HOW MUCH OLD GROWTH?

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Abstract. The 1987 Kootenai National Forest Land and Resources Management Plan has a standard to maintain 10% of the land base below 5,500 feet in elevation in an old-growth condition to be distributed evenly across most watersheds and to represent the major forest types in each watershed. The Supervisor's Office and Districts have been validating and compiling the number of old growth acres since 1987. The standard is highly scrutinized by the public and must be met to satisfy the Record of Decision for the 1987 Plan. This analysis was initiated to aid in the determination of whether or not effective old growth does come close to the 10% standard of even distribution and does represent most major forest types. A number of plots placed on the Kootenai National Forest during field season 1995 were used to determine how much old growth was sampled. The sample design for these plots was intended to represent the variability of landscape-level structure, composition, and process of the Upper Kootenai Sub-Basin, a 4th code hydrologic unit. Structure and composition includes successional stage and so this sample set was determined sufficiently unbiased and adequate for the analysis. Results of this analysis failed to reject the null hypothesis of percent old growth = 10% (95% conf). In addition, the analysis indicated a varied distribution of effective old growth across the variability of environmental gradients of the Kootenai National Forest.

Introduction

Old growth forests have been the focal point of controversy across the Pacific Northwest and Rocky Mountains for years. The importance of old growth forests is well accepted and documented (Franklin et al. 1981, Forsman et al. 1984, Harris 1984, Habeck 1988, Habeck 1990, Oliver and Larsen 1990, FEMAT 1993, Spies and Franklin 1995). Even though there is no universally accepted definition for old growth (Hunter1990), many attempts have been made to define this late successional stage of forest development (Franklin and Spies 1991, Duchesne 1994, Diamond 1998). A simple, straight-forward definition is from Kohm and Franklin 1997: "an ecosystem distinguished by the presence of populations of old trees that is not necessarily in a late successional condition or free from evidence of human activity".

The Kootenai National Forest realized the importance of old growth forests within the scope of its 1987 Land and Resources Management Plan, even though it had difficulty with definitions and specific direction. (FSM 2400, Kootenai Supplement No. 85). The 1987 Kootenai National Forest Land and Resources Management Plan has a standard to maintain 10% of the land base below 5,500 feet in elevation in an old-growth condition to be distributed evenly across most watersheds and to represent the major forest types in each watershed (USDA 1987). The Kootenai Forest is obligated to maintain this standard due to a commitment agreed to with the public as stated in the Record of Decision for the 1987 Environmental Impact Statement. The Supervisor's Office and Districts have been validating and compiling the number of old growth acres since 1987. This analysis was initiated to aid in the determination of whether or not effective old growth does come close to the 10% standard of even distribution and does represent most major forest types.

The Kootenai Forest is not immune from the old growth controversy. Many stakeholders demand to know if the Kootenai Forest has met this standard over the 15 years since the Record of Decision was issued. This study is an attempt to address that issue.

The Setting

The Kootenai National Forest is located between latitude 47 30' to 49 00' N and longitude 114 37' 30" to 116 15' W. The Forest is in the extreme northwestern corner of the State of Montana, bordering north Idaho and the Idaho Panhandle National Forest to the west, Canada to the north, the Flathead national Forest to the east and the Lolo National Forest to the south. The Kootenai National Forest is within the Northern Rocky Mountain physiographic province and located within the Northern Rocky Mountain Forest-Steppe – Coniferous Forest – Alpine Meadow Ecoregion (Bailey et al. 1994). The Whitefish, Purcell, Salish, Cabinet, and Bitterroot mountain ranges and main river drainages are the primary topographic features on the Kootenai Forest. The Kootenai and Clark Fork are the two main rivers that drain the Forest, with the Tobacco, Fisher, and Yaak Rivers as major tributaries to the Kootenai – and Vermillion and Bull Rivers as major tributaries to the Clark Fork (Kuennen and Nielsen-Gerhardt 1985).

Analysis

In order to address the issue of whether or not the Kootenai Forest has complied with the 1987 standard for old growth, the questions to answer with this analysis are: does percent old growth equal 10% on the Forest, and does this old growth represent most major forest types within the Forest?

