor 10% of these FPAs with two six-person field crews, one located on each side of the state.

UMAs in this project were sampled in a standardized manner. This made it difficult to analyze the data for species-specific concerns. Future studies designed to assess the habitat values that UMAs provide should have study designs that vary. This would allow each UMA to be sampled for individual species requirements. Identification of the species the UMA is intended to benefit could be listed on the FPA. UMAs might then be evaluated to determine if specific wildlife objectives were met.

Future Research - New Projects

Another approach to monitor and inventory RMZs and UMAs from a statewide perspective might be to use land-satellite (landsat) imagery and aerial photography. This approach would not only provide a complete census across the state, but also provide an indication of juxtaposition across the landscape. As wildlife/forestry issues begin to focus on landscape factors such as biodiversity, fragmentation, and corridors, this information would prove useful. A subset of RMZs and UMAs could then be selected for detailed monitoring at the ground level. Use of landsat information may also provide a way to collect data on UMAs (or other leave areas) that provide wildlife habitat, but are not declared on FPAs. The maps might also be used to help plan the voluntary placement of UMAs in future harvest schedules and units.

This project collected data on the physical and botanical structure of RMZs and UMAs. The project did not collect data on actual wildiife use of RMZs or UMAs. Studies to determine the extent to which habitat requirements are being met in RMZs and UMAs should be developed with clearly identified and testable hypotheses.

This project was not designed specifically to monitor compliance with the Forest Practices Rules and Regulations. Future studies should be developed to address this issue. If studies of this type are undertaken, effort should be spent on ensuring that data recorded, and inferences made, are statistically valid.

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APPENDICES

APPENDIX A - VARIABLE COUNTS

Westside Streams	Number of Sites	Number of Strips	Number of Subplots
Water Type 1 Gravel/Cobble	30	306	1989
Water Type 1 Boulder/Bedrock	15	121	759
Water Type 2 Gravel/Cobble	11	143	728
Water Type 2 Boulder/Bedrock	2	14	95
Water Type 3 Gravel/Cobble	75	796	4346
Water Type 3 Boulder/Bedrock	7	86	327
Total	140	1466	8244

Westside Lakes	Number of Sites	Number of Strips	Number of Subplots
Water Type 1	7	12	349
Water Type 2	6	44	275
Water Type 3	2	16	100
Total	15	72	724

Eastside Streams	Number of Sites	Number of Strips	Number of Subplots
Water Type 1 Gravel/Cobble	3	26	106
Water Type 1 Boulder/Bedrock	0	0	0
Water Type 2 Gravel/Cobble	5	73	219
Water Type 2 Boulder/Bedrock	0	0	0
Water Type 3 Gravel/Cobble	18	259	962
Water Type 3 Boulder/Bedrock	1	14	44
Total	27	372	1331

Eastside Lakes	Number of Sites	Number of Strips	Number of Subplots
Water Type 1	1	12	58
Water Type 2	1	10	37
Water Type 3	0	0	0
Total	2	22	95

APPENDIX A - VARIABLE COUNTS

Westside UMAs	Number of Sites	Number of Strips	Number of Subplots
BOG	2	12	268
FORESTED WETLAND	9	47	753
UPLAND FOREST	26	44	2050
Total	57	203	3051

Eastside UMAs	Number of Sites	Number of Strips	Number of Subplots
FORESTED WETLAND	1	t2	174
UPLAND FOREST	4	30	651
Total	5	42	825

