Timber Trends on Private Lands in Western Oregon and Washington: A New Look

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Market model projections of private harvest in the Douglas-fir region over the period to 2054 suggest that harvests in western Oregon could be sustained at or above recent levels for the full period with ending inventories at least as high as in 2004. Western Washington, in contrast, may face some harvest reductions, particularly on other private ownerships, as a result of high harvests in the 1980s and continued rapid land loss. Projected silvicultural regimes in both half-states shift toward more use of commercial thinning on all private ownerships. No trend in future log prices is foreseen. In policy simulations, applying Washington’s riparian protection policy to western Oregon led to a 4.4% annual private harvest reduction. Extension to intermittent streams in western Washington reduced annual harvest by 1.9%. Quintupling national forest harvest across the region increased annual regional harvest by 3.2% with more than a quarter of the public increment offset by private harvest reductions.

Keywords: timber supply, market model, private timberlands

The private timberlands of the Douglas-fir region of western Oregon and Washington are among the most productive in the United States. Although they comprise only 3% of the national private timberland base, they provide more than 14% of US private softwood harvest. They are heavily stocked, carrying twice the national average inventory per acre for private ownerships. Their growth per acre in recent years has been two and one-half times the national private average and twice the average of private lands in the South. With the sharp decline in federal harvest after 1990, the share of private lands in regional timber supply has grown from less than 60% in the 1970s and 1980s to nearly 85% since 2000. Clearly, the future timber supply prospects of private timberlands are critical to the region and ultimately to the nation. Reflecting this importance, many studies over the past 50 years have sought to project future private harvests in the region. The earliest (USDA Forest Service 1963, Gedney et al. 1975) correctly foresaw a steady decline in private cut through the early 2000s, although they erred significantly on actual levels. More recent projections generally expect an end to the long-term declining trend, with stable or rising private harvests over the period to 2050 or so.

This article offers a new look at long-term private supply prospects in the Douglas-fir region. It has been more than 10 years since the last simultaneous studies of timber harvest potential in the two half-states (Sessions 1991, Adams et al. 1992). In the years since those studies, the mix of harvest sources in the region has changed dramatically, as noted previously, with much greater demand for private timber. Partly as a result, trends in private harvest have in some cases diverged from those anticipated in the earlier studies and, particularly in western Washington, rates of change in the timberland base have been markedly different from the assumptions used in past projections.

We use updated inventories for both western Oregon and Washington and, unlike many past studies, our projections derive from a market-based model of the region’s log-consuming industries and private timber producers. The model recognizes the spatial distribution of mills and forests in the region and explicitly tracks log flows from woods to mill. The study also projects the mix of silvicultural regimes applied to private lands over time, recognizing the potential financial returns to those investments. The next two sections outline the methods used to make the projections and describe the base case results. A third section examines two hypothetical policy scenarios of interest to private owners: expanded riparian protection zones and increased harvest from national forests.

Methods

Studies of future timber supplies have five basic components: (i) inventory data describing the lands of interest; (ii) assumptions about likely future silvicultural regimes to be applied to those lands; (iii) projections of future timber yields under the several regimes; (iv) assumptions about changes in timberland area through gains or losses to other uses or owners; and (v) a model that projects future harvests based on inventory and other assumptions, applies the management regimes, and updates the inventory over time.

Inventory

At the inception of this study, the USDA Forest Service Forest Inventory and Analysis (FIA) inventory data for the two half-states in the Douglas-fir region were 10–15 years old and the traditional periodic (10-year cycle) inventory system had been supplanted by a revised annual design that had been in place less than 5 years. Consequently, we attempted to update the most recent full periodic inventories (1995–1997 for western Oregon [Azuma et al. 2004], 1988–1990 for western Washington [MacLean et al. 1992]) by projecting and harvesting the plots in a simulation system designed to mimic actual growth and harvest. Inventories were brought to a common starting point (2003) using a harvest scheduling model
that selected plots (condition classes in western Oregon) for harvest to maximize the present net worth of timber returns over the period from the inventory date to 2003. Simulated harvesting was constrained to mimic actual historical cut by year and owner at the county level. Cut by species group, period-to-period changes in harvest per acre, and the area partial cut were constrained at the half-state level (the finest scale for which historical data are available). For western Washington, we also used the total growing stock inventory estimates for 2001 available from the partial sample reported by Gray et al. (2005) as a further check on the accuracy of the update. In this process, tree lists from the original plots were updated using a version of the Forest Vegetation Simulator (FVS) (Dixon 2003).