A dataset and sample design from a gradient analysis study initiated in 1995 on the Kootenai Forest for a gradient modeling and remote sensing project (Keane et al. 2002) was used for this analysis. This data set was determined adequately unbiased and representative of the variability of successional stages across the Forest. The purpose of this modified *gradsect-releve* sample design was to ensure an adequate sample of the variability of landscape-level structure, composition, and function of the Upper Kootenai Sub-Basin, a 4th code hydrologic unit (HUC). Structure and composition includes successional stages, such as old growth. Complete and detailed methodology of this gradsect-releve sample design approach can be found in Keane et al. 2002, USDA Department of Agriculture, Forest Service, Rocky Mountain Research Station, General Technical Report RMRS-GTR-92.

The sample design and plots adequately represents not only the variability of structure, composition, and process of the Upper Kootenai Sub-Basin, but also that of the most of the rest of the Kootenai Forest (Leavell 2000). The Sub-Basin is 65% of the entire Forest (581,937 ha out of 890,308 ha). Plots were placed within the Tobacco Valley, which is one of the drier settings on the Forest, through most mesic environments, to the very wet crest of the Purcell Mountains. These are the driest and most moist areas on the entire Forest. This diversity represents the remaining Forest variability with exception to some

grand fir and mountain hemlock communities south of the Clark Fork River, which is approximately 20% of the Forest area.

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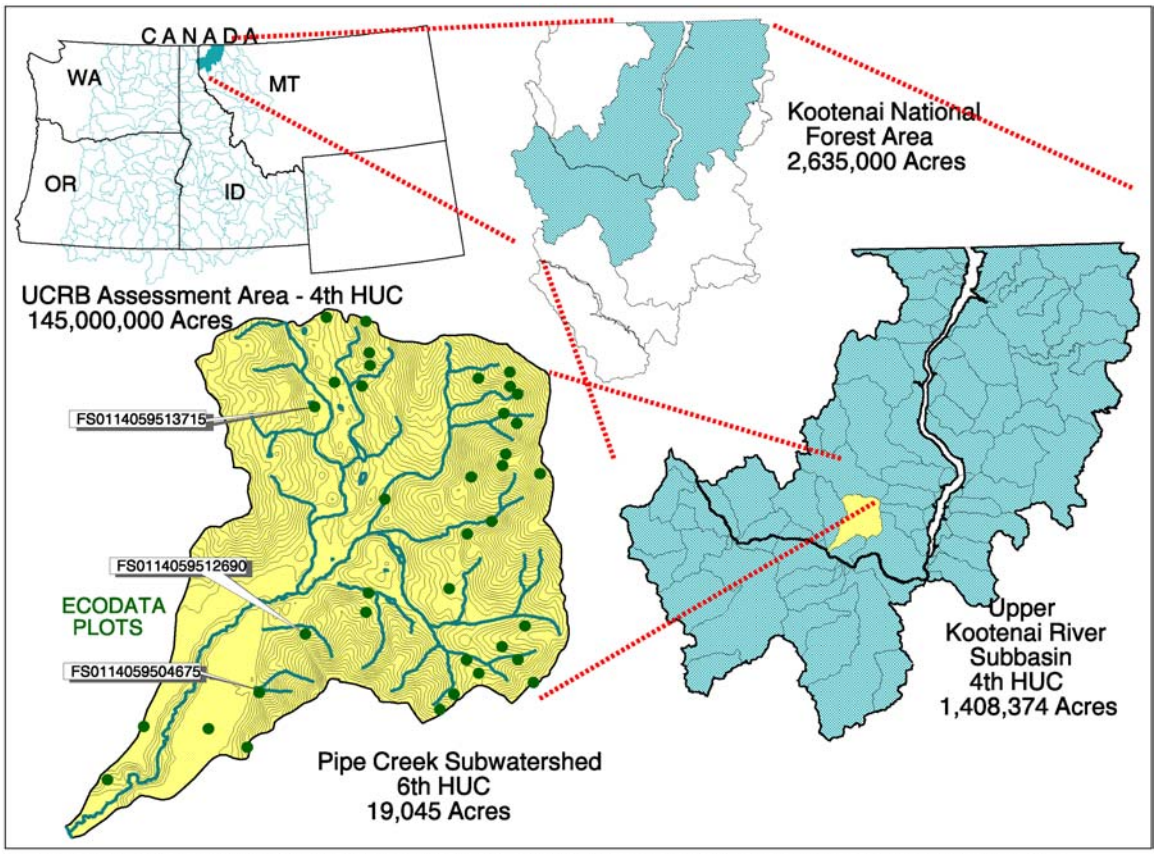
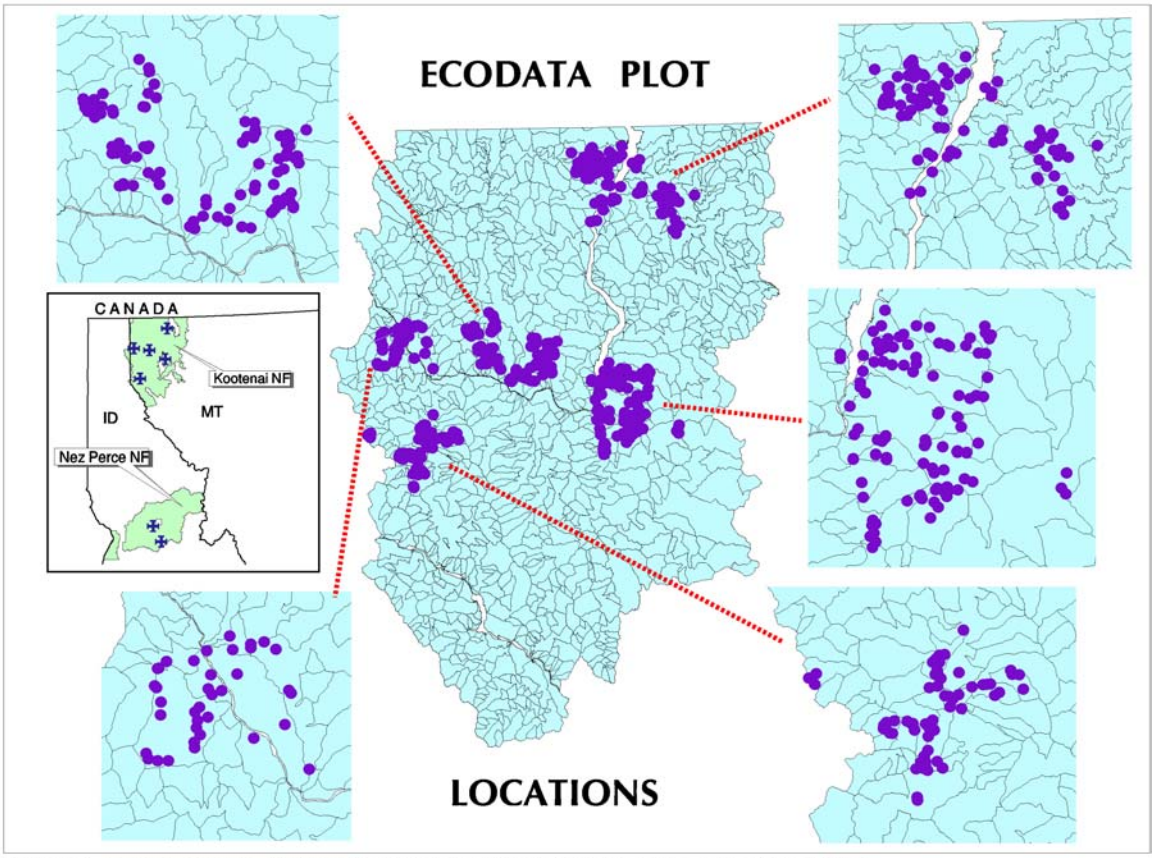