SITE NUMBER	SITE TYPE	WATER TYPE	SUB-STRATE	EAST/WEST	UMA TYPE	FPA NUMBER	T/R/S	STREAM NAME
1	R	3	G	W		415723	17N 06W 14	UNKNOWN
2	R	3	G	W		416846	17N 06W 33	DELEZENE CR.
3	R	3	G	W		206932	18N 09W 06	LYTLE CR.
4	R	3	G	W		207735	19N 08W 17	UNKNOWN
5	R	2	G	W		416173	19N 07W 05	STILL CR.
6	U			W	UF	910383	19N 03W 31	
7	R	3	G	W		207040	21N 09W 19	UNKNOWN
8	R	2	G	W		206840	19N 09W 30	MF HOQUIAM R.
9	R	1	G	W		910383	19N 03W 31	KENNEDY CR.
10	R	3	B	W		1109470	09N 03W 14	DELAMETER CR.
11	U			W	UF	1109470	09N 03W 11	
12	R	1	B	W		1110133	09N 03W 02	MONOHAN CR.
13	R	1	B	W		1110085	09N 01W 31	OSTRANDER CR.
14	R	3	G	W		103416	20N 14E 09	DOMERIE CR.
15	R	3	B	W		103477	22N 13E 25	THORP CR.
16	R	3	B	W		1110445	10N 02W 08	ROCK CR.
17	U			W	UF	1110445	10N 02W 08	
18	R	3	G	W		1108401	08N 01W 16	SF OSTRANDER CR.
19	R	1	B	W		1109294	08N 02E 17	BAIRD CR.
20	L	1		W		907489	19N 03W 09	LTL SKOOKUM INL.
21	R	2	G	E		13624	19N 16E 29	TANEUM CR.
22	R	3	G	E		2309050	36N 42E 08	DEER CR.
23	L	2		E		2308540	31N 41E 25	BENSON LAKE
24	R	3	G	E		2308993	31N 43E 33	HEEL CR.
25	R	3	G	E		103213	17N 15E 17	GOLD CR.
26	U			W	UF	910416	26N 09E 14	
27	L	2		W		911324	24N 08E 05	BEAVER POND
28	R	3	G	W		911451	24N 08E 14	UNKNOWN
29	R	3	G	W		1908964	36N 06E 29	JONES CR.
30	R	3	G	W		1909739	34N 04E 34	UNKNOWN
31	U			W	FW	911324	24N 08E 08	
32	R	3	G	W		412690	14N 01E 32	NF LUCAS CR
33	L	2		W		416389	16N 01W 02	SWAMP
34	U			W	UF	415162	15N 01W 23	
35	R	3	G	W		910518	18N 06E 10	WF GALE CR.
36	L	2		W		911537	17N 05E 07	KAPOWSIN SWAMP
37	U			W	UF	911537	17N 05E 07	
38	R	2	B	W		911535	19N 10E 23	GREENWATER R.
39	U			W	UF	911635	19N 10E 23	
40	R	3	G	W		417835	19N 02W 19	UNKNOWN
41	R	3	G	W		416731	13N 01W 22	UNKNOWN
42	U			W	UF	1909669	30N 07E 14	
43	U			W	UF	1908337	36N 05E 12	
44	U			W	UF	1909975	34N 04E 21	
45	R	3	B	W		1907997	35N 10E 26	O BRIAN
46	R	3	G	W		912202	21N 06W 28	N. F. RABBIT CR.
47	R	3	G	W		417949	13N 02W 1	BERWICK CR.
48	R	3	G	W		415161	15N 01E 31	COAL CR.
49	R	3	G	W		912345	21N 02W 22	UNKNOWN
50	U			W	UF	1109964	05N 04E 35	
51	R	1	B	W		1109864	05N 03E 24	CEDAR CR.
52	R	1	B	W		1110885	05N 02E 07	CEDAR CR.
53	R	3	G	W		1109919	04N 04E 01	FLY CR.
54	R	3	G	W		418682	13N 03W 23	UNKNOWN
55	R	3	G	W		911611	17N 05E 21	OHOP CR.
56	U			W	FW	911602	17N 05E 02	
57	R	2	B	W		910554	18N 07E 05	S. P. CR.
58	R	3	G	W		912336	17N 05E 22	S. F. OHOP CR.
59	U			W	UF	103240	21N 13E 31	
60	R	1	G	W		103692	20N 13E 30	LOG CR.
61	U			W	UF	103114	20N 13E 07	
63	R	3	G	W		206555	27N 13W 28	MINTER CR.
64	U			W	B	208878	29N 13W 09	
65	U			W	FW	205700	30N 14W 23	
66	R	3	G	W		417779	17N 05W 19	EATON CR.
67	R	3	G	W		912001	19N 06W 30	TRIB. E. SATSOP

