EASTERN WASHINGTON TIMBER SUPPLY ANALYSIS: SUMMARY

Bruce B. Bare, Bruce R. Lippke, Chadwick D. Oliver, and Scot Zens

ABSTRACT

The Washington Legislature commissioned a study of future timber supplies for the state during the 1990 session. A westside study based on a doubling of Forest Inventory and Analysis (FIA) inventory plot measurements was completed and documented in the publication titled "Future Prospects for Western Washington Timber Supply." This eastside study is based on a more limited set of inventory plots. It attempts to identify the potential range of future timber harvests and to highlight those aspects of policy, resource base, and owner behavior most significantly impacting the eastside harvest over time. Eastside forests are characterized by substantial differences in stand structures across owners and low productivity relative to the westside, resulting in very different management strategies. To reduce the compounding statistical errors, each inventory plot was grown over time under a number of different management alternatives. Management plans reflecting owner groups' intentions and harvest schedules were simulated under a number of conditions. While the inventory data show that historical harvest levels of just over one billion board feet per year could be sustained, both the decline in USFS harvest plans and the impact of forest practice regulations on private owners are likely to result in a substantial reduction in harvest. There is a surplus in mature inventory to support current or higher harvest rates for one to two decades, subject to decreasing harvests over the longer term. Timber quality linked to timber tree diameter shows continued declines much like that experienced in the shift from natural stands to managed rotations on the westside. Projections show an increasing harvest potential for the Inland Empire in comparison to history. The greatest decline is expected in the national forests and industry harvests. While non-federal harvests may be stable, substantial shifts in owner shares to state and non-industrial private, and regional shares from central to inland are required. Such shifts may be both market- and policy-sensitive.

THE WASHINGTON LEGISLATURE COMMISSIONED A STUDY OF FUTURE TIMBER SUPPLIES FOR THE STATE DURING THE 1990 SESSION

The analysis for western Washington was completed and documented in the publication titled "Future Prospects for Western Washington Timber Supply" (Adams 1992). The western Washington ("Westside") study benefited by an enhanced inventory of state and private forests involving a doubling of inventory plot measurements by the Forest Inventory and Analysis (FIA) Unit of the US Forest Service. After completion of the Westside survey, a more limited survey of eastern Washington ("Eastside") (McKay 1994) was undertaken which provides the primary data for this report on Eastern Washington's timber supply.

The Eastside forests are more varied in structure, and the number of inventory plot measurements per acre of forest is substantially lower. Hence, the objectives of the Eastside study are more limited. The study attempts to identify the potential range of future timber harvests in eastern Washington, highlighting those aspects of policy, resource base, and owner behavior most significantly impacting the harvest over time.

The issues of forest age and health are fundamentally different than for the westside. Most Eastside forests are managed as uneven-aged, so the age class distribution is less important. Nevertheless, there are significant forest health issues that can be affected by management alternatives.

The topography and forest plot data make it practical to subdivide the Eastside data into two timbersheds: the Central timbershed, comprising the eastern slopes of the Cascades; and the Inland Empire timbershed, comprising the rest of the eastern counties.

COMMERCIAL TIMBERLAND COVERS 7.4 MILLION ACRES OF EASTERN WASHINGTON, 28% OF THE LAND AREA

About 25% of the Eastside forests are reserved from timber utilization by statute or administrative regulation, mostly on federal lands. Consequently, 5.6 million acres are "available" for timber production, with just over four million acres on non-federal lands (distribution by owner shown in Figure 1).

The dominant species are ponderosa pine and Douglas-fir or western larch, making up a majority of the timber on over 75% of the non-federal land (Figure 2). The distribution of site class

Reprinted from 1995 symposium proceedings of *Ecosystem Management in Western Interior Forests* held May 3-5, 1994 in Spokane, Washington; Department of Natural Resource Sciences, Washington State University, Pullman, WA 99164-6410.

by owner is generally well balanced across owners and regions except for the Washington State Department of Natural Resources (WDNR) and Native Americans, who own less than the average shares of high-site land for the Inland Empire region (Figure 3).