Gradient Analysis Project - Hydrologic Hierarchy. Illustrating the hierarchical tiering from regional assessment area to subbasin to subwatershed to individual plot data.

Four hundred and forty-nine macroplots were established throughout this 4th code HUC in 1995. Each macroplot was a circular, fixed area plot approximately 0.04 ha in size. Several plots had tree data collected on either 50% or 25% of the 0.04 ha plot. This affected the expansion factor used in this analysis. The 0.04 ha plot has an expansion factor of 10 trees per acre. The plots with tree data collected on 50% of the plot area had an expansion factor of 20 trees per acre and the plots with tree data collected on 25% of the plot area had an expansion factor of 40 trees per acre.

Since the plot placement was arrayed on transects (gradsects) in order to sample the complete variability of structure, composition, and process, some plots landed on roads, gravel pits, and in the reservoir. These were removed from the analysis. Some plots were on Forest Service land at the time of the survey, but the land exchange in 1997 transferred land and forest management to Plum Creek. These plots were also removed from the dataset used. Three hundred and eighty plots remained as useful to this analysis.



Overall view and magnified close-ups of plot locations, on both the Nez Perce National Forest and the Kootenai National Forest.

The first step was to analyze each plot to determine whether or not the plot meets the guidelines for effective old growth. The definition for old growth follows an August 10, 1983 memo, titled, "Interim Guidelines for Old Growth Habitat Management". This definition was used in the 1987 Land and Resources Management Plan and will be used for this analysis:

"Old growth is defined (characterized) as follows:

1. Mixed conifer old growth – (1) stands of overmature trees which contain at least 12 trees per acre greater than 19 inches DBH; (2) a multilayered canopy with 60-70 percent crown closure containing standing dead and decadent trees; (3) down dead material in excess of 20 tons per acre; (4) stand decadence associated with heartrot and various fungi; (5) basal area near or in excess of 150 square feet; (6) favor stands which contain a larch component and are in or near riparian situations.
2. Dry (Ponderosa pine) old growth – (1) stands which consist of large (>/= 20" DBH), scattered, old Ponderosa pine; (2) are growing in a relatively open condition and have a basal area of about 80 square feet minimum.
3. Species specific old growth – These are stands of a relatively pure nature, primarily upper elevation spruce stands. They may also include lodgepole and subalpine fir. Generally these types of stands will be provided for in non-

developmental prescriptions but their occurrence should be noted and they should be provided in representative amounts."

These guidelines were later finalized within Appendix 17 to the Kootenai National Forest Land and Resources Management Plan. The interim guidelines were replaced with similar verbiage, but divided into Warm-Moist (instead of Mixed conifer), Cool Moist (instead of species specific), and Warm-Dry (instead of Dry ponderosa pine) habitat groups.

Step #1:

The plots were separated into two groups – **Warm-Moist** and **Warm-Dry**. We used the plant association classification (Leavell 2000) developed from these plots and separated plots by warm and dry plant associations (PA's 20, 21, and 22) and warm and dry sub-plant associations (SPA's 11, 14, 15, and 16) from the other plots. The remaining plots were then placed into the warm-moist category. The accuracy standard for selection criteria used in this analysis, such as elevation, basal area, DBH, etc., is 5% to 10% of the value of each number added or subtracted to allow for error and rounding of numbers.

Criteria # 3 or Cool-Moist old growth was not included in this analysis. The level of specificity within this category did not have adequate criteria to measure, although Plant Association 8 (subalpine fir – Engelmann spruce / fool's huckleberry – white rhododendron / *brachythecium*) does follow the general intent of characterization. This plant association, with six plots, has an average of 5800 feet, above the 5500' limit specified in the 1987 Forest Plan, and will not be further addressed in this analysis.

Step #2:

All plots with less than 80 square feet of basal area of ponderosa pine less than 20" diameter at breast height (DBH) were removed from the "dry pine" subset. DBH was sampled on each plot for each tree. Each tree sampled represented 10 trees per acre due to the expansion factor of a 1/10-acre fixed-radius plot. Ten plots were taken at 25% and 50% of the $1/10^{th}$ acre plot. These plots had an expansion factor of 20 trees per acre and 40 trees per acre respectively because of the altered expansion factors. Basal area was calculated from the measured DBH * .0005454 (basal area per tree) * the expansion factor for each tree.

Step #3:

All plots with less than 19" DBH and less than 150 feet of basal area were removed from the "warm-moist" dataset.

Step #4:

All remaining plots with elevations higher than 5500 feet (+/- 100 feet) were removed from both datasets.

Step #5:

All plots with less than 20 tons per acre of downed wood (this data was measured for each plot in the original dataset) were removed from those remaining within the warm-moist dataset.

Step #6:

All remaining plots within both datasets and their representative polygons were intersected with the forest timber stand coverage (linked to TSMRS database) and a fire coverage for all stand-replacing fires that occurred after 1995 to determine whether or not any human harvesting, prescribed burning, or wildfires took place on or near the gradient plot polygons that would alter the data collected in 1995. TSMRS database was queried for stand id, stand acres, activity name, year accomplished, and activity acres. The following 6 plots were affected:

> Plot 327 - Five acres of the 36-acre stand had a sanitation/salvage harvest in 1997. Since only a small portion of this stand was affected by a minimal prescription, the plot polygon remained in the final calculation.
> Plot 730 - Six acres of the 24-acre stand had a sanitation/salvage harvest in 1996 in the area that had been burned in the 1994 fire. The harvest area was not in or near the plot polygon.
> Plot 561 – 1 acre of the 27-acre stand had a sanitation/salvage harvest in 1998. Since only 4 acres of the 18 acres plot polygon fell into the stand, it was retained in the dataset.
> Plot 622 – Due to the land exchange with Plum Creek, this plot polygon was divided between Forest Service and private ownership. More than 11 1/2 acres remained under Forest Service management, and had no significant activity or fire. This plot was retained in the dataset (9 acres went to Plum Creek ownership).
> Plots 526, 548 – Both of these plots, although classified as old growth in 1995, were removed from the dataset because the land/trees had been exchanged to Plum Creek.