68	U			E	FW	2308768	31N 44E 21	
69	U			E	UF	2309908	32N 42E 09	
70	U			E	UF	2308855	33N 42E 23	
71	R	3	G	E		2309776	26N 40E 25	COULEE CR.
72	R	3	G	W		417975	16N 06W 21	TRIB. PIONEER CR.
73	R	3	G	W		417118	17N 07W 34	W. F. VESTA CR.
74	L	1		W		1909856	31N 04E 18	MARTHA LAKE
75	R	1	G	W		1909297	34N 05E 29	NOOKACHAMPS CR.
76	R	1	B	W		1906778	38N 05E 14	M. F. NOOKSACK R.
77	R	3	G	W		1906778	38N 05E 14	UNKNOWN
78	R	3	G	W		1909872	29N 07E 18	CARPENTER CR.
79	R	1	G	W		418508	13N 01E 12	S. F. NEWAUKUM
80	R	3	G	W		418209	13N 01E 04	TRIB. LUCAS CR.
81	R	3	G	E		2309343	37N 25E 12	PINE CR.
82	L	1		E		2310121	38N 30E 27	WALKER LAKE
83	R	3	G	E		2307822	32N 33E 21	THIRTY-MILE CR.
84	R	3	G	E		2308133	30N 34E 33	NINE-MILE CR.
85	R	1	G	E		2310418	31N 33E 31	SANPOIL R.
86	R	3	G	E		2310418	31N 33E 32	LIME CR.
87	R	3	G	E		2309726	32N 38E 12	STENSGAR CR.
88	R	3	G	E		2305879	40N 4'E 36	HARTBAUER CR.
89	U			W	UF	912334	17N 06E 32	
90	U			W	FW	912332	18N 05E 26	
91	R	3	G	W		912332	18N 05E 25	FOSTER/KINGS CR.
92	L	2		W		912126	21N 05W 28	JACKPOT LK.
93	R	1	G	W		418404	20N 07W 36	M. F. SATSOP R.
94	R	3	B	W		911783	19N 07E 32	NEW POND CR.
95	R	1	G	W		418533	16N 01E 22	DESCHUTES R.
96	R	3	G	W		418017	13N 02E 8	BEAVER CR.
97	L	3		W		912127	21N 05W 34	UNKNOWN POND
98	R	3	G	W		417048	18N 07W 17	BLACK CR.
99	U			W	UF	417048	18N 07W 17	
100	R	3	G	W		417819	17N 07W 15	ELIZABETH CR.
101	U			W	UF	417819	17N 07W 15	
102	R	1	G	W		912355	25N 08E 21	TOKUL CR.
103	R	2	G	W		912216	25N 08E 18	GRIFFIN CR.
104	U			W	FW	912216	25N 08E 18	
105	U			W	FW	911450	25N 08E 32	
106	R	1	B	W		909203	24N 09E 18	N. F. SNOQUALMIE R.
107	R	1	G	W			24N 08E 09	TEN CR.
108	R	2	G	W		911794	25N 08E 22	TOKUL CR.
109	R	3	G	W		418496	13N 05E 05	TRIB. TILTON R.
110	R	1	G	W		908931	15N 06E 35	BIG CR.
111	R	3	G	W		207321	29N 01W 21	NAYLOR CR.
112	R	3	G	W		207619	27N 01W 22	UNKNOWN
113	L	2		W		208015	27N 01E 05	MUD LAKE
114	R	3	G	W		208015	27N 01E 08	UNKNOWN
115	R	3	G	W		911698	24N 02W 20	UNKNOWN
116	L	1		W		908467	25N 09E 33	CALLIGAN LAKE
117	R	1	B	W		908871	24N 09E 19	N. F. SNOQUALMIE R.
118	L	1		W		908099	25N 08E 34	BRIDGES LAKE
119	L	1		W			24N 08E 03	BOYLE LAKE
120	R	3	G	W		912803	25N 08E 14	UNKNOWN
121	R	2	G	W			25N 08E 22	TOKUL CR.
122	R	3	G	W		911609	18N 05E 24	BEAR CR.
123	R	2	G	W		418529	18N 08W 02	BITTER CR.
124	R	3	G	W		200837	18N 09W 03	WYMAN CR.
125	R	3	G	W		415991	17N 10W 27	STAFFORD CR.
125	U			W	B	418169	12N 10W 35	
127	R	1	G	W		418169	12N 10W 35	S. F. NEMAH
128	R	1	G	W		418169	12N 10W 35	N. F. NEMAH
129	R	3	G	W		416197	13N 10W 12	DELL CR.
130	R	2	G	W		415106	12N 08W 12	UNKNOWN
131	U			W	UF	415738	15N 07W 17	
132	R	3	G	W		207514	26N 13W 36	N. F CEDAR CR.
133	R	1	B	W		247811	26N 10W 27	CLEARWATER R.
134	R	2	G	W		207514	25N 13W 02	S. F. CEDAR CR.
135	R	3	G	W		206691	25N 11W 28	S. F. MANOR CR.

