The Future of Washington's Forests and Forestry Industries

UNIVERSITY OF WASHINGTON
College of Forest Resources

THE FUTURE OF WASHINGTON'S FORESTS AND FORESTRY INDUSTRIES

Fourth Progress Report: November 2006

Prepared for the Washington Department of Natural Resources
By the College of Forest Resources, University of Washington

Introduction and Acknowledgements

This 4th Progress Report on the Future of Washington Forests and Forestry Industries requested by the 2005 State Legislature serves as a preliminary summary report identifying important issues that will be further developed in the final report. A Roundtable was held at the University October 30-31, where 65 individuals commented on the findings of Progress Reports 2 and 3. This Progress Report contains findings presented at the Roundtable but not complete at the time the 3rd Report was written, some new findings discussed at the Roundtable, and questions from the Roundtable that should be assessed at the November 20-21 Forum. A Roundtable Discussion Summary prepared by Washington DNR supports this 4th Report.

This report and the ongoing studies involve many participants and several phases of activity. Each study area is developing assessment information relating to the State of Washington's forests and forest industries and future prospects. Each study is being led by a University of Washington College of Forest Resource (CFR) faculty member and supported by a team of university experts and external consultants/advisors. Brian Boyle, consultant to the Dean and leader of the Northwest Environmental Forum, is managing the integration of the report working with Craig Partridge and Bonnie Bunning, of the Washington State Department of Natural Resources (DNR). DNR is contracting agency and is determining how best to develop recommendations for the Legislature based on the findings from the assessments.

Contact Leads are:

Administrative - PI: Robert Edmonds
Project Manager, and CFR Coordinator for Legislative Recommendations: Brian Boyle
Study 1: Timber Supply and Forest Structure - PI: Bruce Lippke
Study 2: Competitive Position - PI: John Perez-Garcia
Study 3: Economic Contribution - PI: Ivan Eastin
Study 4: Land Conversion - PI: Gordon Bradley
Study 5: State Granted Lands ROI -PI: John Perez-Garcia

Each study plan has a number of advisors and consultants. Study 1 benefits from a Technical Advisory Group (TAG) of over 20 forestry and forest sector experts who are assisting in collecting information about current and future forest practices. Timber supply information is being provided by the USFS Forest Inventory Analysis unit (FIA), Tribes, DNR, and USFS. Study 2 and 3 use data provided by the Departments of Revenue, Natural Resources, and Employment Security in addition to representatives of industry sectors advising Study 1. Study 4 is supported by The Cascade Land Conservancy and a separate expert advisory group. Study 5 depends heavily on DNR internal data and studies and will consult with the UW Department of Economics.

In addition to the many faculty, staff and graduate students listed as report authors, there are others providing critical support for the project. Clara Burnett is the professional staff assistant and along with Angel Ratliff is providing editing and layout. Matthew McLaughlin is providing web and CD production services www.nwenvironmentalforum.org, www.ruraltech.org, www.CINTRAFOR.org, and http://www.dnr.wa.gov The list of supporting resources for each study area will likely grow as the project nears completion.

A study of this scope is a complex undertaking depending upon many inputs from many individuals and organizations; however, any opinions, findings, conclusions, or recommendations expressed in this publication are those of the authors and do not necessarily reflect the views of supporting agencies or project cooperators. The intent of the study task reports is not to make recommendations but to develop assessment information that can be used by others in support of policy considerations and recommendations to the Legislature.

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Study 1: Timber Supply and Forest Structure

Bruce Lippke, Larry Mason, Kevin Zobrist, Kevin Ceder, Elaine Oneil, Alicia Sullivan, Hiroo Imaki

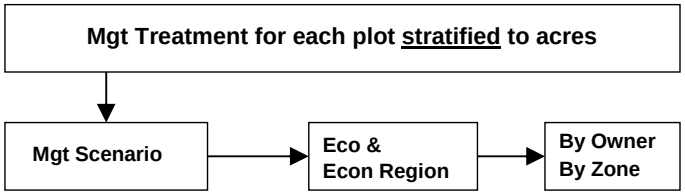
Timber Supply and Forest Structure Study Methodology

By using the USFS Forest Inventory Analysis (FIA) survey of forest inventory plots by owner, supplemented by tribal and DNR inventories, one can estimate the number of acres, by timbershed and owner in each age class, as a basis for developing projections. The inventory plots provide tree list information allowing the use of growth models to project tree growth and forest structure subject to alternative management plans. The forest structure information provides measures of forest diversity and species-specific habitat suitability. Using DNR hydrographic and forest health layers makes it possible to analyze the impacts of stream buffers and forest health issues. Stratifying the management plans over time on acres remaining in forest use and available for harvest results in projections of available harvest. By projecting tree lists forward under different management alternatives we are able to characterize the sensitivity of key outputs such as forest diversity, habitat, fire hazard, insect risk, riparian LWD & DFC, harvest, forest economics, and jobs. However, the quality of measurement of the outputs is limited by the adequacy of the inventory, hydrographic and health measures, and to a lesser degree the ability of growth models, to model factors such as thinning treatments and the impacts of land conversions.

Table 1. Inputs and outputs

Timber Supply and Forest Structure

Key Inputs	Intermediate Drivers	Output (acres & objectives)
Inventory Plots by owner & region (tree lists)	Alternative Treatments on Tree Lists	Insects & Disease
Mgt Intensity Intentions (treatments)	Health Overlays & Density	AFP-LWD / Riparian
Growth Models: Organon, FVS (tree lists & site classes)	Regulatory contraints: Buffers & Reserves	Stand Structure Diversity
		Habitat Suitability
GIS layers (spatial) (DEM, Streams, Health)	Fire Hazard Model	Fire Risk & Carbon
	Log Cut & Marketing (Revenue)	Forest Economics
	Processor Production Function (jobs)	Community Economics



Harvest Trends and Variances in Prior Predictions

The timber supply projections produced in 1991 were benchmarked to data available for 1986-1989, and analyzed for their predictive error variance compared to 1998-2002 harvest by owner, the most recently-available statistics. These prediction errors relative to a baseline projection are large, were not anticipated by possible projection alternatives, and in many cases are not easily explained. The Westside private harvest (industry, NIPF and tribal) was projected to decline by 5%, to 3.7 bbf/year, but actually declined to 2.5 bbf/year, a 31% projection error. While the impact of regulatory constraints for old forest habitat and

riparian buffers was substantially underestimated in the baseline projection, current estimates of acres that cannot be harvested do not come close to explaining the difference. The prediction of an increase in harvest on state lands of 3%, to 850 mmbf, based on a substantial mature inventory, compares to an actual harvest of 490 mmbf, a 43% projection error. While large, the decline in harvest projections associated with the DNR's HCP and other harvest constraints appears to explain most of this variance. While the federal harvest decline was projected to be substantial at 74%, the actual decline was 97%, contributing to an actual decline across all owners of 2.5 bbf, and a total harvest projection error of 36%.

The eastside harvest variance is smaller and more easily explained. The private harvest was projected to increase by 16%, to 870 mmbf/yr, but only increased by 4%, to 780 mmbf. This appears to be in the range explainable by regulatory constraints and forest health impacts. The state land harvest was projected to increase by 33%, to 160 mmbf, but actually declined to 80 mmbf, a 50% error in the projection. This includes the impact of increased reserves and delays in implementing forest health treatment plans. The Federal harvest decline was projected at 69 %, but actually declined by 85%, contributing to the actual decline across all owners of 380 mmbf and a 20% projection error. While more explainable than the Westside projection errors, the projection errors in both regions suggest that the focus should be on what factors may contribute to further change in the harvest and structure of the forest than on the absolute accuracy of the projection.

Understanding what treatments are likely to be applied to what portion of the landscape and the resulting mix of outputs is a key part of the timber supply analysis. The analysis provides estimates of forest sustainability, the attractiveness of forest investments, jobs, rural economic activity, carbon, and a suite of habitat measures. Tradeoffs and changes in these outputs are identified. The decision process to determine the adequacy of habitat and environmental protection, who should provide it and who should pay is a policy debate, not a supply assessment.

Eastside Forest Health Issues

Forest health consequent to climate change is the dominant concern for the Eastside

In the second progress report it was noted that there is an alarming increase in mortality from insects as well as great concern over the increase in fires and the high fire hazard levels for inland forests. The Forest Health Working Group Report (DNR 2004) provided recommendations and the committee was re-convened to assist in communicating the issues to communities. The conditions observed in the two years since that report was prepared have intensified these concerns.

Tree mortality from mountain pine beetle (MPB) has increased from 2.2 trees per impacted acre over the prior 20 years to 8.4 trees/acre over the most recent 4 years, covering over 40 times more affected acres. This suggests more aggressive attacks with greater mortality per acre and substantially more impacted acres. MPB infestations have been related to high summer temperatures, high vapor pressure deficit and very low soil moisture availability. Five year average summer temperature and vapor pressure deficit exceed any measurements made within the previous 100-year period. Pines essentially shut down under these extreme summer conditions, which leaves them more susceptible to MPB infestation. The existing pine forests may succumb to a fate similar to British Columbia with millions of acres of dead trees, and a fire hazard even larger than the consequences from excess tree density.