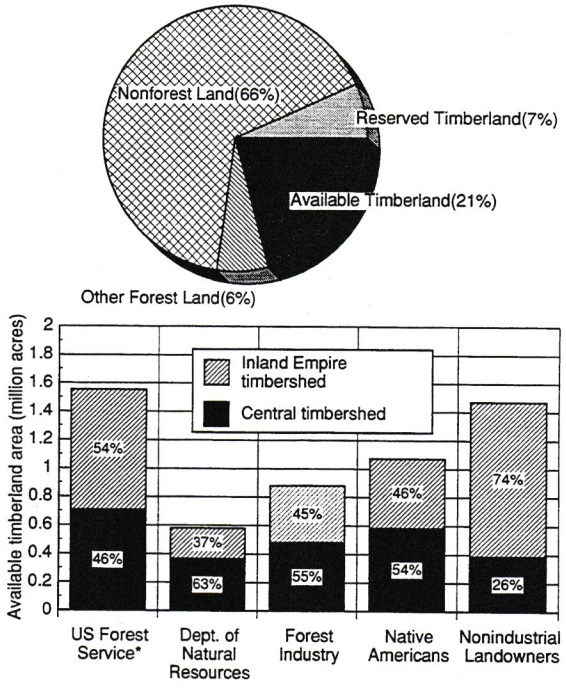


Figure 1.—Eastern Washington Land Use Distribution with Available Timberland by Timbershed and Owner.

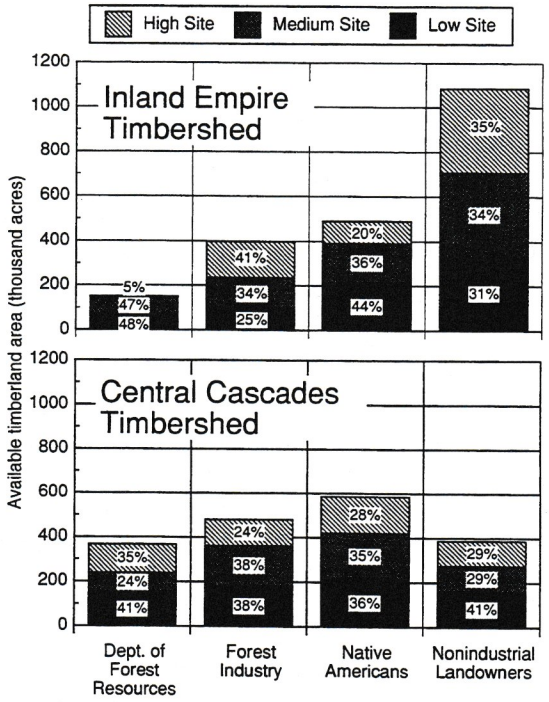


Figure 3.—Eastern Washington Site Class Distribution

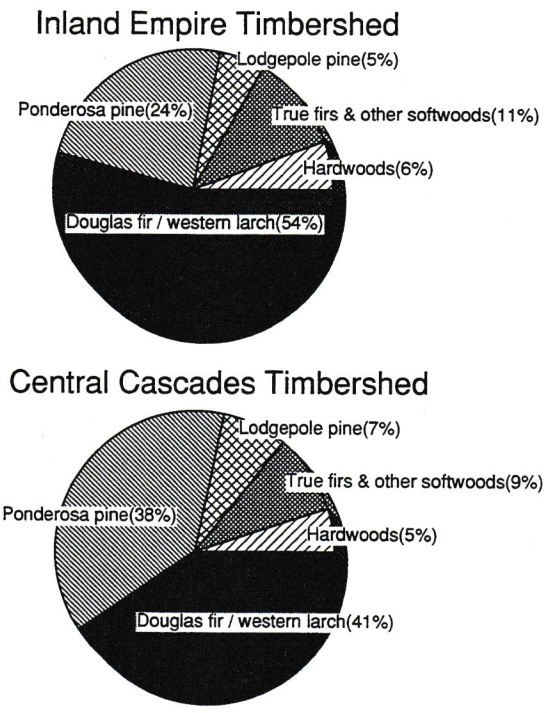


Figure 2.—Eastern Washington Dominant Forest Type Distribution.