Results and Discussion

An analysis of the gradient plots sampled in 1995 yielded 10.2% (39 out of a total of 382) in an old growth condition as defined by the 1983 guideline memo and Appendix 17 in the 1987 Kootenai National Forest Land and Resources Management Plan. Two plots were removed from the final analysis due to a land exchange with Plum Creek. This left 9.8% (37 out of 380). The following table follows the results from a Large-Sample Confidence Interval for a Population Proportion (Devore 1995). All plots are independent and follow a simple, random design.

Confidence	Lower Bound	Upper Bound
95%	6.756	12.718
90%	7.235	12.238
85%	7.548	11.926
80%	7.788	11.686
75%	7.987	11.486

The point estimate for percent old growth = 9.737%. The 95% CI for percent old growth = (6.756%, 12.718%). The null hypothesis: percent old growth = 10%. The alternative hypothesis: percent old growth is not 10%. The result: Fail to Reject Null Hypothesis. In other words there is no evidence to suggest that the true percent old growth is significantly different than 10% at 95% confidence.

The plots followed a variety of plant associations and sub-associations (Leavell 2000) indicating a broad distribution across the representative gradients of the Kootenai National Forest. The photo below is one taken on plot center for plot number 604.

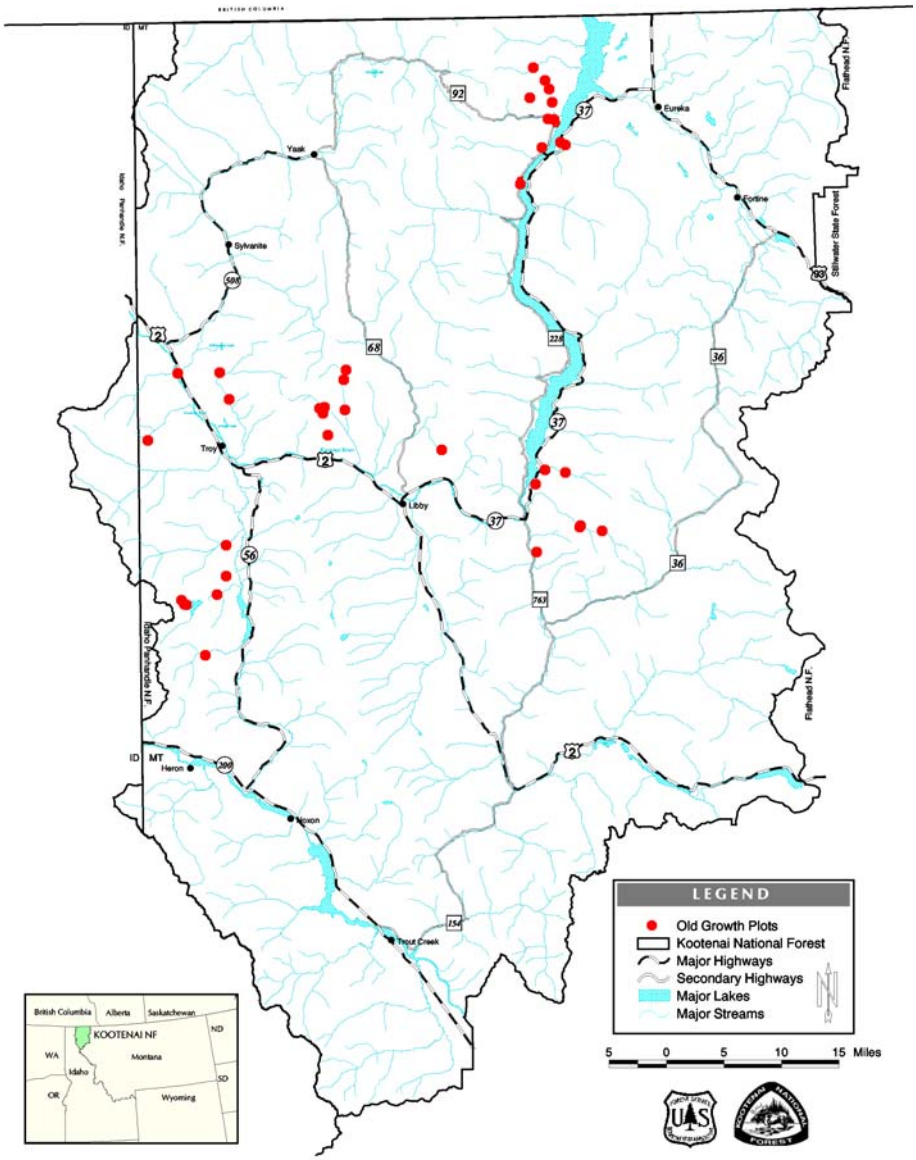
A photograph taken on the plot center of plot # 604