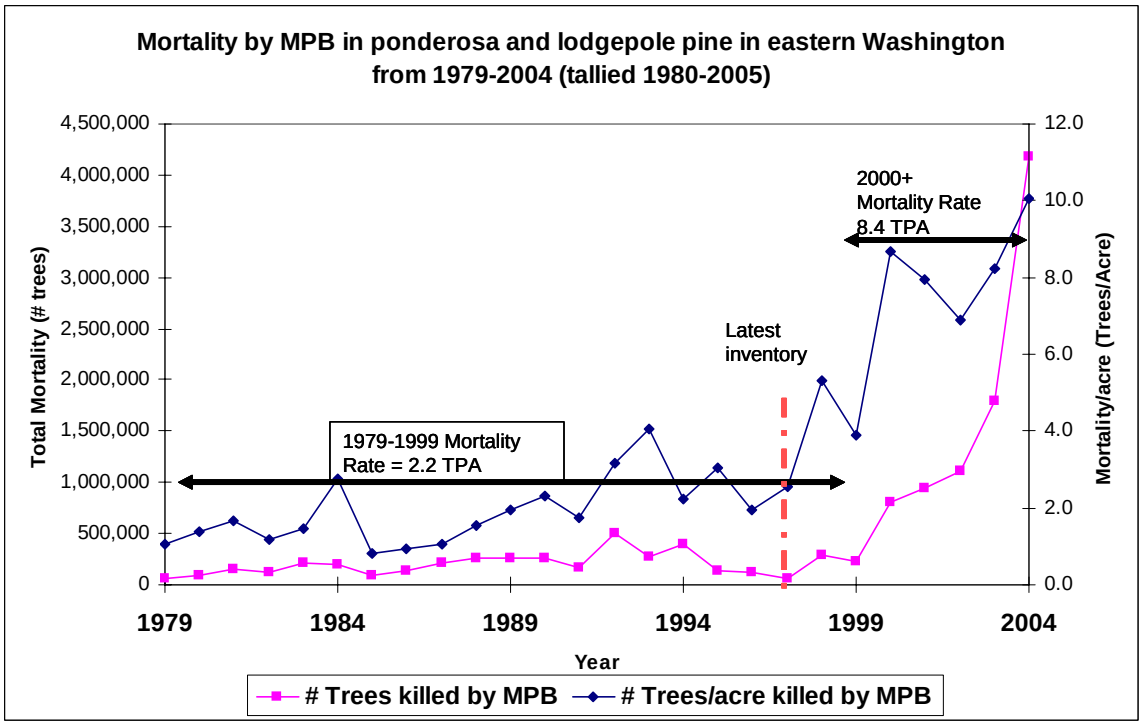


Figure 1. Mountain pine beetle mortality

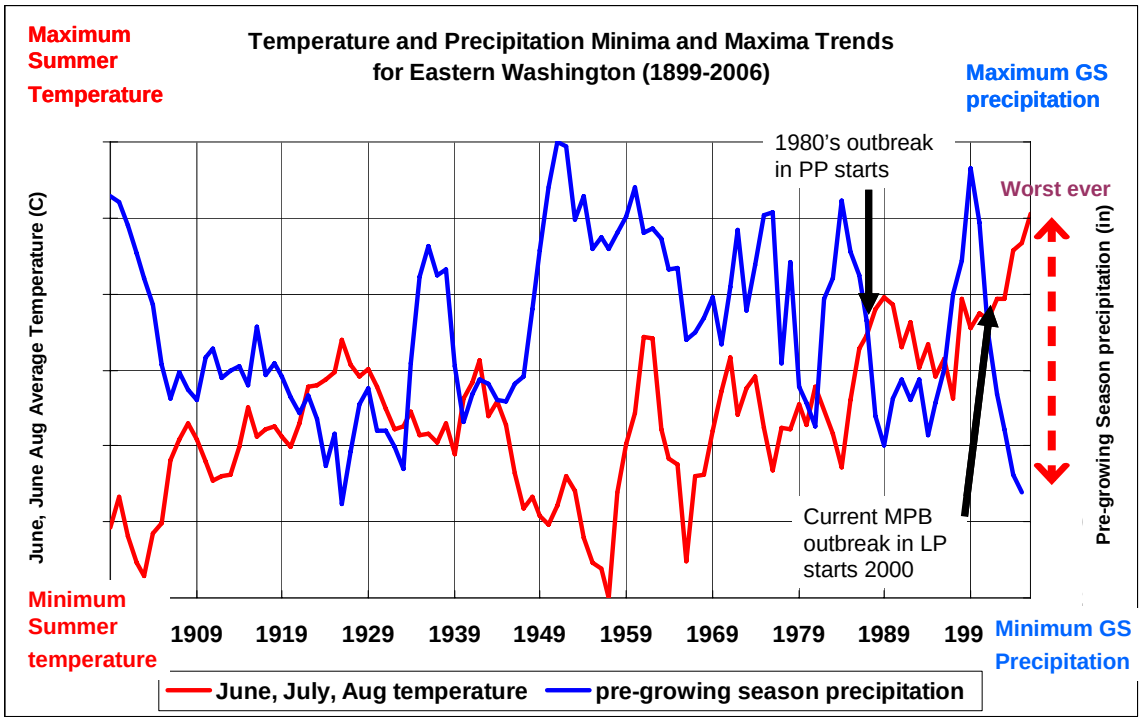


Figure 2. Temperature and precipitation extremes.

While historical data have shown that reducing tree density can improve the resistance and resilience of the remaining stand, there is recent evidence that thinning to densities previously thought to be adequate to reduce insect attack may no longer be enough. Because of the extent of the MPB epidemic, treatment strategies aimed at restoring the fire-resistant pine overstory may not be sustainable under current climatic conditions. However, regenerating forests to pine species is still believed to be a useful strategy, as there is preliminary evidence that pine can adjust to drier climatic conditions in the absence of an overwhelming MPB epidemic. Other inland species may also be threatened. While more research on species resistance and carrying capacity (density management) for Eastside stands is needed, historically recommended treatments need to be reconsidered to include strategies that can restore the productivity of heavily impacted lands and improving the resistance of those not yet affected.

Increasing Fire Hazard

The increasing density carried on many Eastside forests after a century of fire suppression, particularly on Federal lands, is contributing to increases in fire frequency and intensity as well as reducing resilience to insect attack. As density increases the fire hazard increases, resulting in more acres and more volume burned as nature's way of capping the increase in density. Eastside National Forests such as the Okanogan and Wenatchee have 80% of the land at moderate to high fire risk (enough ladder fuels that wind in excess of only 25mph (moderate) and 50mph (high) will carry a ground fire into a crown fire). Burned acres contribute 6 tons of carbon-equivalent to the atmosphere along with a legacy of dead trees that will contribute decomposed-matter carbon emissions for decades. Stands thinned to 45 sq. ft. basal area substantially reduce fire risk for 25 years or more and contribute to increased stored carbon in the forest over time as a consequence of lowered fire risk, increased carbon stored in products, and especially through displacement of fossil-intensive products such as steel and concrete. As much as 19 tons per acre more carbon is stored after a phase-in program to reduce fire risk on moderate and high hazard stands.

Carbon trading markets are currently too undeveloped and poorly formulated to recognize the increased economic value of carbon stored in long-lived products and as displacement for fossil-intensive products, yet forest management has a substantial impact on carbon stocks. Fire fighting costs on the other hand are very real although not linked directly to forest management economics. Fire fighting costs of $1000 per acre on the more remote Federal lands and $2000 per acre on state and private lands can be avoided by treatments that reduce the risk of fires. Avoiding the costs of fighting fires can more than compensate for the high cost of fire risk reduction treatments and can be a justification for public investment in the removal of high cost material that contributes to increasing fire hazards. The combined avoided costs of fighting fires, fatalities, facility losses, forest regeneration costs, and water losses, along with other non-market benefits such as reduced risk of smoke and fires in populated areas, appear to be substantially larger than the costs to effectively remove hazardous material and risk fires. While the value of carbon stored might become sufficient to justify more aggressive fire risk reduction treatments, the future societal costs that can be avoided have the potential to be a much greater motivator.

Declining Private Eastside Harvest

There will likely be a decline in private harvest on the Eastside for the next several decades given the high private (and tribal) harvest rates that appear to have partially offset much of the Federal decline over the last decade. Higher prices caused by the Federal harvest decline induced an increase in the private harvest that is not sustainable in the long term. Yet there is also a possibility of a substantial increase in volume removed, particularly on Federal land, to reduce fire hazards with some volume being merchantable as a potential offset to the declining harvest. Some of this material may only be suitable for biofuel use and only be removed by stewardship contracts on Federal lands or through the use of incentives on private lands. There are growing opportunities for salvage. It appears from the FIA inventory data that DNR should be able to increase its harvest and health restoration activities. This needs to be verified using DNR's own inventory data. Forest health removals of 60 mmbf per year have been identified in the DNR Southeast region for at least the next decade, though marketing opportunities may be limited by inadequate milling capacity.

Based on our simulations on 455,000 moderate and high fire risk stands, the fire risk on about 1 million acres of fire-prone Eastside Federal forests will require treatments on approximately 40,000 acres per year for 25 years involving 840 thousand tonnes of biomass/year, of which at least half (180 mmbf/year) may be merchantable through sawmills. The volume of removals that would result from a 25-year plan to reduce the fire risk just on Federal acres is large and sufficient to maintain the flow of material needed to sustain the lumber processing infrastructure as well as substantially increase the biofuel infrastructure. However, the conflicts that have to date prevented this level of activity would first have to be overcome. A major problem remains with public acceptance of forest health treatments and the institutional arrangements to support such a level of activity.

Increased use of biofuel as a renewable resource is viewed as an essential part of a hazard fuel reduction biomass removal effort. There are many different methods for using biomass as a biofuel or in products that substitute for fossil fuels, yet we are not aware of studies that demonstrate either best methods for producing biofuel or identification of all the local obstacles that need to be removed.

Declining Infrastructure

With an anticipated decline in Eastside harvest, there appears already to be further erosion in the infrastructure, with several existing mills planned for closure. The result will be longer hauls, less competitive bidding for timber, and lower returns for timber investments, just the opposite of desirable conditions to sustain the acres in forestry and restore forest health.

Modeling future conditions

The ability to use emerging forestry modeling capabilities such as FVS and FFE to predict forest vegetation growth, treatment impacts, and relative fire hazard, based on tree list inventories and projection systems such as LMS, is almost essential for restoring forest health. Forest attribute analysis can be customized for local conditions and extended to consider the treatment-associated impacts on stand structure, habitats, forest health, and essential public values. However, the available inventory data collection systems are grossly inadequate to do much more than establish awareness of a problem in an area. Current data are not sufficient to aid owner planning or to advise or monitor forest health progress at the owner or community level.