136	R	3	G	W		208960	26N 12E 22	NOLAN CR.
137	R	2	G	W		206056	25N 12W 10	E. F. MILLER CR.
138	U			W	UF	207998	32N 13W 36	
139	U			W	FW	207824	29N 14W 29	
140	R	3	G	W		912323	20N 09E 10	MAY CR.
141	R	2	G	W		912502	22N 06E 23	ROCK CR.
142	R	3	G	W		910594	19N 06E 35	WILKESON CR.
143	R	1	B	W		414464	15N 03E 36	DESCHUTES R.
144	R	3	G	W		414191	14N 03E 14	DESCHUTES R.
145	R	3	G	W		415204	14N 01E 18	MITCHEL CR.
146	R	2	G	W		0419057	16N 04W 11	CEDAR CR.
147	L	3		W		0419126	18N 01E 31	UNK POND
148	R	3	G	W		0419159	16N 02W 19	UNKNOWN
149	R	3	B	W		0419053	18N 04W 29	BOSY CR.
150	U			W	FW	0912337	17N 05E 29	
151	R	3	G	W		1909220	41N 06E 31	UNKNOWN
152	L	1		W		1910178	41N 01E 34	BEAVER LAKE
153	R	3	G	W		1909151	40N 06E 34	UNKNOWN
154	R	1	G	W		1909318	37N 05E 03	HUTHINSON
155	R	3	G	W		0912337	17N 05E 29	OHOP CR.
156	R	1	B	W		0419678	12N 05W 20	CRIM CR.
157	R	3	G	W		0419715	12N 04W 06	HALFWAY CR.
158	R	1	G	W		0419463	14N 05E 17	ROUNDTOP CR.
159	R	1	G	W		0419370	12N 06E 10	KIONA CR.
160	R	1	B	W		0419335	13N 04E 25	HELLER CR.
161	R	1	G	W		0419454	12N 08E 20	COWLITZ R.
162	R	1	B	W		1111930	03N 08E 08	BEAR CR.
163	R	3	G	E		014362	04N 11E 30	INDIAN CR.
164	R	3	G	W		1110249	03N 09E 01	LAPHAM CR.
165	R	3	G	W		1111087	02N 05E 09	CEDAR CR.
166	R	3	G	E		2311403	36N 30E 33	AENEAS CR.
167	U			E	UF	2311992	39N 28E 26	
168	R	3	G	E		239907	32N 24E 06	HOOKER CR.
169	R	3	G	W		0416848	18N 08W 15	BLACK CR.
170	R	3	G	W		0417240	17N 09W 30	CHAPIN CR.
171	R	3	G	W		0419347	11N 02W 29	McMURPHY CR.
172	R	3	G	W		0419391	11N 02W 05	CURTIS CR.
173	R	1	G	W		0417110	14N 06W 33	ELK CR.
174	U			W	UF	0417110	14N 06W 33	
175	R	1	G	W		0415787	13N 05W 07	8 CR.
176	R	1	G	E		2311038	38N 41E 29	S. DEEP CR.
177	R	3	G	E		2307315	37N 44E 13	HARVEY CR.
178	R	2	G	E		2309764	37N 39E 28	S.F. CLUGSTON CR.
179	R	1	G	W		0417551	14N 06W 10	FALL R.
180	U			W	UF	0417551	14N 06W 10	
181	U			W	UF	0417551	14N 06W 10	
182	U			E	UF	0104066	06N 10E 03	
183	R	2	G	E		0104188	06N 15E 35	UNKNOWN
184	R	3	G	E		0103820	06N 11E 34	HOLMES CR.
185	R	3	G	W		1111598	04N 07E 34	MARTHA CR.
186	R	2	G	E		013624	19N 16E 29	TANEUM
187	R	3	G	E		013644	16N 15E 09	ROCK CR.
188	R	2	G	E		0104289	19N 15E 27	TANEUM
189	R	3	G	W		0416846	17N 06W 33	DELEZENE CR.
190	U			W	UF	0415162	15N 01W 23	
191	U			W	UF	0418386	12N 05W 27	
192	R	1	G	W		0418869	14N 07W 07	N.F. FAIRCHILD CR.
193	R	3	G	W		0419206	14N 07W 22	N. F. WILSON CR.
194	R	3	G	W		0415506	16N 11W 13	BARLOW
195	R	3	G	W		0419024	15N 09W 24	UNKNOWN
196	R	1	G	W		0419628	15N 08W 34	SMITH CR.
197	R	1	G	W		0416422	12N 05W 23	CHEHALIS R.
198	U			W	UF	0416422	12N 05W 23	
199	R	3	G	W		0419094	13N 07W 35	PINNOCK
200	U			W	UF	0418363	13N 05W 06	
201	R	3	G	W		0208105	31N 08W 30	UNKNOWN
202	R	1	G	W		0209178	30N 07W 25	S.F. LITTLE R.
203	R	1	G	W		0209173	31N 09W 28	LYRE R.

204	R	3	G	W		0209138	30N 03W 33	JOHNSON CR.
205	R	3	G	W		0910518	18N 06E 10	W.F. GALE CR.
206	R	3	G	W		0412690	14N 01E 32	LUCAS CR.
207	R	1	G	W		0413357	14N 05E 06	EAST CR.
208	U			W	UF	1110445	10N 02W 08	
209	R	3	B	W		1109470	09N 03W 11	DELAMETER CR.
210	R	3	G	W		1110273	09N 04W 23	WIEST CR.
211	R	1	B	W		1110070	08N 01E 24	COWEEMAN R.
212	R	3	B	E		0103213	17N 15E 17	GOLD CR.
213	R	1	G	E		0103997	12N 15E 18	N.F. AHTANUM CR.
214	R	3	G	E		0103348	13N 15E 33	NASTY CR.
215	L	1		W		0421070	12N 10W 04	WILLAPA BAY
216	R	3	G	E			37N 31E 27	W.F. GRANITE CR.
217	R	1	G	W		0417117	15N 05E 28	NISQUALLY R.
218	R	1	G	W		0418954	11N 08W 11	NASSELLE R.
219	R	1	B	W		0412225	11N 08W 15	NASSELLE R.
220	R	1	G	W		0419407	11N 08W 19	NASSELLE R.
221	R	3	G	W		0209119	30N 06W 17	TUMWATER CR.
222	R	1	G	W		0208151	31N 10W 31	DEEP CR.
223	R	3	G	W		0209068	31N 13W 01	CHARLIE CR.
224	R	1	G	W		0208903	29N 14W 19	DICKEY R.
225	L	2		W		0208874	29N 01W 27	BEAUSITE LAKE
226	R	1	G	W			19N 09W 22	WISHKAH R.
227	U			W	FW		19N 09W 22	

APPENDIX C - WESTSIDE AND EASTSIDE RMZ/UMA VARIABLE COMPARISON

Variable	Westside	Eastside
Total Count of Sampled RMZs	155	29
Total Length of Sampled RMZs (miles)	58	13
Total Area of Sampled RMZs (Acres)	446	70
Total Count of Sampled UMAs	37	5
Total Area of Sampled UMAs (Acres)	136	39
Average Size of Sampled RMZs (Acres)	2.9	2.4
Total Acreage Harvested Adjacent To Sampled RMZs	16862	5875
Average Harvest Unit Size (Acres) Adjacent To Sampled RMZs	109	210
Ratio of Harvested Acres to Acres of Sampled RMZs	38:1	84:1
Average Size of Sampled UMAs (Acres)	3.7	7.8
Total Acreage Harvested Adjacent To Sampled UMAs	4119	1445
Average Harvest Unit Size (Acres) Adjacent To Sampled UMAs	114	289
Ratio of Harvested Acres to Acres of Sampled UMAs	30:1	37:1
Average Elevation of Sampled RMZs (Feet)	700	2800
Average Elevation of Sampled UMAs (Feet)	900	3000
Average Slope of Sampled RMZs (Percent)	26	24
Average Slope of Sampled UMAs (percent)	25	29