The following table is a list of Alliances, plant associations, and sub-associations represented by the selected old growth plots. Additional descriptions and characterizations can be found in the classification.

FOREST ALLIANCE/PLANT ASSOCIATION & SUB-PLANT ASSOCIATION	# PLOTS	PLOT ID
WESTERN HEMLOCK/WESTERN REDCEDAR FOREST ALLIANCE		
Western Hemlock – Western Redcedar/Trefoil Foamflower/Hooker's Fairy-Bells	2	626, 656
Western Hemlock – Western Redcedar (Grand Fir)/Western Goldthread/ Rhytidiopsis	4	671, 622, 604, 761
Western Redcedar/Mountain-Lover – Twinflower/Queen's Cup Beadlily	4	320, 730, 755, 728
SUBALPINE FIR FOREST ALLIANCE		
Subalpine Fir/Sitka Alder - Thimbleberry/Broad-Leaf Arnica - Western Meadowrue	1	603
Subalpine Fir – Western Larch/Dwarf Bilberry/Broad-Leaf Arnica	2	289, 327, 339
Subalpine Fir - Lodgepole Pine/Fool's Huckleberry-Mountain-Lover/Whortleberry	1	750
GRAND FIR FOREST ALLIANGE		
Grand Fir – Douglas-Fir / Rocky Mountain Maple – Twinflower / Wild Sarsaparilla	1	478
Grand Fir – Douglas-Fir (Western Redcedar) / Mountain-lover	4	609, 627, 732, 734
WESTERN LARCH – PAPER BIRCH (TREMBLING ASPEN) MIXED FOREST/WOODLAND ALLIANCE		
Western Larch – Paper Birch (Quaking Aspen)/Rocky Mountain Maple – Sitka Alder	2	304, 682
WESTERN LARCH – DOUGLAS-FIR WOODLAND ALLIANCE		
Western Larch – Douglas-Fir (Lodgepole Pine) / Globe Huckleberry / Beargrass	1	548
Western Larch – Douglas-Fir (Lodgepole Pine)/ Canada Buffaloberry – Shiny-Leaf Spiraea / Pinegrass	1	561
Western Larch – Douglas-Fir/ Creeping Oregon-Grape/ Pinegrass	3	340, 555, 556
DOUGLAS-FIR – PONDEROSA PINE FOREST ALLIANCE		
Douglas-Fir – Ponderosa Pine/ Creeping Oregon-Grape – Common Snowbery – Kinnikinnik / Pinegrass	6	298, 342, 301, 599, 501, 534
Douglas-Fir – Ponderosa Pine (Western Larch)/ Creeping Oregon-Grape – Kinnikinnik/ Pinegrass/ Juniper Moss	3	303, 308, 475
Douglas-Fir – Ponderosa Pine/ Shiny-Leaf Spiraea/ Arrowleaf Balsamroot/ Idaho Fescue	3	307, 526, 618
Douglas-Fir – Ponderosa Pine (Western Larch)/ Mallow Ninebark- Creeping Oregon-Grape/ Frightened Cat-Tail Moss	1	630

Summary table of ECODATA plots with old growth characteristics.