Key summary points for Eastside forests:

- Mountain Pine Beetle impacted acreage is more than double any prior level reached since record keeping began with no decline in the epidemic anticipated in the near future.
- Climate-induced temperature and vapor pressure deficit are outside of their historic range – with little evidence of returning to “normal” conditions.
- Mature pine may not be able to adjust to the climate change before succumbing to MPB attack, but regenerated pine are expected to be more resilient.
- Thinning treatments to reduce density and increase resilience can help but density levels and species selection based on historic experience will need revision to address the stresses associated with climate change.
- Research is needed on the impact of climate on stand carrying capacity, site specific density management, and tree adaptability, to support overstory retention and regeneration strategies.
- Fire hazards continue to increase with growing density and increasing mortality.
- Treatments to reduce fire hazard store more carbon -- in the forest as a consequence of reduced fires, in products, by displacement of fossil-intensive steel and concrete products, and from biofuel use.
- Current carbon credit schemes do not account for many of these impacts.
- Avoiding the future costs of fighting fires, fatalities, facility losses, regeneration costs, erosion restoration, smoke, and other non-market benefits, substantially exceed treatment costs but at present

there is no institutional recognition of these benefits to influence spending decisions, except by tribal decision makers.

- Private harvests will decline but could be offset by increased Federal and state forest health activity to reduce fire hazards and insect risk while making the forest more resilient to climate change.
- Biofuel opportunities exist but depend upon better understanding of obstacles to implementation.
- Processing infrastructure essential to forest health treatments is already declining in anticipation of wood shortages.
- Existing inventory data are sufficient to become aware of forest health problems but not sufficient to promote on the ground site-specific forest health restoration activities or effectively monitor changing health conditions.

Westside Regulatory Impacts and Effectiveness

Owl reserves, riparian protection, road management and unstable slopes have all been addressed by regulations and appear to be a major cause for declining harvest levels. However, the decadal decline in Westside private forests appears to be substantially larger than our current estimates of these impacts even considering the increase in no-management buffers to comply with the Forest & Fish regulations. Our estimated 10% reduction in harvest from riparian buffers, even with the more historic estimate of 5% in other constrained harvest areas for owl nests and other protection, falls far short of the 36% private harvest decline observed over the last 12 years.

Stream typing changes introduced with the Forest & Fish agreement have substantially increased the harvest constraints first estimated for both fish-bearing and non-fish-bearing headwater streams. Using a Lewis county case study, a county with about 20% more buffers than the all county average representing 9% of all Westside buffers, we estimated the impact on large and small owners to be:

	Industry			**Small Owners**		
	Old	New	change	Old	New	change
Increased buffer acres:	5.6%	8.7%	56%	5.8%	10.3%	77%
NPV loss $/total acre	524	337	187	622	351	271

The impact of new headwater streams; +133% for industry and + 145% for small owners, is well above the average impact but also remains very uncertain. Using LIDAR data to refine the accuracy of the topography shows many times more headwater streams. Both the changes in stream typing and the potential of better stream layer data sources casts into doubt the intended stability of regulatory impacts.

More important, these averages do not reflect the disparity of impacts across small owners since some have much of their land in riparian zones. The Stand Expectation Value (SEV) (bare land or return to sustained forest management) for a study of ten small owners ranged from a 34% loss to 115% loss. Average Forest Value losses (including standing timber) of $6000 per acre in buffers or even $600 per total acre where a nominal SEV would have been $1000 are strong motivators for many owners to consider conversion to non-forest use. The riparian easement program, if fully funded, would compensate for the standing timber loss but does nothing to reduce the SEV loss, or the motivation to sustain forest management. Many small owners appear to be leaving the entire riparian zone untouched given the complexity of harvesting within the inner and outer zones resulting in an even worse economic impact.

The regulations do permit alternative plans in order to reduce the economic impact so long as the protection objectives are not diminished. Since almost all stands along streams have been commercially managed for decades, they have been commercially stocked to high densities well beyond natural stands and have grown into very dense overstories, unlike old mature conifer forests. The opportunity to thin in the riparian zone and put the RMZ on a path to produce structures statistically similar to old forests brings with it more viable

economics for the riparian acre, i.e. a positive return at a 5% discount rate. The ecological assessment for these thinning treatments also increases the percentage of time the stand is similar to old forest conditions, from about 32 % to 67%, a substantial ecological gain. In effect, alternative plans hold the promise of keeping forest management for small owners economically viable while accomplishing a substantial improvement in achieving the structural conditions desired along streams. However to avoid the complexity that small owners will avoid, they would have to be identifiable as pre-approved easy-to-implement templates.

Table 2. Ecological & economic metrics from riparian thinning alternatives *(small landowner example)*

Treatment	SEV/acre	Time in DFC (%)
No Touch RMZ	-$800	32
No Touch buffer	-$215	32
Thin & Narrow buffer	$207	65-70
No buffer	$627	<32

These impacts are also disproportionate across counties and species. Buffers as a percent of timberland range from a low of 3% for Island county to almost 17% for Pacific county, compared to 10.5 % averaged across all Westside counties. Alder is only 6% of the inventory yet almost 52% of riparian stands are largely alder. 36% of the alder cannot be harvested based on our industry management intentions survey. Alder values have increased while serving more stable non-commodity markets and have become a viable economic option to fir in some locations.

While the early estimates of road upgrade costs were very substantial (over $300 million for small owners), they are not considered a constraint to the harvest. By a change in the regulations, small owners are not required to upgrade their road drainage systems if there is no public financial support available. Large owners have essentially absorbed upgrading costs. Since not harvesting is not mandated on unstable slopes we were not able to isolate the separate impact of unstable slopes as a part of the unharvestable acres in the industry survey.

Key Summary Points on Regulatory Impacts and their Effectiveness:

- Changes in stream typing have significantly reduced harvestable acres with more negative economic impacts particularly on small owners (a 56% increase in industry buffers and 77% for small owners).
- There is great uncertainty on the number and extent of headwater stream buffers as observed by comparing the current hydro layer to LIDAR studies.
- The increase in headwater stream buffers was substantial and may become much greater with better data (a 133% increase in industry buffers and 145% for small owners).
- Average impacts do not adequately characterize the impact on small owners as many have a substantial acreage in riparian zones, resulting in negative Stand Expectation Values, the measure most associated with sustainable forest management. The riparian easement program, if fully funded, could provide mitigation against standing timber losses but does not provide any return for sustained management.
- Unmanaged dense riparian buffers have unintended consequences motivating land conversions and are much slower in reaching desired old forest conditions than biopathways based on periodic thinnings.
- Many small owners avoid regulatory complexity by not harvesting any trees in the entire riparian zone, a worst case for economic sustainability and attaining old forest conditions along streams.
- Targeting specific forest structures via templates that could be pre-approved and easily applied can improve economic sustainability and ecological attributes especially for those small owners who are disproportionately affected by regulations.

- LIDAR provides an opportunity for much more accurate inventory and hydrology data but may contribute to greater economic impacts. Stability in intent is not stability in impact.
- There is a substantial variation in regulatory impacts on riparian buffers across the landscape, ranging from as little as 3% to as much as 17 % across the Westside counties.
- Rates of return on alder serving non-commodity uses are competitive but are not being exploited and are constrained by no treatments within riparian buffers.

The Impact of Planned Management Alternatives on Westside Forest Economics, Rural Jobs, Carbon, and Habitat

Management Intensification

As a consequence of regulatory changes, the decline in Federal harvest, and the DNR habitat conservation plan, industry lands now make up 73% of the harvest, up from 64 % in 1990 on less than 40% of the unreserved timberland. Commercial management is trending toward shorter rotations with less thinning. The driving factors are several. The growth performance of young stands from the evaluation of test plots that have now been monitored for 10-20 years suggests that early brush control with genetic selection boosts young tree growth substantially making it possible to reach the optimal economic rotation more quickly. Recently-released growth models such as Organon 8, developed to fit the Stand Management test plot data, reflect this impact. Vegetation control is now expected on 60% of the industry land. The increase in value for smaller logs responding to mill technology improvements is also contributing to shorter rotations. However, general weakness in pulp and paper markets has contributed to lower values for the portion of commercial thinning yields that are not suitable for small log lumber processing. The recent downturn in lumber markets has caused reduced mill residuals and a temporary increase in small diameter pulp log values, a periodic cyclical response.

Increased volume from more intensive management improves both forest economics and contributes more direct jobs in rural communities. This also increases net carbon stored with more products displacing fossil-intensive products. These ongoing changes will shift the mix in forest structure on commercially managed lands with negative impacts on some habitat. While the shorter rotations may suggest increased acres in the more open conditions associated with regeneration, the more rapid young growth will also more quickly lead to canopy closure, and when not thinned, a loss of understory complexity. While the number of acres thinned are expected to decline to as low as 35% of the land, the most overly stocked stands will most likely continue to be thinned when the need arises either pre-commercially or commercially, if not both. The increasing share of unthinned stands will be concentrated in only two stand structure classes, open regeneration and canopy-closed stem-exclusion structures, the later supporting the least habitat and diversity. Biodiversity management pathways that include periodic thinnings and some retention of multi-story hardwoods, snags and downed logs provide a management alternative that can more quickly produce old forest structures, and have been adopted by DNR to achieve old forest conditions as a part of the Habitat Conservation Plan. Some lands are being managed as reserves to meet regulatory requirements, some on short rotations, some with at least one and sometimes two thinnings, and some on biodiversity pathways(such as short bio pathways with two heavy thinnings on a 100 year rotation or long bio pathways retaining 35 overstory trees at a third and final entry), as a range of treatments responsive to multiple objectives.