APPENDIX, D - WESTSIDE AN[) EASTSIDE RMZ VARIABLE COMPARISON

Variable	Westside Water Type 1	Westside Water Type 2	Westside Water Type 3	Eastside Water Type 1	Eastside Water Type 2	Eastside Water Type 3
Average Width of Sampled RMZs (feet)	68	59	53	41	30	36
Average Vegetative Riparian Zone Width of Sampled RMZs (Feet)	32	26	27	13	6	13
Average Midstream Canopy Closure (Percent)	69	71	79	41	49	72
Average Number of LOD Pieces (Per 100 Feet)	2.9	5.6	4.8	0.9	3.6	3.6
Average Overstory Canopy Closure in Sampled RMZs (Percent)		84			77	
Average Shrub Coverage In Sampled_ RMZs (Percent)		57			57	
Average Forb Coverage in Sampled_ RMZs (Percent)		53			33	
Average Grass Coverage In Sampled RMZs (Percent)		12			22	
Average DW 1 Coverage In Sampled_ RMZs (Percent)		1			1	
Average DW2 Coverage In Sampled RMZs (Percent)		2			2	
Average DW3 Coverage In Sampled_ RMZs (Percent)		5			5	
Average Water Coverage in Sampled RMZs (Percent)		1			1	
Average Rock Coverage In Sampled_ RMZs (Percent)		3			2	
Average Soil Coverage In Sampled RMZs (Percent)		3			2	
Average aGO Coverage In Sampled RMZs (Percent)		88			go	
Average Number of Trees Per Acre In Sampled RMZs		276			458	
Average DBH of '[Fees In Sampled RMZs (Range in inches)		8-12			4-8	
Percentage of Conifer To Hardwood Trees in Sam_pied RMZs		45 : 55			46 : 54	
Most Common Tree Species Found In Sampled RMZs		Red Aider			Other Hardwoods	
Average Number of Snags Per Acre In Sampled RMZs		33			45	
Average DBH of Snags In Sampled RMZs (Range in inches)		4 -8			4 -8	
Percentage of Conifer To Hardwood Snags In Sampled RMZs		54 : 46			SO : SO	
Most Common Snag Species Found In Sampled RMZs		Red Alder			Other Hardwoods	
Percent of The Total Tree Count Blowdown In Sampled RMZs		3			1	
Average DBH of Blowdown in Sampled RMZs (Range in inches) - -		8 - 12			8 -- !2	
Percentage of Conifer To Hardwood Blowdown In Sampled RMZs		40 : 60			62 : 38	
Most Common Species Blowdown In 9, Sampled RMZs		Western Hemlock			Other Hardwoods	

APPENDIX E

Five Most Common Shrubs and Herbs

Westside RMZs:

SHRUB NAME	FREQUENCY ENCOUNTERED	COVERAGE
Salmonberry	34%	57%
Vine Maple	17%	70%
Not Present *	8%	0%
Salal	8%	51%
Trailing Blackberry	5%	34%

HERB NAME	FREQUENCY ENCOUNTERED	COVERAGE
Swordfern	28%	44%
Piggyback Plant	12%	58%
Oregon Oxalis	11%	60%
Lady-fern	5%	35%
Grass	5%	57%

Eastside RMZs:

SHRUB NAME	FREQUENCY ENCOUNTERED	COVERAGE
Snowberry	19%	49%
Alder spp.	11%	62%
Red-osier Dogwood	9%	62%
Not Present *	8%	0%
Vine Maple	8%	64%

HERB NAME	FREQUENCY ENCOUNTERED	COVERAGE
Grass	22%	52%
Not Present *	6%	0%
Horsetail	6%	36%
Sweetscented Bedstraw	6%	27%
Pine Grass	4%	42%

Westside UMAs:

SHRUB NAME	FREQUENCY ENCOUNTERED	COVERAGE
Vine Maple	16%	72%
Salmonberry	16%	49%
Salal	10%	51%
Not Present *	9%	0%
Trailing Blackberry	8%	47%

HERB NAME	FREQUENCY ENCOUNTERED	COVERAGE
Swordfern	24%	45%
Not Present *	8%	0%
Grass	8%	54%
Bear Grass	6%	33%
Carex spp.	5%	67%

Eastside UMAs:

SHRUB NAME	FREQUENCY ENCOUNTERED	COVERAGE
Not Present *	21%	0%
Shiny Leaf Spirea	12%	10%
Mallow Ninebark	7%	71%
Vine Maple	6%	53%
Hazelnut	6%	34%

HERB NAME	FREQUENCY ENCOUNTERED	COVERAGE
Pine Grass	28%	50%
Not Present *	11%	0%
Lady-fern	10%	47%
Grass	7%	55%
Western Starflower	5%	8%

* Not Present indicates that there were no shrubs or herbs within the subplot.