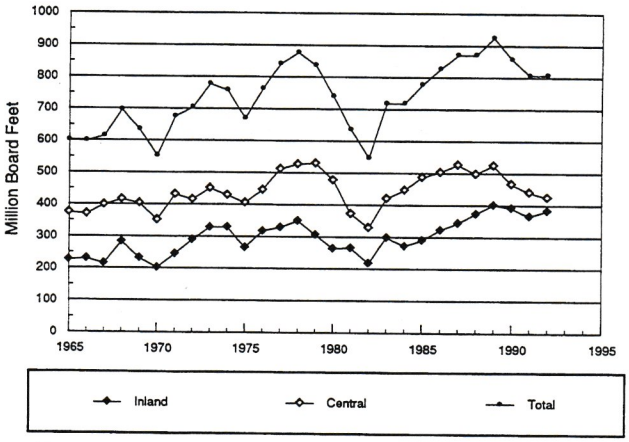
EASTSIDE FORESTS ARE CHARACTERIZED BY SUBSTANTIAL DIFFERENCES IN STAND STRUCTURES

Each measured survey plot was therefore grown over time under a number of different management alternatives. Management plans were estimated from a survey of the owner groups' intentions. Harvest schedules were simulated under a number of different conditions, including variations in the amount of decline in the harvest that would be acceptable from decade to decade, alternative management intensities, and regulatory or land-availability constraints.

There are many reasons to avoid interpreting these results as a precise portrayal of future harvests: accuracy of the basic FIA data, the uncertainty in yield projections, the realism of future management assumptions, the absence of natural disturbances, as well as instability in future markets. However, the evidence does suggest a potential range of harvests for state, private, and Native American lands relative to the recently-revised management plans for federal forests. The importance of management practices and policies that will affect these practices, including forest health options, is also apparent. The Eastside results do, however, fall short of the Westside study in predictive power because of less certain inventory data and much greater variation in stand conditions.

HISTORIC HARVEST RATES SHOW WIDE YEAR-TO-YEAR VARIATION AROUND A 1.1 BILLION BOARD FOOT TREND

The historic harvest rate in eastern Washington over the last 30 years has fluctuated as much as 25%, around a fairly stable trend (Figure 4). The large fluctuations correspond generally to the peaks and troughs in business cycles. There is some evidence that changing supply conditions affect the harvest rate as well, especially at the timbershed level. The large variations in harvest rates from peak to trough provide economic evidence that the region is not a low-cost supplier, but rather a marginal supplier that is greatly impacted by competitiveness with other regions. When market conditions are weak, production declines more than in other supply regions.



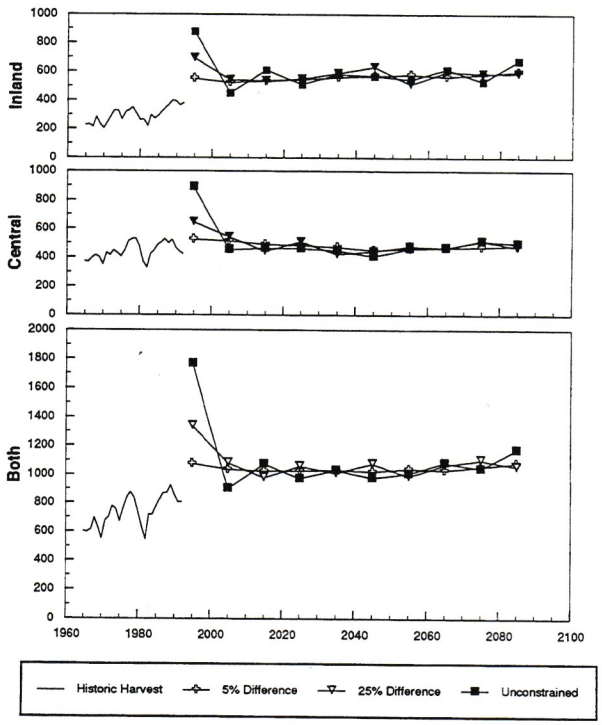
All owners except national forests.

Figure 4.—Historical Harvest by Timbershed.

Future harvests based on the productivity potential of the land provide insights into the changing share of harvest by owner groups. Initial condition assumptions are based on FIA inventory data, Prognosis model growth and yield projections (Johnson 1990; Wykoff et al. 1982), and estimates for land management plans for non-federal land. Under these conditions, harvest levels increase from 0.8 billion board feet to 1.0 billion board feet (excluding the impact of changing regulations on state and private lands and revised estimates of the planned harvests on federal forests) (Figure 5).

While this potential increase might appear to be an offset to the planned decline in federal harvest from 400 million board feet over the last three decades to 133 million under recent plans, actual harvests will probably fall short of this potential, as they have in the past. Harvest levels might be expected to be roughly 10% below the potential because of harvest losses, estimation errors, and variability in ownership objectives.