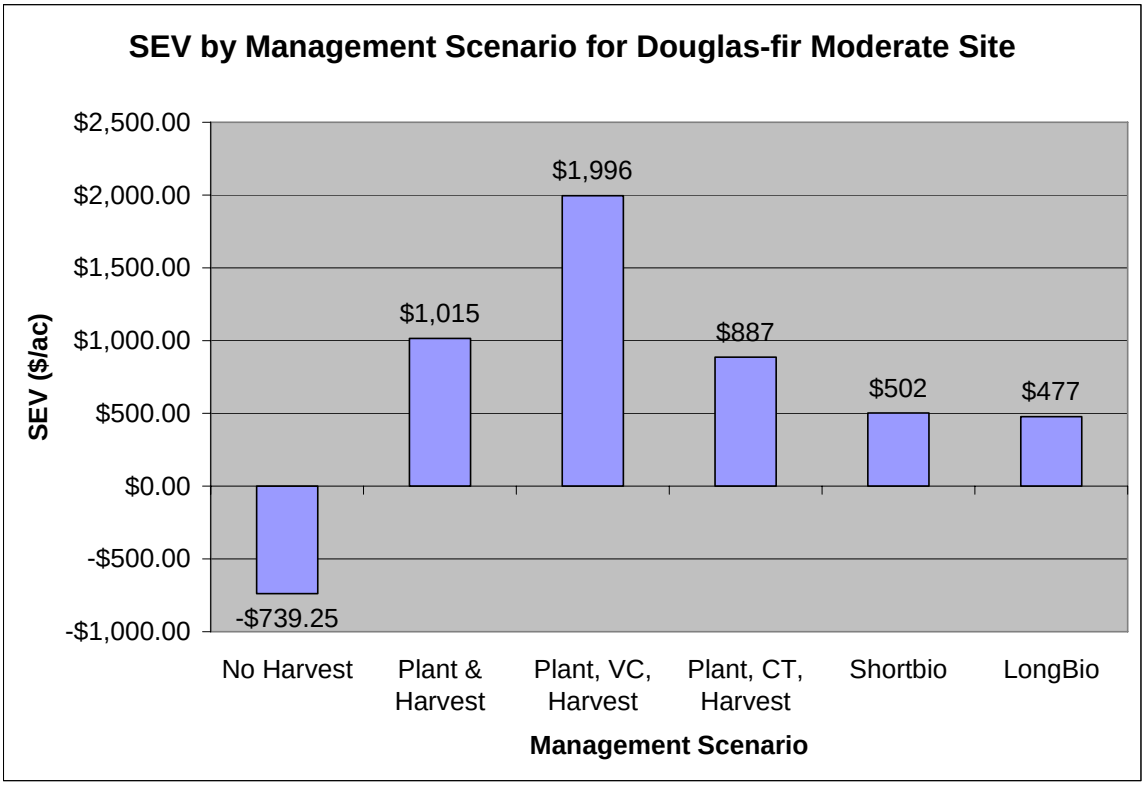


Figure 3. SEV by management scenario

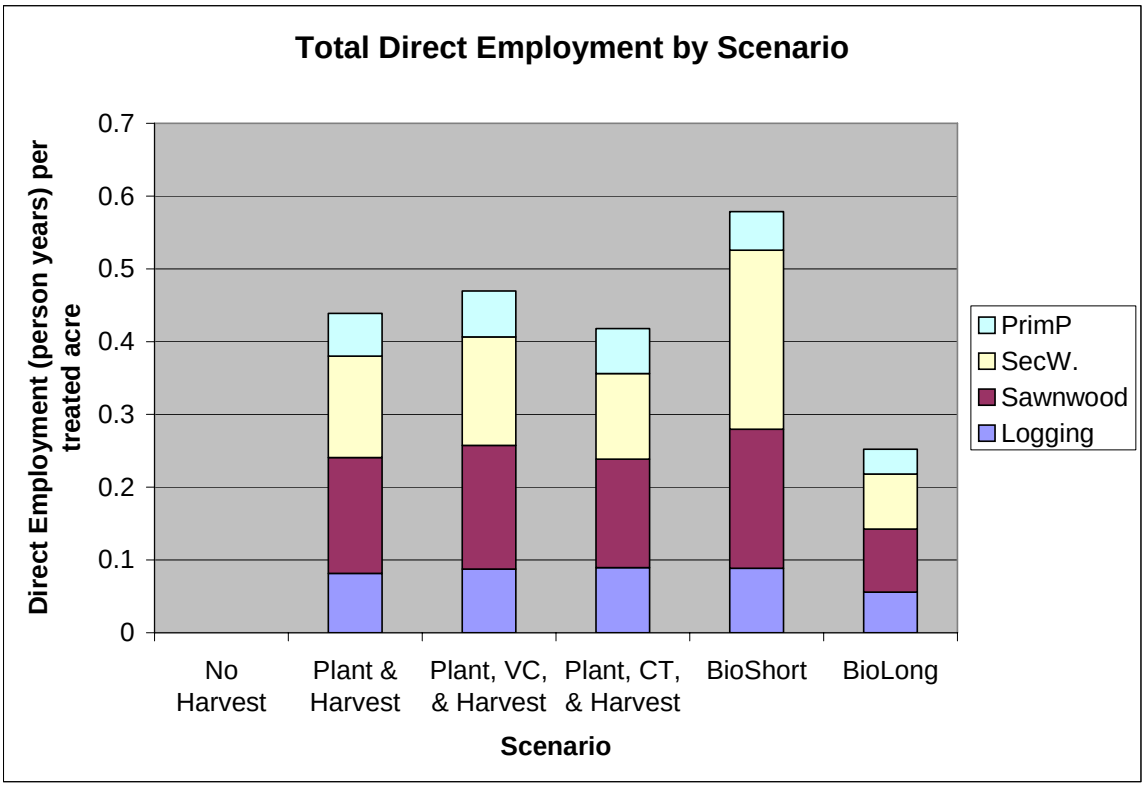


Figure 4. Direct employment by management scenario

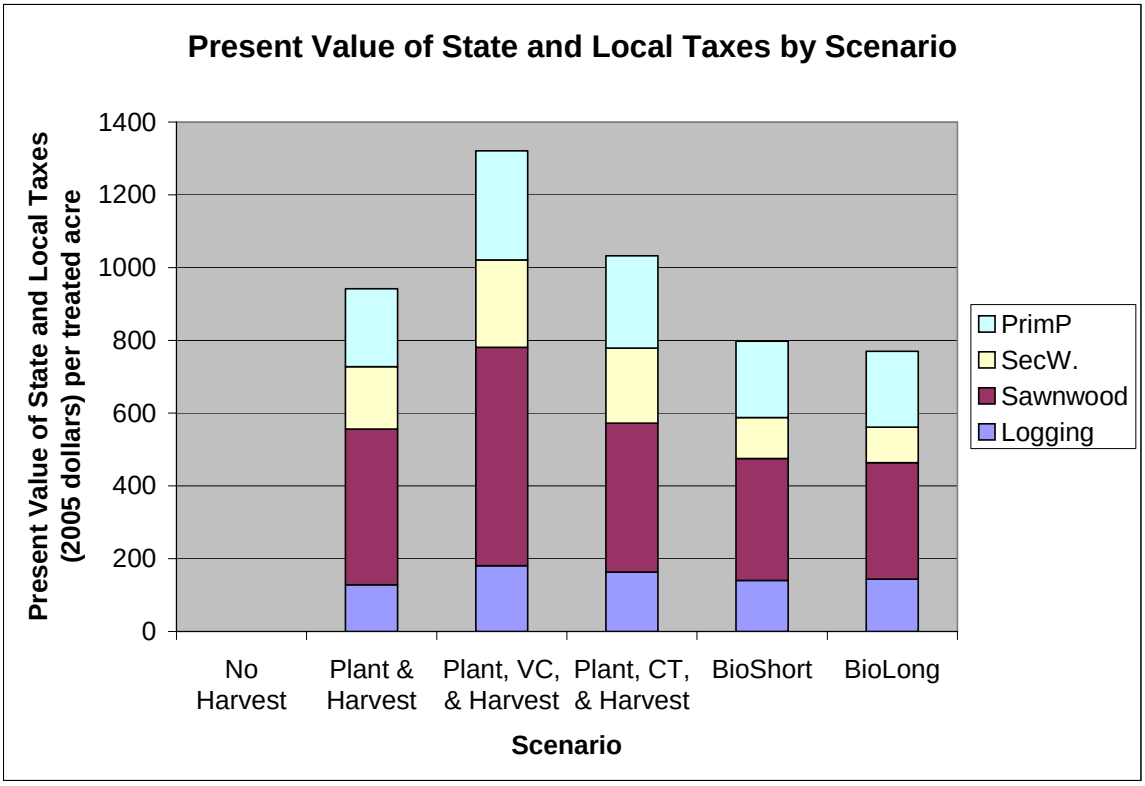


Figure 5. Present value of state & local taxes by management scenario

Biodiversity Pathway Support for Older Forest Habitat:

Commercial management reduces the availability of acres for species dependent on old-forest complexity. Biodiversity pathways involving periodic thinnings and longer rotations can achieve these conditions much more quickly than ageing and natural mortality. Stands on a biodiversity pathway can achieve old forest structural conditions (DFC, desired future condition) about 40% of the time (compared to never on short rotations.) But the cost of biodiversity pathways has increased considerably with the decline in premiums for larger and higher-quality logs, resulting in the need for larger incentives to motivate such pathways on private land. Some of this decline in premium is directly related to the decline in availability of large logs and the shutdown of large-log processing facilities, and it could be argued would return if owners were motivated to produce viable volumes of large logs for processing. However, the increase in engineered wood and small log processing technologies represents a more permanent shift away from the premium value for large logs. Some of the decline is related to reductions in log exports as foreign markets have historically paid higher prices for larger logs. This decline will also likely be more permanent as the foreign demand has changed with much greater emphasis on precut engineered wood applications.