APPENDIX F

FIVE MOST COMMON TREES AND SNAGS

Westside RMZs:

TREE NAME	TOTAL NUMBER OF TREES	PERCENTAGE
Red Alder	10,536	39%
Western Hemlock	6,376	23%
Other Hardwoods	2,730	10%
Western Red Cedar	2,607	10%
Douglas-fir	1,562	6%

SNAG NAME	TOTAL NUMBER OF SNAGS	PERCENTAGE
Red Alder	1,361	41%
Western Hemlock	781	24%
Douglas-fir	306	9%
Other Hardwoods	248	8%
Western Red Cedar	228	7%

Eastside RMZs:

TREE NAME	TOTAL NUMBER OF TREES	PERCENTAGE
Hardwoods	2,187	29%
Red Alder	964	13%
Grand Fir	856	11%
Western Red Cedar	760	10%
Douglas-fir	640	9%

SNAG NAME	TOTAL NUMBER OF SNAGS	PERCENTAGE
Other Hardwoods	166	22%
Grand Fir	125	17%
Willow	99	13%
Douglas-fir	88	12%
Red Alder	6O	8%

Westside UMAs:

TREE NAME	TOTAL NUMBER OF TREES	PERCENTAGE
Red Alder	3,270	27%
Western Hemlock	2,845	24%
Other Hardwoods	2,021	17%
Douglas-fir	1,356	11%
Western Red Cedar	895	7%

SNAG NAME	TOTAL NUMBER OF SNAGS	PERCENTAGE
Red Alder	393	25%
Western Hemlock	367	24%
Other Hardwoods	216	14%
Douglas-fir	187	12%
Unknown	124	8%

Eastside UMAs:

TREE NAME	TOTAL NUMBER OF TREES	PERCENTAGE
Douglas-fir	1,567	38%
Grand Fir	691	17%
Subalpine Fir	480	12%
Western Larch	333	8%
Western Red Cedar	261	6%

SNAG NAME	TOTAL NUMBER OF SNAGS	PERCENTAGE
Douglas-fir	580	45%
Western Larch	151	12%
Lodgepole Pine	145	11%
Grand Fir	138	11%
Subalpine Fir	136	11%

	Westside	Eastside
Average Overstory Canopy Closure In Sampled UMAs (Percent)	87	82
Average Shrub Coverage In Sampled UMAs (Percent)	55	29
Average Forb Coverage In Sampled UMAs (Percent)	39	24
Average Grass Coverage In Sampled UMAs (Percent)	12	24
Average DW1 Coverage In Sampled UMAs (Percent)	1	1
Average DW2 Coverage In Sampled UMAs (Percent)	2	1
Average DW3 Coverage In Sampled UMAs (Percent)	5	4
Average Water Coverage In Sampled UMAs (Percent)	1	1
Average Rock Coverage In Sampled UMAs (Percent)	3	5
Average Soil Coverage In Sampled UMAs (Percent)	2	3
Average OGC Coverage In Sampled UMAs (Percent)	91	88
Average Number of Trees Per Acre In Sampled UMAs	346	441
Average DBH of Trees In Sampled UMAs (Range in inches)	8 – 12	4 – 8
Percentage of Conifer To Hardwood Trees In Sampled UMAs	50 : 50	90 : 10
Most Common Tree Species Found In Sampled UMAs	Red Alder	Douglas Fir
Average Number of Snags Per Acre In Sampled UMAs	44	137
Average DBH of Snags In Sampled UMAs (Range in inches)	4 – 8	1 – 4
Percentage of Conifer To Hardwood Snags In Sampled UMAs	50 : 50	90 : 10
Most Common Snag Species Found In Sampled UMAs	Red Alder	Douglas Fir
Percent of The Total Tree Count Blowndown In Sampled UMAs	2	4
Average DBH of Blowdown In Sampled UMAs (Range in inches)	8 – 12	4 – 8
Percentage of Conifer To Hardwood Blowdown In Sampled UMAs	64 : 36	98 : 2
Most Common Species Blowndown In Sampled UMAs	Douglas Fir	Douglas Fir

APPENDIX H- RESAMPLE DATA

RMZs	Westside 1988	Westside 1990	Westside Change	Eastside 1988	Eastside 1990	Eastside Change
Midstream Canopy (%)	74	92	-18	42	43	-1
LOD (Pieces/IO0 ft.)	3.6	3.6	0	3.5	2.7	0.8
LOD Diameter (inches)	15	13	2	14	12	2
Shrub Cover (%)	55	65	-10	30	51	-21
Forb Cover (%)	55	69	-14	24	14	10
Grass Cover (%)	7	6	1	45	16	29
Overstory Canopy Coverage (%)	78	88	-10	54	59	-5
Trees/ Acre	159	222	63	188	892	704
Snags/ Acre	27	40	13	23	51	28

UMAs	Westside 1988	Westside 1990	Westside Change
Shrub Cover (%)	78	83	-5
Forb Cover (%)	39	50	-11
Grass Cover (%)	1	2	-1
Overstory Canopy Coverage (%)	95	96	-1
Trees/ Acre	504	543	39
Snags/ Acre	72	139	67