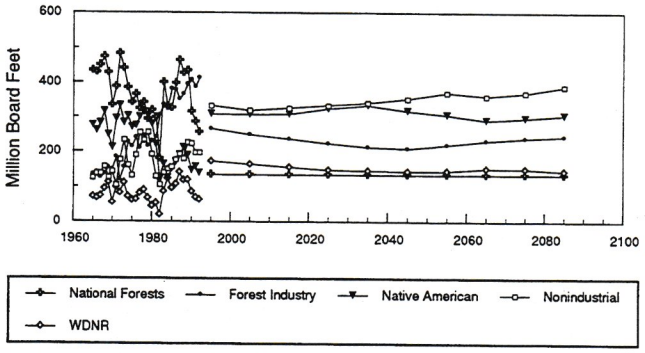
This projected harvest level stability and similarity to the historical trend also hides large uncertainties relative to market conditions, owner behavior, forest health conditions, and the impact of forest policy changes. For example, at the regional level, even these projections show an increasing harvest potential for the Inland Empire but no increase in potential for the Central timbershed.



Average annual harvest (million bd.ft.) by timbershed for all modeled owners aggregated under three harvest flow variants for initial conditions.

Figure 5.—Projected Annual Harvest—Non-federal Owners.

By ownership group, the greatest harvest decline is expected in the national forests, declining by 270 million board feet from earlier trends, or 150 million board feet from recent harvest levels. Industry harvest levels are also likely to decline over the next several decades by about 150 million board feet from recent levels, returning to the levels of the 1970s and early 1980s. As a partial offset, the non-industrial private sector can increase harvests approximately 100 million board feet, as can the WDNR and Native American owners. Over history, substantial changes in harvest levels of the different owner groups has produced a rather stable trend for the total Eastside region (Figure 6). The estimated potential harvest levels suggest the same could be possible in the future for the non-federal lands, with the decline in federal harvest contributing to an overall decline for the region.



Average annual harvest for both timbersheds by ownership (including the national forests) for initial conditions. For all owners but the national forests, the 5% variant of harvest flow is assumed.

Figure 6.—Eastside Total Historical and Projected Annual Harvest.

THE IMPACT OF ENVIRONMENTAL CONSTRAINTS IS UNCERTAIN

The open question is whether the same environmental factors that are contributing to a dramatic decline in federal harvest may have a substantial impact on the non-federal harvest as well. A harvest sensitivity analysis for the non-federal forests suggests a wide range of outcomes is possible. Questions addressed to private owners on the likely impact of forest practice changes suggest concern that there could be a 15-20% reduction in harvest through mandated reserves such as streamside buffers and other habitat requirements. Under assumptions requiring even-flow or non-declining harvest over time, this impact would be immediate since it would reduce the available harvestable inventory. Sensitivity analysis with no constraints on decade-to-decade harvest level changes shows that non-federal owners have as much as 7.0 billion board feet of marketable or essentially mature inventory which could be liquidated over a 10-20 year period and potentially offset the immediate impact of increased harvest constraints (Figure 5 "unconstrained").