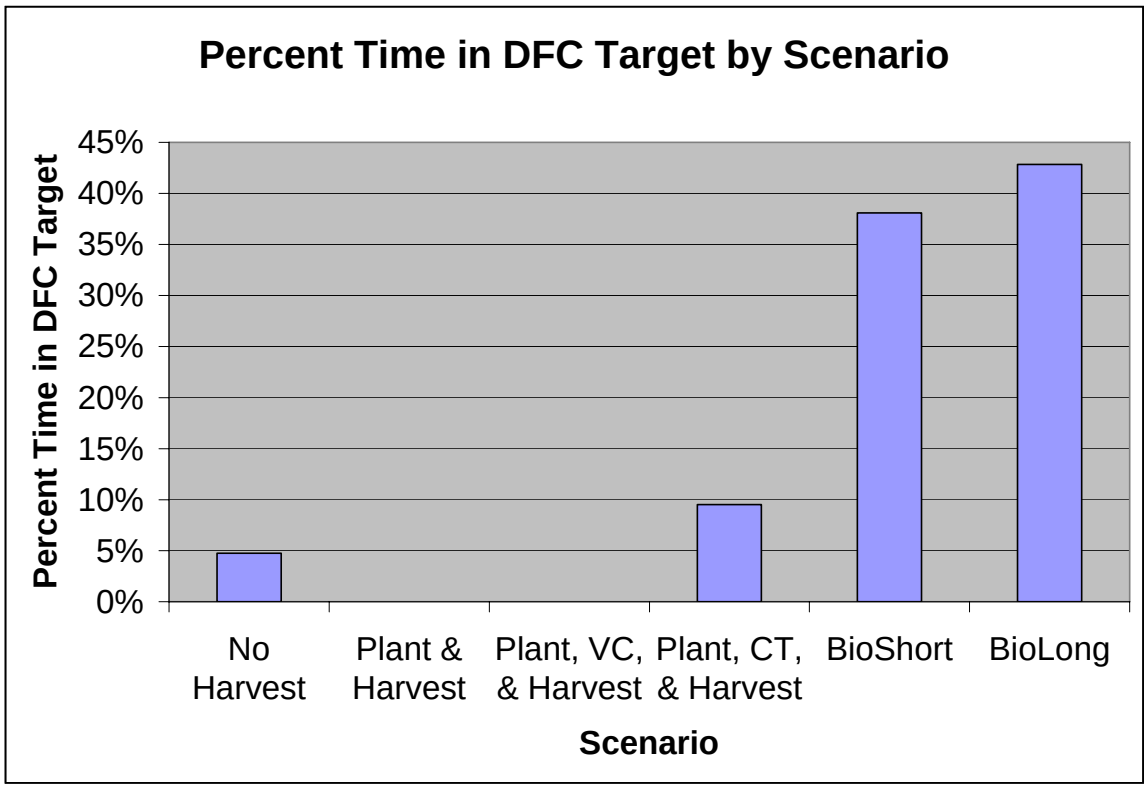


Figure 6. Percent time in DFC by management scenario

Reliance on No-Action Alternatives:

While federal management has shifted toward an emphasis on ecosystem management and protection, the operating paradigm has defaulted to the no-management alternative. Forests old enough to have acquired some diversity through disturbance events and mortality provide most of the remaining old forest habitat. Overly-dense stands resulting from prior commercial management and regeneration and fire suppression will remain unlikely to produce old forest conditions in the near term unless some natural disturbance events such as fires or windstorms produce more structural heterogeneity. Open stands have nearly disappeared on Federal forests with the absence of removals and fire suppression, producing a loss of habitat for some species. While the preservation of some older stands provides most of the old forest habitat available across all owners, there is no active Federal program to accelerate the restoration of old forest structures and the reliance on no-management comes with consequences. While there may be a diversity of structure classes across all owners, the diversity within each owner class is limited and appears to be declining.

Ecosystem Services

Forests provide much more than products for markets, jobs and habitat as they provide a broad range of other social values, including clean air and water. For example, there is recognition that sequestration of carbon in forest biomass may help to reduce heightened levels of atmospheric carbon. Carbon is one the first ecosystem services that may become internalized in the market on a large scale as efforts are increased to reduce emissions resulting from combustion of fossil fuels. Carbon trading systems and carbon registries are being created, however until the markets and registries achieve agreement on performance metrics with system-level accounting these systems will remain relatively ineffective and can be counterproductive. When tracking carbon across all carbon pools, the export of carbon from the forest into products that displace fossil-intensive products more than offset the continued growth in forest carbon over time. Producing more volume in a shorter time period without natural disturbance losses tends to produce the most carbon across all carbon pools. Carbon is only one example of an ecosystem service with public value.

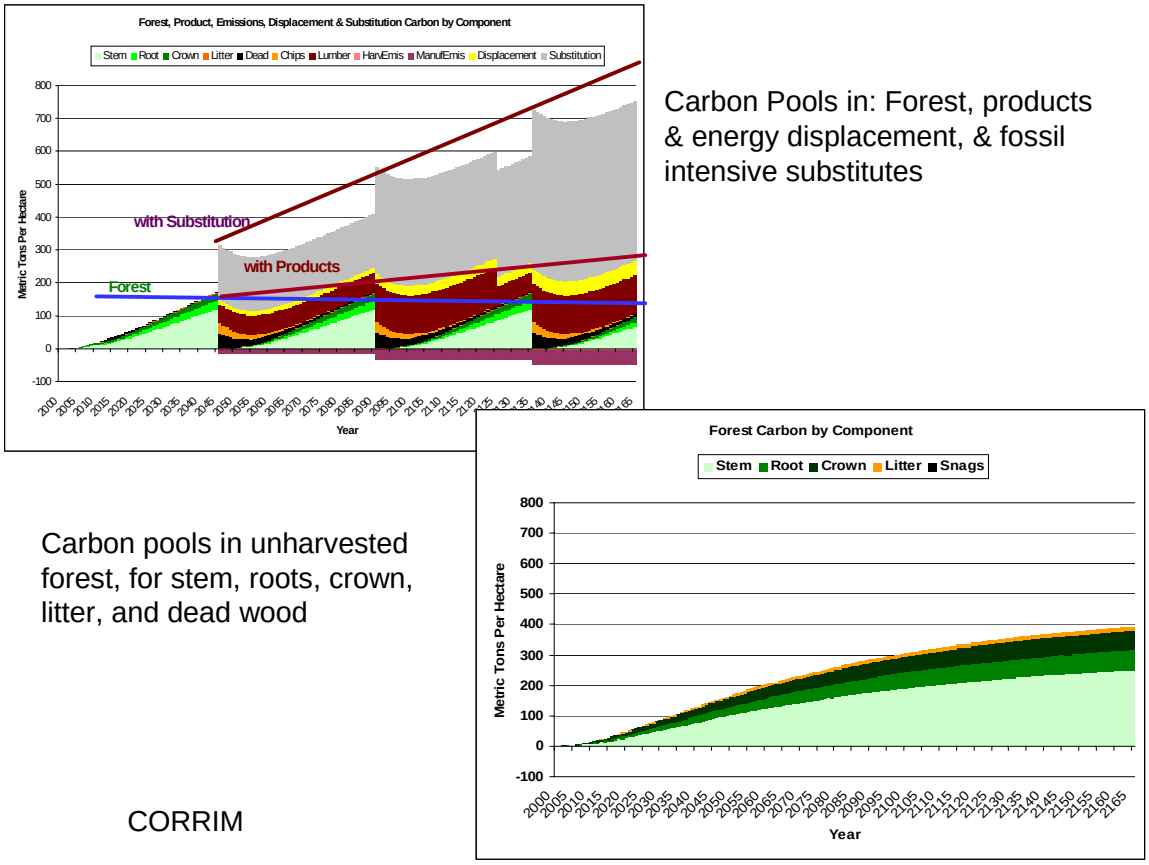


Figure 7. Carbon in forest, products, energy displacement & fossil intensive substitutes

Declines in habitats and forest diversity may be a concern for many owners and engaged publics. Different treatments produce different amounts of suitable habitat. Industrial forestlands on relatively short rotations are becoming increasingly homogenous. Non-industrial lands are under pressures from landuse conversion, and buffer regulations are complicated by intergenerational ownership transfer. Federal forests are protecting most old forests but have relied on no-management with continued fire suppression and, as a result, have less diversity with a heightened threat to old forests. The DNR habitat conservation plan increases targeted old forest habitats but at some cost to beneficiaries. Tribes are challenged by issues associated with legacies of past management such as lack of heterogeneity and overly-dense forests.

Offering incentives for ecosystem services provides a new opportunity to mitigate some of the disproportionate impacts resulting from regulations and should reduce land conversions.

Management Treatments

	NA	PC	PTC	PVC	PTTC	PTTL
Pileated Woodpecker	14.3	0.0	28.6	19.0	38.1	23.8
Douglas' Squirrel	71.4	33.3	38.1	19.0	66.7	71.4
Golden-Crown Kinglet	85.7	61.9	57.1	57.1	76.2	81.0
Roosevelt Elk	100	100	100	100	100	100

Figure 8. Percentage of suitable habitat for select species by management scenario

Managing for Multiple Objectives with Tradeoffs

Short intensive rotations produce the highest returns to owners, create the most near term jobs, support the most tax revenue, and provide the most carbon storage. Thinning when canopies first close can contribute to increased understory complexity of benefit to some species but not those that depend heavily on old forest structures. They also provide the option to proceed with a biodiversity pathway and a longer rotation as the alternative to a future clearcut and regeneration. Taking no action will eventually induce some mortality but many stands will become overly dense and stagnate. The market cost of biodiversity pathways measured as a reduced economic return has increased about 30% to 50%, requiring incentive payments of about $29/acre/year to make a landowner equally motivated. This cost estimate for the ecosystem service of providing old forest habitat is currently implicit to regulations that require such habitat (owl, marbled murrelet and riparian reserves) and may be several times larger ($89/acre/year) if no harvest is allowed.

Harvest Projections:

The industrial harvest has trended down for more than a decade, responsive partly to a changing age class distribution and partly to regulatory constraints. Management intentions surveys support a leveling in the harvest over the next several decades and then an increase as a response to increases in mature age classes. However, when the decline in industry acres is factored in, based upon trends observed from the FIA inventory data, the near term harvest trend may continue to decline, prior to the boost from more mature age classes returning the harvest back to current levels. Non-industrial harvests are not as likely to decline, as they are picking up land from industry as fast as they lose it to land conversions and they continue to retain an excess in mature age classes.