The 1987 Land and Resources Management Plan standard to maintain 10% of the land base below 5,500 feet in elevation in an old-growth condition representing a cross-section of most forest types on the Kootenai National Forest is consistent with this analysis. This is a map of plots sampled during the 1995 field season for the gradient modeling effort having old growth characteristics as defined in the 1983 guideline memo and Appendix 17 in the 1987 Kootenai National Forest Land and Resources Management Plan. In addition to representing a cross-section of most forest types (below 5500 feet in elevation) on the Kootenai National Forest, the plots also demonstrate a broad geographic distribution, another element of the 1987 Plan standard.



Map of the distribution of gradient modeling plots with old growth characteristics.

Citations

Bailey, R.G., P.E. Avers, T. King, and W.H. McNab (eds. and compilers). 1994. Ecoregions and subregions of the United States. Prepared in cooperation with the ECOMAP Team of the USDA Forest Service and US Geological Society.

Diamond, D. 1998. An old growth definition for southwestern subtropical upland forests. Gen. Tech. Rep. SRS-21. Ashville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 7 pp.

Duchesne, L.C. 1994. Defining Canada's old growth forests – problems and solutions. The Forestry Chronicle 70(6): 739-744.

FEMAT. 1993. Forest ecosystem management: an ecological, economic, and social assessment. Report of the Forest Ecosystem Management Assessment Team. Jack Ward Thomas, Team Leader. Nine Chapters. USDA Forest Service, US Dept of Commerce, USDI Bureau of Land Management, USDI Fish and Wildlife Service, USDI National Park Service, and EPA. 1993-793-071. Washington, DC:GPO. Irregular pagination.

Forsman, E.D., E.C. Meslow, and H.M. Wright. 1984. Distribution and biology of the spotted owl in Oregon. Wildl. Monogr. 87:1-64.

Franklin, J.F., K. Cromack, Jr., W. Denison, A. McKee, C. Maser, J. Sedell, F. Swanson, and G. Juday. 1981. Ecological characteristics of old growth Douglas-fir forests. USDA Forest Service Gen. Tech. Rep. PNW-118. 48 pp.

Franklin, J.F. and T.A. Spies. 1991. Composition, function, and structure of old growth Douglas-fir forests. In: Wildlife and vegetation of unmanaged Douglas-fir forests. Tech cords. L.F. Ruggiero, K.B. Aubry, A.B. Carey, and M.H. Huff. Gen Tech rep. PNW-GTR-285. Portland, Or: USDA Forest Service.

Habeck, J.R. 1988. Old growth forests in the northern Rocky Mountains. Natural Areas Journ. 8:202-211.

Habeck, J.R. 1990. Old growth ponderosa pine-western larch forests in western Montana: ecology and management. The Northwestern Environmental Journal, 6:271-292. University of Washington, Seattle.

Harris, L.D. 1984. The fragmented forest., island biogeography theory and the preservation of biotic diversity. Univ. Chicago Press, Chicago, IL. 211 pp.

Hunter, M.L. 1990. Wildlife, forests, and forestry: principles of managing forests for biological diversity. Prentice Hall, Englewood Cliffs, NJ. 370 pp.

Keane, R.E., M.G. Rollins, C.H. McNicoll, and R.A. Parsons. 2002. Integrating ecosystem sampling, gradient modeling, remote sensing, and ecosystem simulation to create spatially

explicit landscape inventories. RMRS-GTR-92. Fort Collins, CO: USDA, Forest Service, Rocky Mountain Research Station. 61 pp.

Kohm, K.A. and J.F. Franklin (eds.). 1997. Creating a forestry for the 21st century. Island Press, Washington, DC. 475 pp.

Kuennen, L.J. and M.N. Nielsen-Gerhardt. 1985. Soil survey of Kootenai National Forest Area, Montana and Idaho. USDA Forest Service and Natural Resources Conservation Service and the Montana Agricultural Experiment Station. 242 pp.

Leavell, D.M. 2000. Vegetation and process of the Kootenai National Forest. Dissertation Abstracts, catalog #9970-793, vol. 61-04B, starting on page 1744, Ann Arbor Michigan. 508 pp.

Oliver, C.D. and B.C. Larsen. 1990. Forest stand dynamics. McGraw-Hill, Inc., New York, NY 467 pp.

Spies, T.A. and J.F. Franklin. 1995. The diversity of maintenance of old growth forests. In: Biodiversity in managed landscapes, ed. R.C. Szaro and D.W. Johnson. New York, NY: Oxford University Press.

USDA Forest Service. 1987. Kootenai National Forest Land and Resources Management Plan. Kootenai National Forest, Libby, MT.

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