Management Intensity Classes (MIC)
An MIC is a regime of silvicultural activities applied over the life of a stand. In our analysis, stands are classified as either (i) “existing,” those that are part of the original inventory at the start of the projection, or (ii) “new,” those that are regenerated during the projection. MICs used for both groups are summarized in Table 1. There are seven MICs for existing stands and eight for new stands. The same stocking limits shown in the upper portion of the table for precommercial thin (PCT) and commercial thin (CT) are applied in both new and existing stands.

Yield Projections
As in the inventory update process, yields for each MIC in each stand were generated using one of three regional variants of FVS. FIA surveys do not distinguish between stands of planted or natural origin. Consequently, we assumed that the stems per acre and species composition in new naturally regenerated stands (by ecoregion) were the same as that derived from averages for all young stands from the FIA database. New planted stands have a density of 436 trees/ac for softwood types and 350 trees/ac for hardwood types. In these stands, 95% of the species composition is the planted species (e.g., Douglas-fir) and the additional 5% is assumed to be the same proportional mix of species as found in natural stands. This latter addition recognizes the contribution of volunteer seeding and legacies from previous stands.

Table 1. Management practices and management intensity classes for existing and new stands in Douglas-fir region model.

<table>
<thead>
<tr>
<th>Definitions of management practices</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precommercial thin (PCT)</td>
<td>if &gt;263 trees/ac at stand QMD = 2 in.</td>
</tr>
<tr>
<td>Commercial thin (CT)</td>
<td>if &gt;20 mbf/ac remove 30% of volume</td>
</tr>
<tr>
<td>PARCUT HILO*</td>
<td>if &gt;35 mbf/ac remove 15% of volume</td>
</tr>
<tr>
<td>PARCUT LOME</td>
<td>if &gt;15 mbf/ac remove 3% of volume</td>
</tr>
<tr>
<td>PARCUT MEHI</td>
<td>if &gt;30 mbf/ac remove 50% of volume</td>
</tr>
</tbody>
</table>

Management intensity classes

<table>
<thead>
<tr>
<th>Existing stands</th>
<th>New stands (natural or planted)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grow only (no additional practices)</td>
<td>Regeneration only</td>
</tr>
<tr>
<td>PCT</td>
<td>Regeneration + PCT</td>
</tr>
<tr>
<td>CT</td>
<td>Regeneration + CT</td>
</tr>
<tr>
<td>PCT and CT</td>
<td>Regeneration + PCT and CT</td>
</tr>
<tr>
<td>PARCUT HILO</td>
<td>PARCUT LOME</td>
</tr>
<tr>
<td>PARCUT MEHI</td>
<td></td>
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* PARCUT is partial cut with no final harvest.

Figure 1. Illustration of log market model from perspective of a single milling or processing center.

Land Area Changes
Over the past 20 years, the largest timberland area changes have occurred in Washington, where, on average, industrial owners have lost 3.5% of their land base every 5 years, and the other private group has lost about 1.5% every 5 years. For industrial owners, the predominant form of land area change involves shifts to other private owners. For other private owners, land has been lost primarily to urban development. In western Oregon, in contrast, both owner groups have realized small gains in timberland since the late 1970s, for industry owners, through transfers from other private, and for other private owners, through reclassification of nonforest to forest (agricultural land reversion).

In the projections, we assume that the general direction of past area trends will continue over the next 15 years but at reduced rates. The recent historical gain in western Oregon’s private base was small, and we assume constant timberland area for that region. In western Washington, we assume the industrial base falls by 3.5% and the other private base by 2.5%, over the next 15 years. Both are then stable in the remainder of the projection.

Market Model
Timber harvest is a measure of the processing activity on the supply side of the regional log market. From the market perspective, future levels of timber harvest will depend on developments in both log supply and demand and not solely on timber inventory or other resource characteristics, as is often the case in flow-based analyses of timber supply potential. In this study, we construct a model of the Douglas-fir region log market that explicitly recognizes the spatial dispersion of log processing facilities and the forested lands that supply logs. Demand is derived from lumber and plywood production and log exports, all of which are sensitive to the delivered price of logs. The supply of logs in the short term is based on private owners’ decisions about harvest timing to optimize the value of their timber investments given stand growth and interest rates. In the longer term, it depends on management (silvicultural) investments because these are influenced by anticipated yield increments, management costs, interest rates, and price expectations.