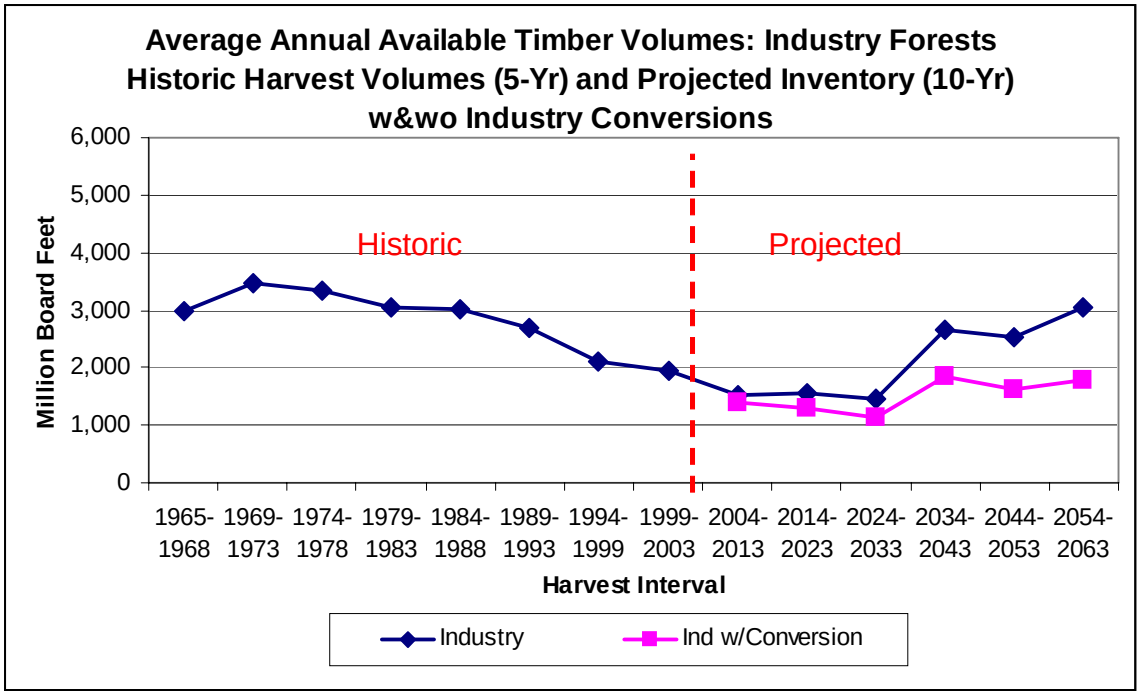


Figure 9. Industry harvest projection with and without conversion trends

Key Summary Points on Managing for Multiple Objectives and Ecosystem Services

- Shorter intensive rotations increase jobs, taxes, and carbon pools but not old forest habitat.
- Biodiversity pathways increase habitat at a high cost to owners that can be offset by incentives but result in near term carbon and economic activity losses.
- Unmanaged young Federal forests provide a potential opportunity for both economic activity and enhanced habitat by implementing biodiversity pathways.
- There are opportunities to better integrate non-market values and market economics by providing ecosystem service compensation or incentives for carbon, habitat, and other values.
- The declining trend in industry harvest levels has been impacted by regulations and available age class distributions but is expected to bottom out and ultimately increase with the increase in mature forests. However, a continuation of the decline in industry acreage from land sales/conversions will likely extend the downward trend until the increase in mature forests restores current harvest levels.

Inventory Data Challenges

FIA survey plots provide tree list measurements and other site information on a grid which has been the basis for prior timber supply studies. However there are many limitations in this source data. Most plots were last measured in 1990-91. The partial new sample was not linked to the exact location of the prior plot hence the forest growth increment is not known, substantially lowering the utility of the re-measurement. Many plots have since been harvested, burned or otherwise disturbed. Updating a plot may not reflect the current tree list. The plot density (1 per 6000 acres) is too coarse to gain any insights on sensitive areas such as riparian zones. The privacy amendment makes access to the specific locations and owners very difficult. It took one year to get confidentiality agreements for access to even know which plots were industry vs. tribal in order to categorize data by owner.

As a new alternative, LIDAR (Light Detection and Ranging) collected by aircraft overflights can produce a much more accurate digital elevation model, and can be converted to tree lists with high accuracy (e.g., height, trees per acre, Basal area, volume, biomass) It also provides vertical structure (branch volume and

height) which is not collected by ground measures and is of value in habitat analysis. The price is competitive with ground surveys while providing much more and higher quality information. The information is also of value to many other users than forestry (counties, transportation and other agencies, utilities) to lower the joint cost of collecting data. Collection costs can also be reduced by using cheaper systems for intermediate updating such as IFSAR (Interferometric Synthetic Aperture Radar) in tandem with LIDAR.

Using LIDAR information provides information at the GIS polygon level for linking to the appropriate growth model providing complete rather than sparse data. In addition to tree list measures and stream locations it can provide measures appropriate for determining forest health, fuel loading, and road access.

The quality of timber supply and forest structure studies would be substantially enhanced by collecting LIDAR data over time and implementing already-developed analysis routines.

Key Summary Points on Measurement Problems and Data Improvement Alternatives

Inventory measurement problem summary:

- Forest Inventory Analysis ground survey plots are too sparse to provide information of current interest (sensitive areas, riparian areas, forest health, stand level polygons)
- LIDAR and related systems can provide more accurate information on a timely basis at a competitive price.
- The information collected will be of value to a broader range of users to share costs.
- The information will be of much greater value to forest, mill and wildlife managers as well as policy makers and other users.

Next Steps in the Timber Supply and Forest Structure Study

The materials summarized here and covered in more detail in the Progress Reports 2 and 3 examine the impacts of management treatments, regulations, and forest health. They provide expectations on how industry plans to manage its lands providing a basis for stratifying treatments across the land. A base case projection will be produced consistent with initial conditions and business-as-usual policies across all owners and timbersheds. Alternative scenarios and an assessment of the resulting differences across alternatives are expected to sharpen the focus on problems and opportunities affecting the future. Inventory data has been collected for all owners. GIS assessments have been prepared for owner type acreages, stream buffers, upland areas, and other spatial attributes of interest. This will provide the assessment information for a closer look at the impact of alternatives and support for the consideration of policy alternatives.

Study 2: Competitiveness: Summary Points and Questions from UW Roundtable

John Perez-Garcia, Hideaki Kubota, Adam Lewis

- Washington's forest products industries are predominantly sawmills, log exporters, veneer and plywood manufacturers, and pulp manufacturers.
    - Sawmills consumed 2.4 BBF (61%) of Washington's timber harvest in 2002 (latest available survey, new survey currently undertaken as part of Economic Study).
    - Veneer and plywood mills consumed 0.5 BBF (11%) of Washington's timber harvest.
    - Log exporters utilized 0.9 BBF (22%) of Washington's timber harvest.
    - Chipping mills consumed 0.2 BBF (5%).
    - Sawmills, veneer and plywood mills and chipping mills provided the majority of the wood chip material to pulp manufacturers.
    - Pulp mills consumed 3.1 million tons of sawmill, veneer and plywood mill residues in 2002. Local mill residues were not sufficient to meet demand by pulp mills.
    - 8.3 million tons of newsprint was produced in 2002. This represents 77% of the main products produced by Washington pulp mills.

- Demand factors in determining competitiveness include:
    - From 0.6 to 1.0% per year growth in aggregate demand for wood products and wood fiber.
    - 8.2 BFF growth in softwood lumber for U.S from 2000 to 2040 reaching 70 BBF by 2040. In 2004 we consumed 61.8 BBF.
    - North America is the largest newsprint consumer but this sector is not growing.
    - Japan, our largest trading partner, has growing newsprint consumption, but at a rate that is lower than the global average.
    - Recent growth in U.S. housing is highest in the South and West regions.
    - Levels of Russian log exports to Japan have been maintained while Washington's log export sector has continued to decline.
    - The Washington's softwood lumber exports to Japan have declined.

- Supply factors determining competitiveness
    - Softwood and hardwood log and lumber production has expanded in North America, mainly at the expense of Asian producers.
    - Washington timber harvest levels have steadily declined since 1989 while U. S. South, Canadian provinces, plantations overseas, and European producers have increased their harvest levels.
    - OSB imports to the U.S. continue to grow. OSB capacity in Chile and Brazil is projected to grow substantially.

Summary Questions from the Roundtable

Overall question: Does Washington produce wood products competitively given the above economic state of the wood product markets where Washington producers compete?

How do Washington producers compare with U.S. Southern mills, Oregon mills and Canadian mills cost-wise?

How do regulations affect cost competitiveness?

Can U.S. western mills produce an additional 2 BBF to meet the projected growth in demand for softwood lumber? Are Western Washington's new green field softwood lumber mills sufficient? What role will eastern Washington mills play?

The proximity and growth of U.S. markets encourages investments in capital and forest management. Do tax incentives exist that promote investment? Which taxes discourages investments? How do Washington producers compare with competitors on taxes?

Eastern Washington mills have traditionally been high-cost producers servicing U.S. regional markets. What impact might forest health issues have on the future of these mills? What options exist to maintain the competitiveness of these mills?

How does land fragmentation affect competitiveness?

International markets have lost prominence over domestic markets for western Washington producers. What are the implications of a switch from international to domestic markets on the competitiveness of Washington's sector?

Study 3: Economic Contribution

Dr. Ivan Eastin, Indroneil Ganguly, Daisuke Sasatani Larry Mason and Bruce Lippke

Summary, Trends, and Observations

Investment by value-adding wood industries is critical to sustaining forestland ownership. An increasingly complex array of forest owners and investors suggests a business climate that views forests as a financial, rather than an industrial, asset. However, maintaining the ecological, environmental and economic health of the forests in Washington requires a vibrant and competitive forest products industry. The lack of a diversified and competitive forest products industry to process the logs, small diameter timber and thinnings removed from the forest undermines the ability to manage forests in Washington in a sustainable manner and reduces the range of management options available to forest managers in the state. The lack of competitive markets for intermediate forest products derived from forest management operations undermines the economic rationale of forest management, adversely affects forest health and ultimately results in increased fire risks. At the same time, the forestry and forest products industries make significant contributions to the economy of Washington state, particularly in rural, timber dependent communities.

The preliminary analyses of the economic data suggest that the forestry and wood products manufacturing sectors have played an increasingly important role in the economy of Washington state since 2001. Not only did this sector provide over 45,000 jobs in 2005 but it also generated approximately $16 billion in gross business revenue, paid out over $2 billion in wages and over $100 million in tax receipts, Figure 1. As a result, the forestry and wood products sector of the state economy employed 1.43% of the workers in the private sector in Washington, accounted for 1.8% of the total wages paid within the private sector and generated 3.2% of the gross business income within the private sector. Their contribution within the individual timbersheds varies and in several timbersheds the forestry and forest products industry makes disproportionately-large economic contributions in terms of jobs and gross business income. At the same time, jobs in these forest-based industries provide family wages in rural regions where there are few other viable employment options, Figure 2.