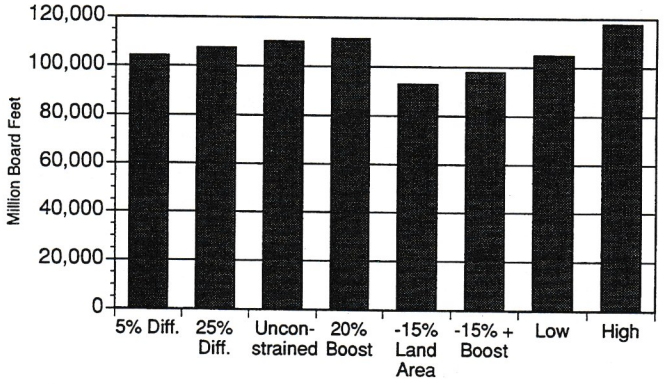
EXCESS MATURE INVENTORY COULD BE USED TO OFFSET CONSTRAINTS IN THE NEAR TERM

Using even-flow constraints to model harvest intentions is at best only an approximation of an owner's rationale for smoothing out harvest levels over time. The favorable economics of harvesting timber as soon as it is mature generally cause substantial year-to-year changes for each owner, since inventories do not steadily move toward maturity because they are impacted by prior natural disasters, changing market patterns, and purchase decisions. With no consideration for stabilizing (unconstrained) harvests, owners would be expected to liquidate any mature inventory quickly. Early liquidation also promotes management of the stand at an earlier date, thereby increasing land productivity. Such an unconstrained harvest simulation produces a 60 million board feet increase in harvest per year over the long term, while also gaining the economic value of several billion board feet of mature inventory in the first two decades. To a considerable degree, this tendency for some owner groups to liquidate mature inventory explains some of the variations in harvest levels between one owner group and another over the historic period. Inventory on industry land was most likely harvested as soon as it was mature and economical to harvest, subject to the need to stabilize the flow of wood to mills. WDNR and non-industrial private owners, on the other hand, feel less economic pressure, have maintained more mature inventory, and will benefit more from the decline in federal and industry harvest levels in the future. Harvest levels could be increased for one or two decades, potentially offsetting shortages.

HARVEST LEVELS MAY BE IMPACTED BY FUTURE TIMBER MANAGEMENT CHANGES

Harvest levels are also sensitive to management assumptions. In comparison to the initial conditions, increasing management to the highest levels increases the harvest level over the next 100 years by 130 million board feet per year. If harvest levels in the first decade are large and well above even-flow harvest levels, higher trend harvest levels can be restored in 80 years. In effect, the liquidation of about 20 billion board feet of mature inventory, in conjunction with increased management of those acres, produces nearly the highest long-term harvest, but at the expense of a 30% reduction in harvest for a few decades beyond the first. These sensitivity alternatives suggest one possible response to the increased environmental constraints on private harvest would, therefore, be to accelerate the liquidation of mature inventory, thus postponing the impact of the constraints and accompanying them with some increase in management. Assuming no more than a 5% departure from even-flow harvest levels, a 20% acreage boost of one management level in conjunction with 15% increased harvest restrictions results in a 6% reduction in harvest over a 10-decade period but with almost no loss in harvest at the end of the period. On the other hand, if environmental constraints interfere with the motivation to increase management by increasing the cost of management, there could be a reduction in management, compounding the impact of reduced land availability.

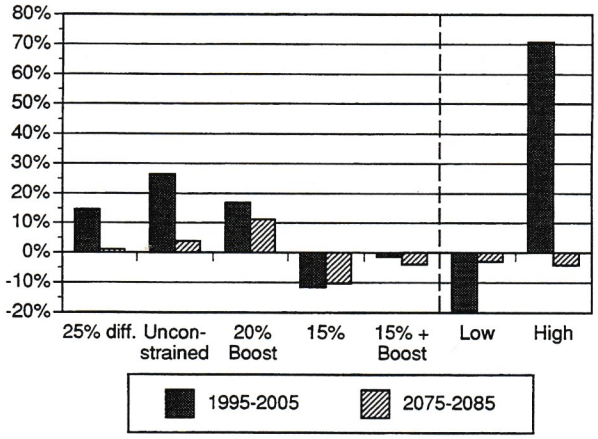
The sensitivity of harvest levels to variations in flow constraints and management levels is summarized in Figure 7 for the 100-year interval, and in Figure 8 for the first two and last two decades. Over the first 100 years the highest harvest level is obtained from all lands placed in the highest management level, or no harvest constraints (see Figure 7).



Projection of cumulative harvest over 100 years for all modeled owners under three harvest flow variants for initial conditions and for five sensitivity analysis scenarios.

Figure 7.—Projected 100 Year Cumulative Harvest—Sensitivity Analysis.

The difference between these two scenarios is substantial, with the potential harvest estimated from the highest management up by 70% over the first two decades, then off by 30%, and recovering to sustainable levels by the last two decades (see Figure 8). Without the higher management, unconstrained harvest flows increase the harvest potential in the first two decades by 27% (with a relatively small decline in the mid-term harvest) and restored harvest levels by the last two decades.



First five scenarios display percent difference in harvest volume from 5% harvest flow constraint in first two and last two decades. "Low" and "High" display percent difference from the unconstrained management scenario.

Figure 8.—Harvest Volume Sensitivity to Different Management Scenarios.

FOREST HEALTH ISSUES INCREASE THE MOTIVATION FOR EARLIER HARVESTS AND INVESTMENT

Attention to forest health issues may increase the near-term harvest and increase the long-term harvest at the expense of lower harvest levels over the intermediate decades.