Figure 1 illustrates the general form of the model (see Adams and Latta [2005] for details of a similar model). Log processing is grouped into specific milling or processing centers in the region. Figure 1 is the log market at a single milling center. Mills generate a demand for delivered logs at this center, which varies with log price up to the point of capacity. Log demand would shift depending on product prices, technology, nonwood costs, and capacity. In the
arbitrage of the market, log buyers trade off possible log sources until their costs are as low as possible for their level of output. Capacity itself is not fixed but varies with product prices, equipment costs, depreciation, and interest rate.

Potential sources of private log supply lie at various distances from the processing center and have varying cost characteristics depending on the types of forest management, logging conditions, haul distances, and the interest rate. The several segments of the supply “curve” in Figure 1 represent potential log supplies from different timberland locations. From the log supplier’s perspective, market arbitrage involves trading off possible destinations until its net return is as high as possible. The balance between buyers’ and sellers’ actions sets prices in the market, harvests, flow patterns from woods to mills, and levels of output at the milling centers.

**Additional Assumptions**

In the projections, assumptions about future prices of products and of labor and “other” variable inputs were derived from the 2005 Resource Planning Act Timber Assessment Update (US Forest Service 2005, Timber Assessment Update, available online at www.fs.fed.us/pnw/about/programs/hnri/index.shtml; last accessed Jan. 27, 2006). Harvest from public lands is determined by policies within the respective managing agencies and generally is not sensitive to log price over the 5-year time interval used in this analysis. Consequently, we treat public log supply as exogenous and in the base case assume that it will remain constant at recent (2000–2002) average levels throughout the projection.

**Base Projection**

As illustrated in Figure 2, the long-term (multidecade) harvest trends for both forest industry and other private ownerships have been broadly similar in western Oregon and Washington. Forest industry harvest has declined. This drop has been particularly rapid in western Washington, so that industry and other private harvests were nearly equal in the most recent harvest reports (2002). The drop has been slower in western Oregon, where industry cut remains nearly five times the other private level. Other private harvests, in contrast, have shown little long-term trend but considerable short-term variation. In both half-states other private cut moved up rapidly in the 1980s, particularly in western Washington, and then declined in the 1990s.

**Forest Industry**

The base harvest projections (Figure 2) suggest that forest industry lands in both half-states could sustain harvests over the next 50 years near the average levels observed in the past 10 years. The western Oregon projection, proceeding from similar inventories and future yield assumptions, is close to the earlier projection by Adams et al. (2002). It is substantially higher than the projection by Sessions (1991), because of continued expansion in inventory in the intervening 15 years (see Figure 3) and markedly different projection methods. The western Washington projection, in contrast, is roughly 30% lower than both the projections by Adams et al. (1992) and Larson and Wadsworth (1982). In this case, industrial inventory and land base have declined sharply over the past 10 years (Figure 3), reducing long-run supply potential.

Western Oregon softwood harvest exceeds growth after 2010 (Figure 3) and inventory falls until 2034. Western Washington inventory remains roughly stable until this same period. In the remainder of the projection (after 2034), both inventories rise as stands planted after 2004 reach the ages of most rapid board foot volume growth.

Past studies in the Douglas-fir region have found that forest industry owners expected to use a modest range of management regimes in current and future stands (Adams et al. 1992, 2002, Haynes 2003). The largest concentration was expected to be in “regeneration-only” regimes, with some use of either early (PCT) or late (CT) stocking control. Projected patterns of investment in the base case generally are consistent with these earlier findings as illustrated in Figure 4. Regimes involving regeneration only and regeneration plus PCT dominate in stands at the start of the projection but gradually are replaced by regimes using commercial thinning or commercial thinning plus PCT by 2044. The shift to regeneration plus CT regimes is stronger in western Oregon. Movement toward PCT plus CT is more extensive in western Washington.

**Other Private Lands**

Other private lands in western Oregon and western Washington are similar in the extent of area (both comprise about 1.88 million
ac), but they differ markedly in historical harvest levels and recent sawtimber inventories (see Figures 2 and 3). Cut in western Oregon has been roughly one-half of that in Washington over the period shown in Figure 2 and less than growth as well. Consequently, western Oregon inventory has been rising (Figure 3). This provides part of the basis for the marked expansion in projected cut, together with sizable areas of older timber, no projected land area loss, and a large concentration of stands in the near merchantable ages in the current inventory. Expanding inventory, stable land base, and large areas of older stands have long been traits of these lands; therefore, earlier studies (e.g., Sessions [1991]) have shown similar increments in projected future harvest.

