

SELECTED IMPACTS OF MARBLED MURRELET LTCS

Introduction

The Washington Department of Natural Resources has been working with the U.S. Fish and Wildlife Service to amend DNR's State Trust Lands Habitat Conservation Plan and replace the interim conservation strategy for marbled murrelet with a long-term conservation strategy (LTCS). On November 7, 2017 the Board of Natural Resources selected a preferred LTCS alternative to be analyzed in a revised draft environmental impact statement. At this board meeting, the Commissioner of Public Lands (CPL) directed staff to conduct a parallel analysis of the impacts of the LTCS preferred alternative on jobs and economic vitality.

Subsequent to the November 2017 board meeting, the legislature passed [HB 2285](#), a bill that requires that DNR prepare an economic analysis of the "losses and gains" of the proposed alternative.

This analysis seeks to fulfill the request of HB 2285 and the direction from the CPL, and to provide insight to the "Solutions Table", a stakeholder advisory group on the LTCS. It presents estimates of the impacts of the preferred alternative for the first 10 years of its implementation on:

- the volume and value of timber supply (Table 4);
- annual revenue to DNR and to trust beneficiaries (Table 3);
- the value of processed output produced (Table 2);
- the state-wide and county-wide economic output and employment (Tables 1 and 2).

The results of this analysis will also complement the revised draft environmental impact statement, which is being prepared separately.

In this economic analysis, marbled murrelet long-term conservation strategy alternative A and H are paired with the Board of Natural Resources preferred alternatives for arrearage harvest and riparian thinning. Specifically, these include the harvest of 382 MMBF of arrearage volume and exclude riparian thinning volume when setting the sustainable harvest level. As a result, the data presented in this document are estimates of the difference in economic output due only to differences in marbled murrelet conservation.ⁱ

There are some significant limitations to this analysis. In particular, it only covers the first 10-year period of the preferred LTCS, which DNR models suggest has an increase in harvest volume across the state. This leads to a positive impact on employment and output that is not the case in further decades, when the change in harvest becomes negative. See the 'Limitations and future directions' section for additional information about the scope of this report.

Key Takeaways

The model suggests that, compared to Alternative A, Alternative H harvest levels will annually support about 12 more jobs across the state economy, with around 5 of those jobs being in logging or a wood processing industry. The results also show economic output across the economy increasing by \$2.5

million annually, of which \$1.6 million is from logging or wood processing industries. Tables 1 and 2 characterize Alternative H's annualized changes to employment and economic output, respectively.

It is important to note that these impacts are not evenly distributed across counties. Clallam, for instance, sees a relatively large increase in employment while others, such as Snohomish, see relatively large decreases. Additionally, the impacts will not be evenly distributed across industries, even within a county. The results for Jefferson County illustrate this. There is a decrease of around 1.5 mmbf in annual harvest and a net decrease of about 1 job in Jefferson despite an *increase* in economic output for the county. This is because Jefferson has a pulp mill that, according to the Washington State Mill Survey, sources much of its timber from Clallam, which has an increased harvest. This results in an increase in pulp and paper output in Jefferson that offsets a decrease in logging output. However, pulp and paper processing does not employ as many people per volume of logs that it uses compared to logging, so the increase in employment in pulp and paper is not large enough to offset the decrease in employment in logging, resulting in a net decrease in jobs for the county.

Table 1: Employment impacts by county (annual, Decade 1)

County*	Direct Employment	Indirect Employment	Induced Employment	Total
Clallam	19.7	7.4	6.9	34.0
Grays Harbor	10.0	3.5	3.4	16.9
Thurston	1.6	0.3	0.7	2.5
Pierce	1.3	0.4	0.5	2.3
Lewis	0.7	0.2	0.2	1.1
Mason	0.2	0.0	0.0	0.2
Kitsap	0.0	0.0	0.0	0.1
Klickitat	0.0	0.0	0.0	0.0
Skamania	0.0	0.0	0.0	0.0
Ferry	-0.1	0.0	0.0	-0.1
King	0.0	0.0	0.0	-0.1
Clark	-0.2	-0.1	-0.1	-0.3
Cowlitz	-0.5	-0.2	-0.2	-0.9
Jefferson	-1.3	1.2	-1.0	-1.2
Wahkiakum	-1.3	-0.3	-0.1	-1.7
Pacific	-4.1	-0.8	-2.0	-6.9
Whatcom	-5.1	-1.1	-1.8	-8.1
Skagit	-6.6	-1.4	-2.8	-10.8
Snohomish	-9.0	-1.2	-5.0	-15.2
Total	5.4	7.9	-1.3	12.0

* Note: only counties where employment or output change was identified are listed; some “0.0” values are very small non-zero values.