APPENDIX I - RMZ COMPLIANCE DATA

Westside	Amount Measured	Minimum Required	Difference From Required	Number of Sites Sampled
Water Type 1 Average RMZ Width in Feet	68	25	+ 43	52
Water Type 2 Average RMZ Width in Feet	59	25	+ 34	19
Water Type 3 Average RMZ Width in Feet	53	25	+ 28	82
Water Type 1 Trees/1000 Ft. (G.G., > 75")*	297	50	+ 247	3
Water Type 1 Trees/1000 Ft. (B.B., > 75")*	577	25	+ 552	3
Water Type 1 Trees/1000 Ft. (G.G., < 75")*	468	100	+ 368	27
Water Type 1 Trees/1000 Ft. (B.B., < 75")*	485	50	+ 435	12
Water Type 2 Trees/1000 Ft. (G.G., < 75")*	305	100	+ 205	11
Water Type 2 Trees/1000 Ft. (B.B., < 75")*	490	50	+ 440	2
Water Type 3 Trees/1000 Ft. (G.G., > 5")*	296	75	+ 221	75
Water Type 3 Trees/1000 Ft. (B.B., > 5")*	232	25	+ 207	7

G.G. : Gravel/Cobble Substrate
B.B. -- Boulder/Bedrock Substrate
* Stream Channel Width

Eastside	Amount Measured	Minimum Required	Difference From Required	Number of Sites Sampled
Water Type 1 Average RMZ Width in Feet Partial Cut)	41	30	+ 11	4
Water Type 2 Average RMZ Width in Feet Partial Cut)	29	30	− 1	5
Water Type 3 Average RMZ Width in Feet Partial Cut)	36	30	+ 6	13
Water Type 1 Average RMZ Width in Feet (Not Partial Cut)	N.A.	N.A.	N.A.	0
Water Type 2 Average RMZ Width in Feet Not Partial Cut)	35	30	+ 5	1
Water Type 3 Average RMZ Width in Feet (Not Partial Cut)	36	30	+ 6	6
Conifers Per *Acre* Between 12 - 20 in. DBH	19	16	+ 3	29
Hardwoods Per Acre Between 12 - 16 in. DBH	4	3	+ 1	29
Trees/Acre > 4 inches DBH (Lakes)	171	75	+ 96	2
Trees/Acre > 4 inches DBH (B.B.)	52	75	− 23	1
Trees/Acre > 4 inches DBH (G.G.)	147	135	+ 12	26

O.O. - Gravel/Cobble Substrate
B.B. = Boulder/Bedrock Substrate

APPENDIX J

KEY CONTACTS:

SOURCE FOR FOREST PRACTICE INFORMATION

DNR

REGION	NAME	TITLE	TELEPHONE
CEN	John Baarspul	FP Regional Coordinator	(206) 753-3410
CEN	Debie Boyd	FP Admin Asst	(206) 753-3410
NE	Bob Anderson	FP Regional Coordinator	(509) 684-5201
NE	Bob Hartley	Deer Park FP Forester	(509) 684-5201
NE	A1 Lang	Chewelah FP Forester	(509) 684-5201
NE	Diana Hoffman	FP Admin Asst	(509) 684-5201
NE	Mel Kuipers	Republic: FP Forester	(509) 684-5201
NE	Don Strand	Colville FP Forester	(509) 684-5201
NW	Dave Dietzman	FP Regional Coordinator	(206) 856-0083
NW	Diane Paustain	FP Admin Asst	(206) 856-0083
OLY	Russ Holt	Sequim FP Forester	(206) 374-6131
OLY	Dan Christensen	Ozette FP Forester	(206) 374-6131
OLY	Wayne Radcliff	Quinalt FP Forester	(206) 288-2448
OLY	Jackie Simmons	FP Admin Asst	(206) 374-6131
OLY	Jack Zaccardo	FP Regional Coordinator	(206) 374-6131
SPS	Diane Andersen	FP Admin Asst	(206) 825-1631
SPS	Ben Cleveland	FP Regienal Coordinator	(206) 825-1631
SE	Don Aden	South Half FP Forester	(509) 962-1006
SE	Linda Hazlett	FP Admin Asst	(509) 925-6131
SE	Len Riggin	North Half FP Forester	(509) 962-1006
SE	Ben Startt	FP Regienal Coordinator	(509) 925-6131
SW	Llyod Handlos	FP Regienal Coordinator	(206) 577-2025
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WEYERHAEUSER

REGION	NAME	TITLE	TELEPHONE
CEN	John Helm	Area Forester	(206) 748-8661
CEN	Ken Lentz	District Engineer	(206) 748-1167
CEN	Kieth Metcalf	District Engineer	(206) 942-2442
CEN	Tim Shere	District Engineer	(206) 942-2442
CEN	Warren Sorenson	District Engineer	(206) 748-8661
OLY	Don Jordan	District Engineer	(206) 532-7110
SPS	Steve Anderson	TFW Industry Coord.	(206) 888-251]
SPS	Mike Bradley	Area Forester	(206) 825-5715
SW	John Keatly	TFW Industry Coord.	(206) 425-2150
SW	Jim Booher	District Engineer	(206) 425-2150