Forest health issues include imbalances of forest structures or processes, such as excesses of dense or multi-canopy stands susceptible to insect attacks, mistletoe, or fungi and ultimately to fires. Past management and natural cycles have led to many forest stands in eastern Washington being attacked or susceptible to attack by bark beetles (over-crowded stands), mistletoes and defoliating insects (multiple canopy stands), and root or stem rots (over-crowded or previously injured trees). These conditions not only reduce volume through rotting wood or killing trees, they also lead to increased forest fires (Everett 1993; Sampson et al. 1994).

Active management for forest health could lead to thinning or harvest of "unhealthy" stands and active management of other stands to avoid the unhealthy conditions. These activities would lead to increased harvest in the short term, less harvest in the intermediate term, and higher harvest in the long term as the earlier-harvested stands become available for harvest again.

Another scenario would be for the unhealthy stands to burn in wildfires (a highly likely scenario for many areas). These fires will probably occur sometime in the next three decades. Sporadic salvage harvesting could occur for about three years after the fire, creating "pulses" of wood from the burned areas. If the fires are large enough, they will create the same high harvest levels in the next few decades, low harvest levels in the intermediate decades, and high harvest levels in the long term as the burned stands again become harvestable, assuming the post-harvest stands are managed (regenerated or thinned, as necessary).

If neither fires nor harvesting occur to a large degree in unhealthy stands, the result will be a decline in harvest levels at all times, since there will be a reduction in volume produced by the unhealthy stands.

EASTSIDE LAND PRODUCTIVITY IS ONE-THIRD TO ONE-HALF THAT OF THE WESTSIDE, RESULTING IN VERY DIFFERENT MANAGEMENT PRACTICES

Under survey of management plans, Eastside industry will harvest timber at a rate of roughly 300 board feet per acre per year, roughly one-third of the rate of Westside industry lands. The harvest rate per acre of WDNR and non-industrial private lands are roughly one-half of their Westside counterparts. The harvest rate per acre on Forest Service lands remains at roughly 80 board feet per acre per year since their decline in harvest is largely related to increases in reserved land.

THE STANDING INVENTORY VOLUME MAY REMAIN STABLE, BUT THE MEAN DIAMETER WILL DECLINE

At sustainable harvest rates, the standing inventory volume remains stable. If the mature inventory is harvested early, stand inventory volume declines. The highest levels of management and most rapid levels of inventory reduction reduce the standing inventory by over 30% by 2090. These highest harvest rates at the end of the 90-year period correspond to the lowest levels of standing inventory, not the highest. They also move stands from the condition of potential health risk to increased productivity more quickly.

The average diameter of trees harvested decreases with the reduction in mature inventory from approximately 20 inches to 14 inches over 90 years; hence, the relatively stable inventory is made up of a larger number of smaller trees. Alternatives that result in a more rapid liquidation of mature inventory and intensive management lead to a more rapid reduction in the diameter to about 13 inches.

The increasing share of grand fir in the late decades is evidence of generally undesirable shade tolerant, fire intolerant, and disease susceptibility trends under almost all alternatives. These scenarios suggest that even selective cutting that emphasizes leaving preferred trees for the next growth cycle may not be sufficient to contain health degeneration in the absence of occasional fires.

The reduced average diameter at harvest may not mean reduced wood quality if the harvest tree size is made more uniform. Presently, many stands contain a few large trees and many small trees as a result of past selective harvesting. Other even-aged stands (resulting largely from past stand-replacement fires) are over-crowded and contain many very small stems. Future management which reduces the number of small stems in both even-age and uneven-age stands can increase the value of the wood even though the maximum size of the harvested trees may

be less. Such managed stands will also contain fewer rotten or otherwise defective trees than many stands presently available for harvest.

EMPLOYMENT WILL BE IMPACTED BY HARVEST LEVELS

Historically, there has been a reasonably stable relationship between harvest level and employment. Labor productivity gains have not been steady and have been impacted both by the severity of business cycles and, even more substantially, by the price of the resource. More labor is used when resource prices are high, than when prices are low, so higher values can be obtained from the resource.

Projections of employment are illustrated (Figure 9) for two scenarios. The high level reflects the full harvest potential of non-federal owners plus the reduced harvest on federal lands. This potential, of course, may be 10% or more above owners' behavior, as suggested earlier. The lower projection shows the impact of a 15% land reduction that might correspond to environmental pressures on non-federal lands. These projections are based on trend levels since this research has not attempted to project supply and demand balance conditions over time. Employment could be higher with high management levels and high prices, or lower with low prices and policies that inhibit management.