Table 2: Output impacts by county (real dollars, annual, Decade 1)

County*	Direct Output	Indirect Output	Induced Output	Total
Clallam	\$3,484,300	\$798,600	\$735,800	\$5,018,800
Grays Harbor	\$2,029,800	\$494,200	\$379,100	\$2,903,100
Jefferson	\$856,200	\$190,500	-\$101,500	\$945,300
Pierce	\$353,100	\$64,600	\$61,900	\$479,600
Thurston	\$138,300	\$26,300	\$78,200	\$242,800
Lewis	\$91,300	\$18,200	\$24,200	\$133,700
Kitsap	\$4,800	\$400	\$2,300	\$7,500
Skamania	\$0	\$0	\$0	\$100
Klickitat	\$0	\$0	\$0	\$0
Ferry	-\$3,800	-\$800	-\$700	-\$5,300
King	-\$9,200	-\$600	-\$4,700	-\$14,500
Mason	-\$23,600	-\$3,000	-\$1,700	-\$28,300
Clark	-\$44,200	-\$7,200	-\$5,700	-\$57,100
Wahkiakum	-\$81,500	-\$23,100	-\$16,300	-\$120,900
Cowlitz	-\$160,300	-\$45,500	-\$21,800	-\$227,500
Whatcom	-\$538,000	-\$114,900	-\$201,100	-\$854,000
Pacific	-\$723,500	-\$72,500	-\$189,700	-\$985,700
Skagit	-\$1,631,300	-\$190,300	-\$312,000	-\$2,133,700
Snohomish	-\$2,364,600	-\$140,300	-\$563,900	-\$3,068,800
Total	\$1,377,900	\$994,700	-\$137,700	\$2,234,900

* Note: only counties where employment or output change was identified are listed; rounded to the nearest \$100.

Changes to Trust Revenue

Aside from the potential impacts on employment and economic output, a reduction in harvest volume will reduce trust revenue, assuming fixed prices from the forest estate model. The forest estate model estimates harvest timing across decades, optimized for revenue; this analysis assumes that the sales volume plans are such that they will deliver those harvest volumes. Although this assumption biases the model upward, it also simplifies the task of modeling the lag between sales volume and the actual

harvest—or sales value and realized revenue—which can be as long as three years and depends on many factors.

Table 3 shows an annual average estimate for change in the discounted revenue by trust, as well as the share of that value that will go to the trusts and to DNR to pay management costs. Note that in Table 3, the management costs and the trust revenue for the State Forest Purchase Trust do not add to the total revenue difference. This is because for that trust there is also a portion of the revenue that goes to the state general fund.

Table 3: Revenue difference - trust revenue and management costs (real, annual, Decade 1)

Trust	Total Revenue Change	Mgmt. Costs	Net Trust Revenue	Mgmt. %
State Forest Transfer	\$1,290,500	\$322,600	\$967,900	25%
CEPRI	\$337,300	\$104,600	\$232,700	31%
University Original	-\$600	-\$200	-\$400	31%
Scientific School	-\$16,900	-\$5,200	-\$11,700	31%
Escheat	-\$66,400	-\$20,600	-\$45,800	31%
Ag School	-\$106,600	\$0	-\$106,600	0%
Normal School	-\$108,700	-\$33,700	-\$75,000	31%
State Forest Purchase	-\$205,100	-\$102,600	-\$54,400	50%
Common School	-\$378,100	-\$117,200	-\$260,900	31%
University Transfer	-\$391,200	-\$121,300	-\$269,900	31%
Capitol Grant	-\$481,000	-\$149,100	-\$331,900	31%
Total	-\$127,000	-\$122,700	\$43,900	

* Note: rounded to the nearest \$100.

Methods

Two models provide the estimates presented in the analysis. The DNR's forest estate model is used to estimate decadal volume of timber harvested and the corresponding decadal revenue. The volume estimates from the preferred alternative and the current policy are then used with a modified IMPLAN input-output (I-O) model to estimate the employment and economic output impacts of the policy change. The IMPLAN model uses 2016 market relationships adjusted to 2018 values; the forest estate model has actual data through the end of 2017.

Input-output models

I-O models estimate economic and employment impacts across an economy by estimating how a change in output for a given industry filters back through that industry's supply chain. For instance, if a sawmill expands its output, then it will need to purchase more hauling services, which will hire more labor, which will spend money on healthcare, and so on. I-O models usually separate out these impacts: direct impacts are those that happen in the specific industry experiencing the shock, the sawmill in this case;

indirect impacts are those in industries up the supply chain, hauling services in this example; and induced impacts are those that result from increased spending from labor income.

I-O models are fairly straight-forward to use with end-use products, those that are either consumed directly or exported. However, they do not readily translate to products that are inputs into other industries—i.e. it is not straightforward to estimate impacts *downstream* in the supply chain. For instance, an I-O model is not inherently well suited to model how a change in timber supply will affect the output of downstream industries, such as sawmills.

However, with some modification, an I-O model can be used to estimate the employment and economic impacts of a change in timber supply on wood processor output. While there are several ways to accomplish this, in this analysis, direct employment multipliers developed (referred to as direct response coefficients, or DRCs) by Sorenson, et al. (2016)ⁱⁱ are used to translate changes in log harvest volume into changes in direct employment by industry. Because the internal relationships in the I-O models are linear, the ratios of an I-O model's direct employment changes to its indirect changes are constant, as are the ratios to induced employment and economic activities. This means that, for a given quantity of timber destined for a particular processor type (sawmill, pulp mill, etc.), the I-O model relationships can be used with the DRCs, and thereby translate changes in timber to output and employment impacts.