The sawmill industry in Washington state suffered through a tough period between 1987 and 1993, much of which can be attributed to the 1990-1991 recession and the loss of federal timber as a result of the listing of the spotted owl as an endangered species in 1989. Between 1987 and 1993 softwood lumber production in Washington decreased by 23.5% as 45 sawmills closed and almost 1,400 jobs were lost. Industry consolidation ensued throughout much of the past decade and by 2005 the number of sawmills had declined from 217 (in 1994) to 128, Figure 3. Much of this decline in sawmills can be attributed to the closure of older, inefficient sawmills that relied on the large, old-growth logs coming from the federal forests. Despite the huge decline in sawmills, employment in the sawmill sector actually increased from 7,721 to 8,565 between 1994 and 2005 as larger, more efficient, sawmills were built to replace the smaller, older mills being closed.

The plywood industry in Washington, previously the largest in the US, has been in decline since 1962, Figure 3. The number of plywood mills has declined from 35 to 8 during this period although plywood production has only declined from 1.8 billion square feet (3/8 inch basis) to 1.1 billion square feet (3/8 inch basis). As observed in the sawmill industry, the closure of smaller, inefficient mills has been offset to a degree by the establishment of larger, more efficient plywood mills. Annual production per mill in 1962 was just 52 million square feet whereas this has jumped to 137 million square feet in 2005. It is important to note that as the end-use market continues to transition to greater uses of OSB as an alternative to many plywood uses, there are no OSB mills located in the state of Washington. The challenge for the structural panel industry is to successfully make the transition from plywood to OSB.

The Washington pulp and paper sector is the second largest following wood products manufacturing, Figure 3. In addition to its importance within the economy, this sector also plays an important demand role within the forest products industry. Pulp and paper companies are important consumers of lower quality pulp logs

as well as providing a demand for by-products from other forest products industries such as sawdust and planer shavings from the sawmill industry. Given the cost structure of the sawmill industry, lumber manufacturers often break even at best with their lumber production, but with the sales of their residual by-products they are able to maintain an operating profit. This industry segment, which is able to use sawmill and logging residuals, is particularly important to the health of the industry. From a strategic industry perspective, it is extremely important that this industry remain healthy and viable within the state of Washington. Adding value to the lower grade residuals is an essential contribution to the economic vitality of the sector.

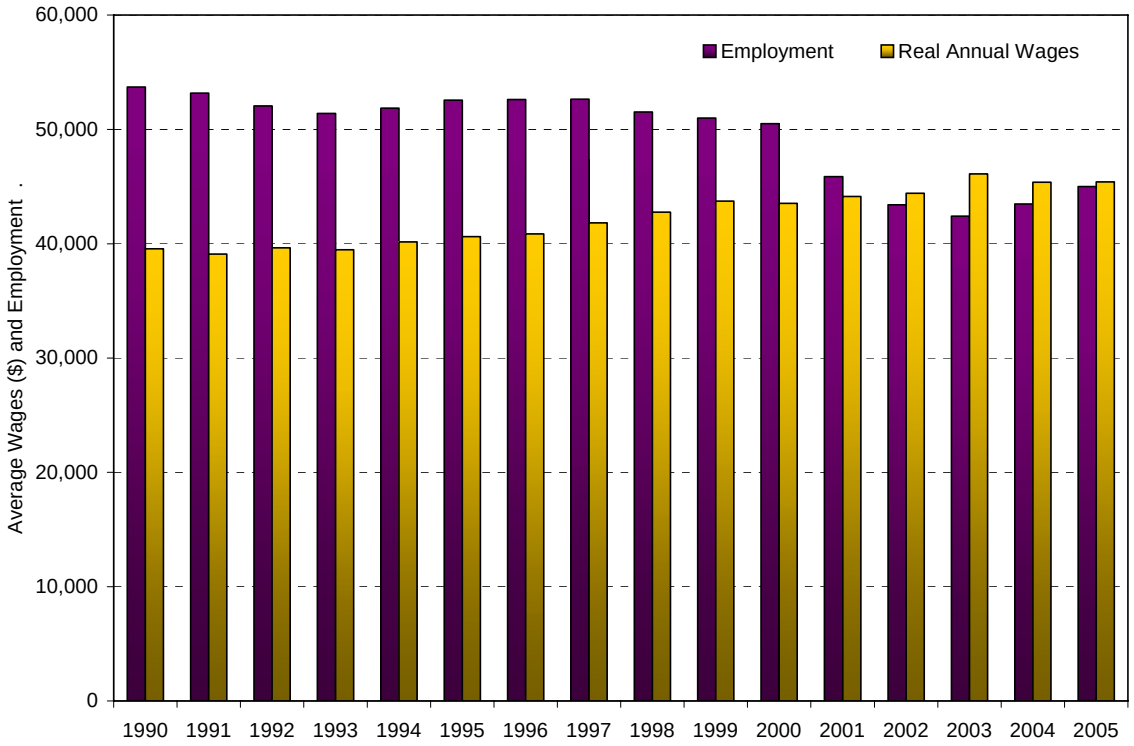


Figure 1. Average Annual Wages and Employment in the Washington forestry and forest products sectors.

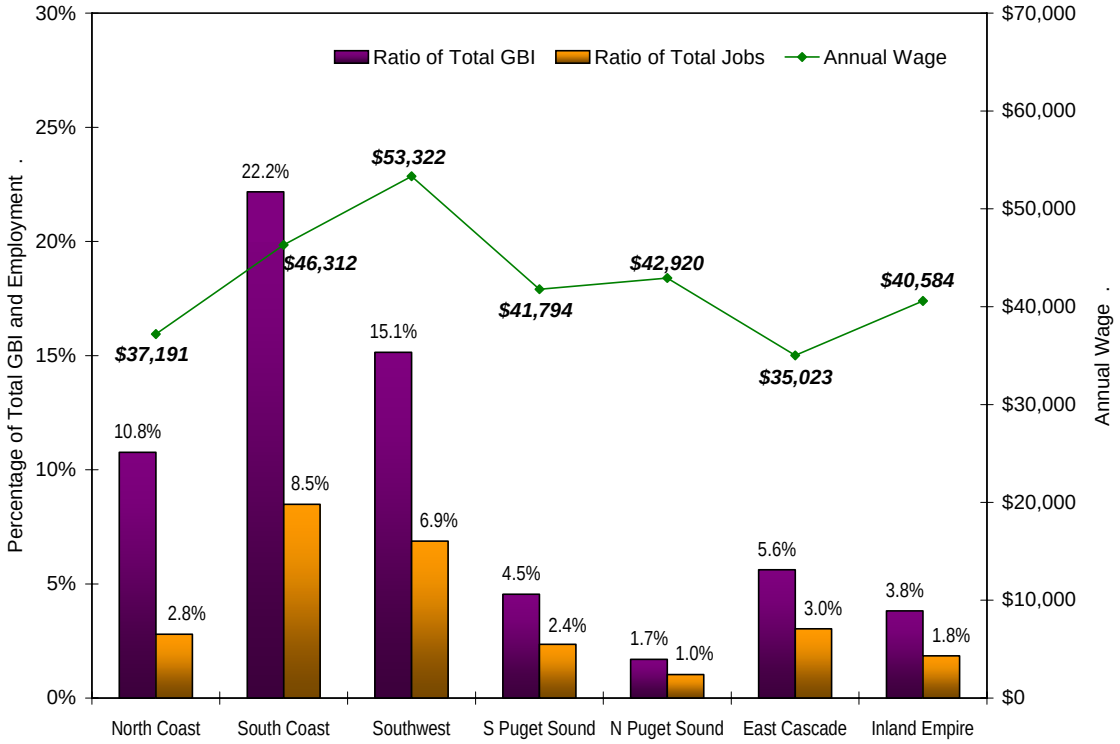


Figure 2. Ratio of forestry and forest products manufacturing jobs, gross business income and annual wages in the Washington timbersheds, 2005.

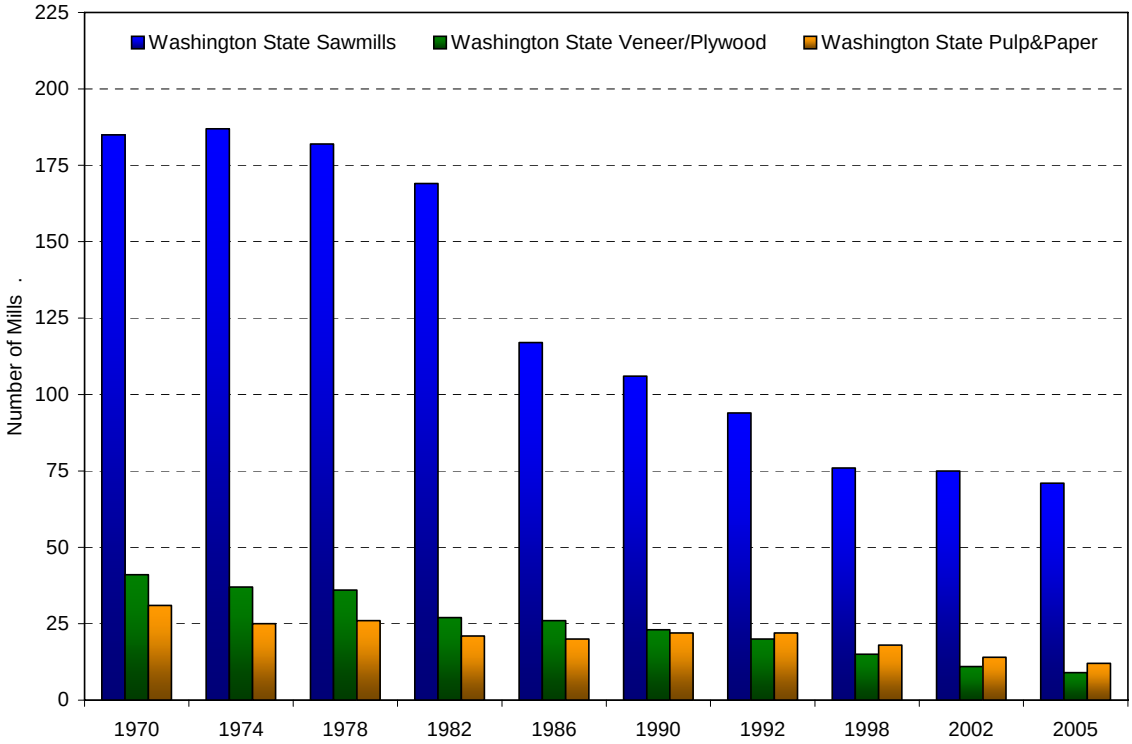


Figure 2. Trend in the number of primary forest products manufacturing mills.