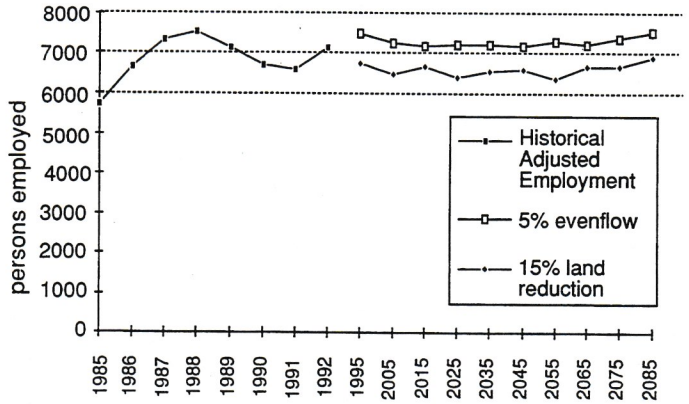


Figure 9.—Projected Employment for Eastern Washington in Lumber and Wood Products Under Two Alternative Scenarios.

SUMMARY: NON-FEDERAL HARVESTS MAY BE STABLE, BUT ONLY THROUGH A MARKET- AND POLICY-SENSITIVE SHIFT IN SHARE

The potential harvest level on non-federal lands appears to be relatively stable in the aggregate but requires a shift from industry harvests to other owners and from the Central Cascades to Inland Empire timbershed. Forest practice constraints may cause a 15-20% reduction in the harvest on non-federal lands, but the existence of significant mature inventory could reduce the impact of this over several decades. There is also a chance that increased management activities could offset some of this impact over the longer term.

Environmental constraints, management practices, market conditions, policy, and salvage operations after natural disturbances are all likely to be important to the ultimate determination of harvest levels. The decline in federal harvests and constraints in forest practices on private harvest, accompanied by the decline in industry harvest based on declining mature inventory, may be somewhat more certain than the potential increase in harvest on non-industrial and WDNR managed lands,or potential increases in management intensity. Limitations in the accuracy of the forest inventory could also mask significant deviations in actual owner response from those projected. While the potential exists for the harvest on non-federal lands to increase and potentially offset the projected decline in the federal harvest, there is little evidence to substantiate that it will happen.

LITERATURE CITED

Adams, D., R. Alig, D. Anderson, J. Stevens, and J. Chmelik. 1992. Future Prospects for Western Washington's Timber Supply. Institute of Forest Resources #74, College of Forest Resources, Univ. Washington, Seattle.

Everett, R. (Team Leader). 1994. Eastside Forest Ecosystem Health Assessment. USDA Forest Service, National Forest System and Forest Service Research. 5 Volumes. Forest Science Lab., Wenatchee, WA.

Johnson, Ralph R. 1990. The East Cascades Geographic Variant of the Stand Prognosis Model. WO Timber Management, Ft. Collins, CO.

McKay, N., P. M. Bassett, and C. D. MacLean. 1994. Timber Resource Statistics for Eastern Washington. USDA Forest Service, Pacific Northwest Region. PNW-RB-201.

Sampson, R. N., D. L. Adams, S. Hamilton, S. P. Mealey, R. Steele, and D. Van De Graff. 1994. Assessing forest ecosystem health in the Inland West. Amer. For. Magazine. 100:13-16.

Wykoff, W. R., N. L. Crookston,and A. R. Stage. 1982. User's Guide to the Stand Prognosis Model. USDA Forest Service, Intermountain Forest and Range Exp. Sta., Ogden, UT. Gen. Tech. Rep. INT-133.

Authors

Bruce B. Bare
Professor
Box 352100
College of Forest Resources
University of Washington
Seattle, WA 98195-2100

Bruce R. Lippke
Professor
Box 352100
College of Forest Resources
University of Washington
Seattle, WA 98195-2100

Chadwick D. Oliver
Professor
Box 352100
College of Forest Resources
University of Washington
Seattle, WA 98195-2100

Scot Zens
Graduate Research Assistant Zens
Box 352100
College of Forest Resources
University of Washington
Seattle, WA 98195-2100

Research Support

Joao Batista, John Dirks, Jeffrey Moffett, and Guy Robertson