In western Washington, the other private land base is projected to continue to decline over the next 15 years. Coupled with reduced inventories and a heavier concentration of stands in young ages (because of heavy cutting in the 1980s),[1] harvest over the next 50 years is projected to fall to or below the long-term historical average and is below projections of earlier studies until after 2040 (Figure 2).

Projected inventories on other private lands in western Oregon and Washington follow roughly similar time paths (Figure 3). Harvest exceeds growth for the first 25 years in both cases and inventories fall. In western Oregon this reflects the heavy concentration of lands in older age classes, well in excess of the age of financial maturity, and projected harvests higher than historical averages. In western Washington, high harvests over the past 15 years have shifted large areas into very young ages and inventory falls despite declining harvest. After 2029 both inventories begin to rise, reflecting improved stocking in regenerated stands and maturation of large areas presently in the youngest ages.

Projected patterns of change in management regimes on other private ownerships are similar to those on industrial lands (Figure 4). Most lands initially are concentrated in the simplest (regeneration only) regimes. Over time land is shifted into more complex forms of management, with the heaviest concentration in regeneration plus CT.

Log Prices
Recent studies of North American sawtimber markets anticipate strong continued growth in both offshore product supplies and in southern sawtimber harvest potential (see, e.g., Haynes [2003] and US Forest Service 2005 Timber Assessment Update, available online at www.fs.fed.us/pnw/about/programs/hnri/index.shtml; last accessed Jan. 27, 2006). Consequently, little growth is expected in future real product prices or regional sawtimber stumpage prices. In the present study, we use the product price projections from the Forest Service’s 2005 Timber Assessment Update as shifters in our half-state log demand equations. In part, because of these product price assumptions and because of slow projected future capacity expansion in the region, our delivered log price projections show little change from current levels (see Figure 5).

Comparisons to Past Studies
Private forestlands of the Douglas-fir region have been the subject of numerous studies of timber supply potential over the past 50 years. Figure 6 compares the aggregate private harvest projections from several of these studies with our base projection. Methods vary markedly across the studies. Rahm (1980) Forest Policy Project, the Timber Assessment reports by the Forest Service, and the current study use different forms of market models. The remaining studies use various volume flow and judgmental approaches.

Most past studies have correctly foreseen the continued decline in regional private harvest (from their particular historical perspective) and all have anticipated (incorrectly to this point) that the decline eventually would cease. The present study and the 2005 Timber Assessment Update both envision a modest further decline. Unlike the Update, however, our study does not foresee a resurgence to higher levels after 2030.

Alternative Policy Scenarios
The base projections were made under the assumption that current policies governing both private and public forestlands would remain unchanged, but this condition certainly has not characterized the Douglas-fir region over the past 50 years. From the standpoint of timber harvest, some of the most significant policy shifts
have been the adoption of increasingly complex regulations for private forest practices by the states and major changes in management directions for the national forests. How sensitive is the base projection to further changes in these two policy areas? This section examines two hypothetical policy changes to illustrate the potential harvest impacts.

Expanded Riparian Protection

Consider a case in which the riparian protection policies in western Oregon are modified to mimic those currently applied in western Washington, while those in western Washington are extended to cover intermittent as well as perennial streams. The net effect would be to raise the proportion of the private land base in both half-states that is under some form of harvest restriction.

Because streams can be identified only as perennial or intermittent in the FIA inventory data (nothing in respect to their fish-bearing characteristics), the impacts of current riparian protection regulations are approximated by means of fixed zones and management restrictions around the perennial and intermittent stream classes. This is a significant simplification of much more complex sets of rules in both Oregon and Washington, but we believe it captures the general form and extent of removing or limiting harvest access to lands in the actual regulations. Current (base case) riparian policy in western Oregon involves a no-harvest buffer on certain fish-bearing streams and partial cutting buffers of varying widths for these and other streams. We approximate this as a 20-ft no-cut zone around all streams and a partial cut buffer from 20 to 50 ft on perennial streams to mimic the “average” impacts across all stream types. Using this approach we estimate that current riparian protection rules remove about 4% of private lands from harvest in the no-cut zone and limit harvest to partial cutting in another 2.5%.