The closure of forest products manufacturing firms over the past twenty years is a natural evolution within the industry towards larger, more capital intensive and resource efficient manufacturing facilities. However, this transition has had a dramatic impact on the processing capacity within specific timbersheds and has adversely impacted the forest management options available to forest managers as they consider ways to address forest health issues and potential wildfire threats. This problem is particularly evident in the East Cascades timbershed where there are no longer any mills located between central Okanogan County and central Yakima County, Figure 4. The distance between mills in these two locations is approximately 200 miles and represents substantial transportation costs in shipping low value wood (e.g., thinnings and small diameter timber). The lack of readily accessible processing facilities limits forest managers' options as they consider strategies to remove dead and dying beetle- killed timber as well as thin over-dense forest stands that represent a significant fire risk.

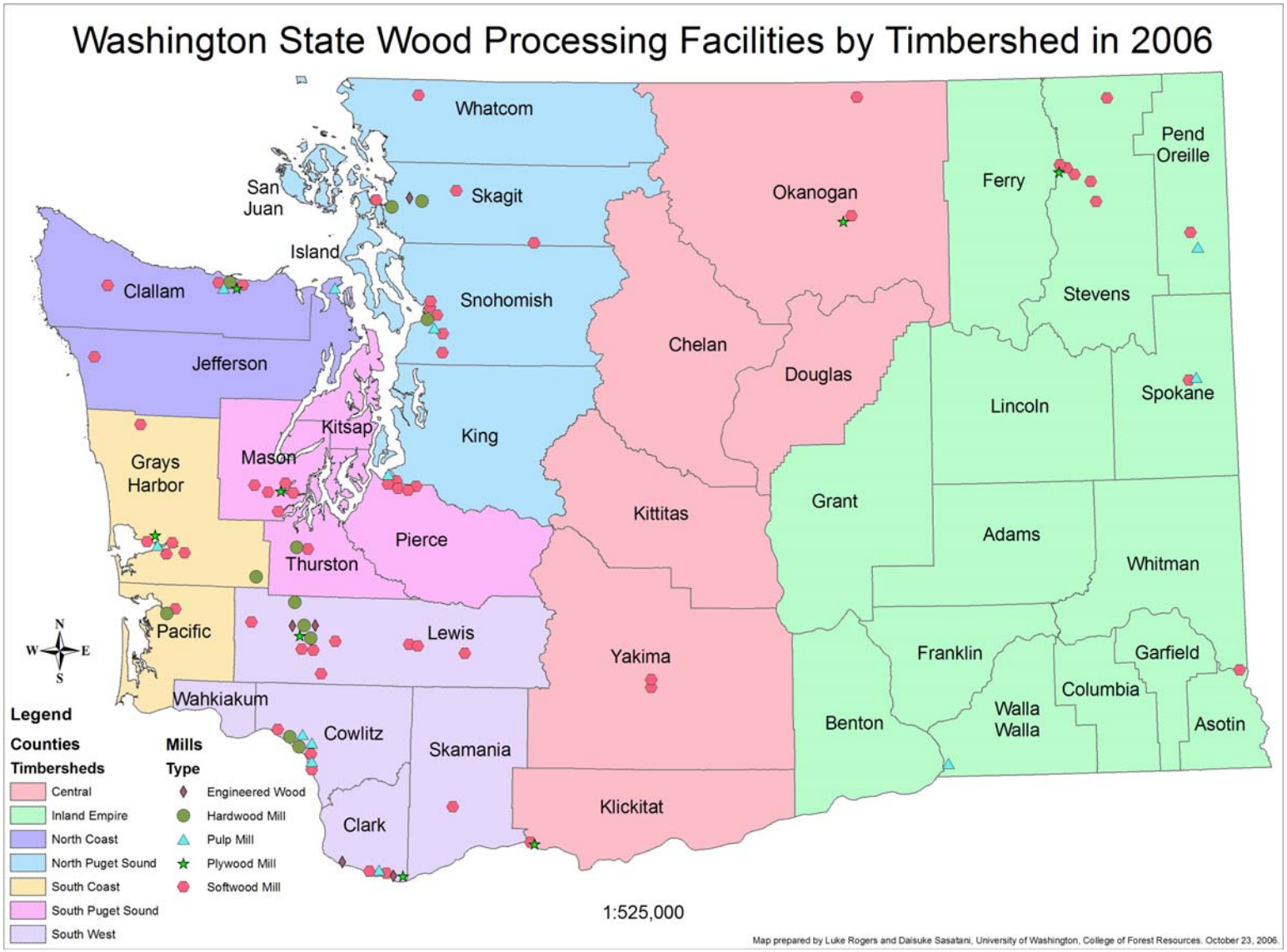


Figure 3. Location of primary forest products manufacturing firms in Washington in 2006.

Summary Observations

- The Washington forest products industry has the second largest level of capital investment in the US, the most productive forestland and the largest volume of low priced residuals.
- Employment, GBI and GBI contribution to state GBI have been increasing since 2001.
- Taxes paid by companies in the forestry and forest products sector have been increasing since 1994 and exceeded $100 million in 2005.
- Direct employment in the forestry and forest products sector was almost 45,000 in 2005.
- Indirect employment attributed to the forestry and forest products industry was estimated to be 106,000 in 2005.
- Forest products manufacturing represents almost 15% of total manufacturing jobs in Washington (many of which are in rural locations) with an average annual wage of $49,329.
- Since 2002, forestry and forest products GBI and employment have been stable or increasing across all timbersheds.
- The forestry and forest products industry is particularly important to the economies of counties in the North Coast, South Coast, Southwest and East Cascades timbersheds.
- Despite a substantial reduction in sawmills and plywood mills, production has increased due to investment in larger mills, mill expansion and new processing technology which has resulted in substantial productivity increases.
- While the number of sawmills in Washington has declined from 240 to 126 between 1991 and 2005, lumber production has increased by 60% and Washington has seen its share of US lumber production increase from 10.3% to 14.2%.
- There has been a significant decline in the number of ***small*** sawmills operating within the state, suggesting that they are more susceptible to supply and regulatory changes.
- The decline in the number of pulp mills in Washington undermines the market for sawmill residues and adversely impacts the economic viability of sawmills where the sale of residuals represents a substantial contribution to mill profitability.
- The plywood industry continues to consolidate and no other panel production mills (e.g., OSB, particleboard or MDF) are located in the state.
- Despite the on-going consolidation in the plywood industry there are specific niche markets where the industry remains very competitive.
- Productivity has increased substantially in all sectors of the forestry and forest products industry but logging.
- As emphasized in the Timber Supply Study, increasing volumes of dead and dying timber in the East Cascades represent a significant fire risk and require that substantial volumes of timber be removed to mitigate this risk and improve forest health.
- Years of fire suppression efforts have resulted in many Eastside forests having unnatural stand structures that have high volumes of small diameter trees and shrubs that undermine forest health and represent a significant fire risk.
- The loss of processing mills across the state (but particularly within the East Cascades timbershed) undermines the ability to manage forests sustainably for health and reduction of fire risk.
- DNR timber supply has been very important within several timbersheds and will become more important in the future.
- The threat to forest health and fire risk posed to Eastside forests from mountain pine beetle and bark beetle infiltrations makes it incumbent upon the State to consider options to reduce this risk. If the

economics do not support the establishment of wood manufacturing facilities to process the wood removed from unhealthy forests, then it may be necessary for the State to consider incentives that would encourage the establishment of the required mills. The benefits from this strategy would be four-fold: forest health could be improved, fire risk could be reduced, social losses (such as health risks from smoke and housing burn-downs) could be contained, and new employment options would be provided in a rural region.

- An analytical framework to assess strategic options to improve forest health could assess the total avoided costs of fire suppression against the cost of incentives to establish wood manufacturing facilities to process the timber removed from unhealthy forests.

Study 4: Land Conversion

Ara Erickson

Land Use Classification and Accuracy

As a review, the Legislature established the following scope of work: An assessment of the trends and dynamics that commercial and residential development play in the conversion of the state's forests to non-forestry uses. The assessment will involve gathering relevant data, reviewing that data, and analyzing the relationship between development and the conversion of forest land uses.

The Washington Department of Natural Resources expanded the scope of work to include the following items:

- Indicate a plan to consult with knowledgeable land use and land conservation organizations so as to make use of existing data and analysis.
- Distinguish among classes of forest landowners likely to be differentially affected by conversion pressures.
- Identify most important influencing factors.

Have we accomplished the goals set forth by the Legislature and DNR?

We have assessed the trends of forest land conversion (on a broad scale) using both FIA data and a seamless land use change data set for western Washington (we will complete a similar analysis for eastern Washington). FIA has yet to release comparable data for the same analysis for eastern Washington, so we will have to rely on past trends (1978-1988) and on similar land use change data (in progress) for the overall trend.

The first step in our project, identifying the factors associated with forest land conversion, provides a summary of the different reasons why landowners are converting to non-forestry uses in Washington. This summary distinguishes factors for different classes of owners: small private and industrial/large private.

For a more specific look, we will use the King County data to differentiate the presence and quantity of forest practice applications, parcelizaton, and development patterns between different owner groups. We will analyze the rate of parcelization and development compared to the participation in the current use taxation program and/or land use based on the assessor's records. To summarize the case study analysis and tie it into the larger assessment of forest land conversion, we will conduct additional literature reviews of published data and case studies of differing ownership patterns and the trends of residential and commercial development in other regions of the country. If possible, we will prepare similar analysis of Spokane County, although we may be limited due to data availability.

We will do further accuracy assessment of our land use change data by quantifying the relationship between parcelization and development permits in areas identified as having changed to other non-forest uses and areas that did not change. In addition, we will attempt to further test the accuracy of the land use change data by comparing it to other land cover change data (National Land Cover Data, for one).

The final part of our report addresses incentives and disincentives facing Washington's forest land owners: the presence of and participation estimates in currently existing programs, perceived burdens (both regulatory and tax-based), and the social opinion of forestry in Washington.