PLUM CREEK

REGION	NAME	TITLE	TELEPHONE
NE	Dwight Opp	Timberlands Superint.	(509) 447-3686
SPS	Gary Johnson	Timberlands Superint.	(206) 825-5596
SE	Pete Heide	Timberlands Superint.	(509) 649-2218
SE	Steve Griswold	Forester	(509) 649-2218
SW	Roger Wimer	Production Superint.	(206) 636-2650

OTHER INDUSTRY

REGION	NAME	TITLE	TELEPHONE
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CEN	John Ensinger	Menesha	(206) 754-1711
NE	Steve Tveit	Boise Cascade	(509) 738-6421
NE	Wayne Vaagen	Vaagen Bros.	(509) 684-5071
NW	Dave Chaimberlain	Georgia Pacific	(206) 733-4410
NW	Pete Poeschol	Poeschol & Schultz	(206) 659-5666
NW	Bill Rawlins	Crown Pacific	(206) 826-3951
NW	Norm Schaaf	Crown Pacific	(206) 826-3951
OLY	Frank Phillips	ITT Rayonier	(206) 374-6565
SPS	Craig Beals	Champion International	(206) 879-5311
SPS	Vaughn Webb	Pope Resources	(206) 297-3341
SPS	Dave Baxtrum	Simpson Timber	(206) 426-3381
SE	Jeff Davies	Boise Cascade	(206) 925-5341
SE	Bill Hatch	Boise Cascade	(509) 773-4343
SE	Bill Howard	Boise Cascade	(509) 453-3131
SE	Jeff Jones	Boise Cascade	(509) 925-5341
SE	Bob McGruder	Boise Cascade	(509) 925-5341
SW	Marc Norberg	International Paper	(206) 423-2110
SW	Monte Martinsen	Longview Fibre	(206) 425-1550

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III	Bill Weiler	Habitat Biologist	(509) 575-2740
IV	Dana Base	Habitat Biologist	(509) 629-2488
V	Bob Bicknell	Habitat Biologist	(206) 274-9814
VI	Gloria Mitchell	Habitat Biologist	(206} 753-2600
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HQ	Peter Haug	Systems Ecologist	(206) 753-3318

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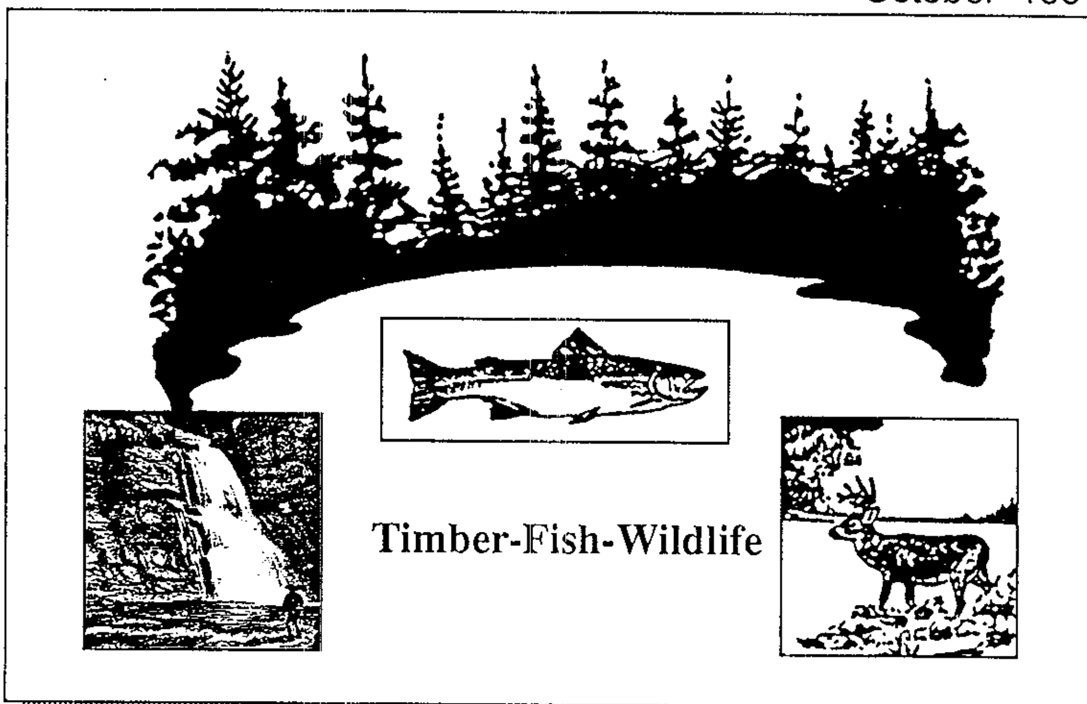
DEPARTMENT OF WILDLIFE

Washington

October 1991



1988..90 CUMULATIVE REPORT

Characterizaton of Riparian Management Zones and Upland Management Areas with Respect to Wildlife Habitat Report # TFW-WLI-91-001

HABITAT MANAGEMENT DIVISION

Washington Department of Wildlife

Serving Washington's wildlife and people—now and in the future