In western Washington the current policy comprises three nested zones (core, inner, and outer) varying in width by site quality. It is modeled here (again with considerable simplification) as a 50-ft no-cut core area for both perennial and intermittent streams and an inner zone of 81, 49, and 21 ft for high, medium, and low sites, respectively, on perennial streams only. The outer zone for perennial streams is set at 54, 41, and 29 ft for high, medium, and low sites, respectively. There is no final harvest in the inner or outer zones, but the residual tree density is higher in the inner zone. The resulting base case buffer area in western Washington involves some form of restriction on 8.2% of private lands.

In the scenario, the western Oregon policy is changed to the more restrictive western Washington form, increasing total buffer acreage in western Oregon to 16.5% of the private timberland base. In western Washington the alternative policy extends the base case rules to intermittent streams, increasing buffer acreage to 16.7% of the private timberland base by expanded application of the inner and outer zone restrictions.

The scenario regulations remove an additional 4.3% of the private land base from harvest access in western Oregon (expanded no-cut core) and more than double the acreage subject to various levels of retention in both states. As illustrated in Figure 7, total harvest in the Douglas-fir region is projected to fall by some 2.8% or about 177 million board feet (mbf)/year on average over the period to 2054 (relative to the base case). The largest harvest impact is in western Oregon, where projected annual cut falls by 4.4% (roughly proportional to the area limitations), while annual western Washington cut falls by an average of 1.9%. Despite some expansion in harvest on areas outside of the riparian zones, the additional no-cut timberland grows rapidly, and total private inventory in the Douglas-fir region rises over the projection, reaching more than 13% above base levels by 2054.

Expanded Harvest on the National Forests

Between 1989 and 2002, annual national forest timber harvest in the Douglas-fir region fell from nearly 3 billion board feet (bbf) to roughly 57 mbf. Some expansion from these low levels might be expected under the Northwest Forest Plan (Regional Ecosystem Office, Northwest Forest Plan, available online at www.reo.gov.
...ing stock inventories by 2054 are as high or higher than at the start.

harvest levels vary over time relative to growth, but softwood grow-

decreasing trends in industrial harvest would not continue. Projected

private ownerships. Total Douglas-fir region harvest would be

Washington private harvest is foreseen, however, particularly on other

western Oregon. Consistent with national-level stud-
ies, regional log prices in the base projection show no long-term

Although there is much debate about what might constitute

base scenario has some of the commonly discussed attributes of

Although the average age of private inventories will fall. Given

our assumptions of limited levels of public harvest, inventories

on public lands in the region would expand dramatically and

their average age would rise. [3] Projected private harvests are

attainable under conditions of essentially constant real product

and stumpage prices, suggesting that the industry may be com-

petitive in the broader (national and international) market con-

text foreseen in the base case. The silvicultural regimes applied in

the region shift toward various forms that include thinning but
do not depend on any assumptions about genetic yield improve-
ments or use of highly intensive methods.

The expanded riparian protection scenario, extending Wash-

ington’s elaborated zone system in Oregon and Washington,
leads to nearly equal proportions of the private land base covered

by some form of buffer protection in both half-states. The big-

gest impacts occur in western Oregon, where the hypothetical

policy represents a doubling in the area of the no-harvest zone.
Quintupling national forest harvest in the region (relative to

average 2000–2002 levels) leads to an expansion in regional

harvest, again with greatest effects in western Oregon. Substitu-

tion of public for private cut in this case means that only 71% of

the increment in public harvest is reflected in expanded regional

cut. Because both scenarios lead to reduced private harvest, both
give rise to higher private inventories averaging more than 13%
above base levels by the 50th year of the projection.

Endnotes
[1] The rapid rise in western Washington nonindustrial private forest (NIPF) har-
vest during the 1980s shown in Figure 2 was due in part to the growth in log
exports during this period. Washington Mill Study reports (see, e.g., Larsen
[1994]) show that the volume of NIPF logs used in exports during this period
more than doubled as did the share of NIPF logs in the total log consumption of
the export sector.
[2] The years 2000–2002 are the last 3 years for which harvest data are available for
both Oregon and Washington.
[3] See the Forest Service’s RPA Timber Assessment Update (US Forest Service
2005, Timber Assessment Update, available online at www.fs.fed.us/
prw/about/programs/hzri/index.shtml; last accessed Jan. 27, 2006) for details of
projected growth in national forests and other government inventories under
similar assumptions about public harvest in the region.

Literature Cited
harvest projections for private land in western Oregon. Research Contribution 37,
Oregon State University, College of Forestry, Forest Research Laboratory,
Corvallis, OR.