The central problem that DRCs (the employment multipliers) address is in translating changes to timber volume into changes to final processor output, so that the I/O models can interpret them and apply them backward up the supply chain.

Inter-county log flows

For this analysis county level impacts are estimated because some are, potentially, particularly reliant on timber-related industries. While DNR's forest estate model estimates where the proposed policy will affect timber harvests, it is less clear how that timber will be processed *across* neighboring counties. For instance, timber harvested in Pacific County is processed locally, as well as in Lewis and Grays Harbor counties. Table 4 shows a summary of these harvest and consumption volume changes.

Data from the Washington State Mill Survey were used to address this issue by estimating how much timber from each county was used in industries in that and neighboring counties.

For instance, in Jefferson County the average annual harvest difference between the preferred alternative and current policy is around -1.4 mmbf. However, according to the Mill Survey much of the timber harvested from Clallam is used in Jefferson, which actually expands its harvest so the volume consumed in Jefferson increases by around 1.0 mmbf. The 1.0 mmbf expansion in production is modelled *without* the backward linkage to logging and the 1.4 mmbf decrease in logging is modelled separately.

The major advantage of this method is that it separates out the impacts of the volume of timber processed from the volume of timber actually logged in the county. However, this is a limiting assumption of the method as well – all of the timber harvested in a county is assumed to be harvested by local companies, meaning that all of the indirect and induced effects happen in that county (less any leakage).

Table 4: Summary of changes by county (real dollars, annual, Decade 1)

County	Harvest Volume	Consumption Volume	Revenue	\$/mbf
Clallam	5,180	2,840	\$1,551,500	\$300
Grays Harbor	2,341	1,144	\$584,400	\$250
Thurston	668	0	\$233,700	\$350
Lewis	204	71	\$59,600	\$292
Mason	144	-49	\$50,600	\$350
Cowlitz	68	-244	\$23,100	\$341
Pierce	54	509	\$8,100	\$149
Kitsap	10	0	\$3,600	\$372
Clark	0	-63	\$100	\$341
Skamania	0	0	\$0	\$360
Ferry	0	-22	\$0	NaN
Klickitat	0	0	\$0	NaN
King	-14	0	-\$9,900	712
Wahkiakum	-540	0	-\$365,900	\$678
Skagit	-833	-1,728	-\$289,700	\$348
Pacific	-1,300	-363	-\$404,600	\$311
Jefferson	-1,406	1,043	-\$384,800	\$274
Snohomish	-1,707	-1,818	-\$563,900	\$330
Whatcom	-1,813	-263	-\$622,800	\$344
Total	1,058	1,058	-\$127,000	-120

* Note: revenue rounded to the nearest \$100.

Limitations and future directions

Although the modelled effects seem straightforward, it is important to remember that because **I-O models are static and do not take into account market adaptations** such as price changes or substitutions, these estimates are, at best, an upper estimate of the impacts of the LTCS and are almost certainly an overstatement of the real impacts. In particular, this analysis is best thought of as a ‘contribution’ analysis, meaning that the harvests volumes *contribute* to this output and these jobs. Timber processing companies will likely change their timber source, buying more from private landowners and potentially bidding up prices in the process, re-allocating timber from other uses (such as exports) or inducing more private landowners to sell timber. Additionally, the LTCS will not have any

effect on the output demanded from any of the timber processing industries, which is much more affected by the demand for housing in the U.S.

I-O models are static, and so it is inappropriate to use them too far in the future from their base year. This analysis used 2016 as a base year and only modelled impacts for the first 10-year period. This limitation is readily understood in the timber and wood processing context because the industry has changed tremendously from even a relatively short time ago. The industry was very different in 2016 compared to 2006, and even more different from 1996; predicting output changes in 2027 and beyond from 2016 data would be misleading and probably inaccurate.

The limitation of this analysis to the first 10-year period has another problem: outside of the first decade, the total harvest volume change from the current policy becomes negative. So the overall positive impact of this analysis may give the mistaken impression that the economic impacts from the policy are positive overall.

Unprocessed timber harvested from State Lands is prohibited from export, so it will be processed locally or within the neighboring states, meaning that a change in the timber supply from state lands will affect the output of the local wood processing industry to some degree. In this analysis it is assumed that *all* of the change in timber will affect Washington logging and wood processing only – essentially, that there is no leakage to neighboring states. This assumption was made because of a lack of adequate data on inter-state/inter-county movement of timber.

Future directions

A more accurate estimate of the impacts could be obtained if there were reliable estimates of the price elasticity of demand for timber for the different industries (preferably by county). This would allow the estimation of price changes that might occur and how county economies might adapt to the change in the supply of timber.

HB 2285 called broadly for a “losses and gains analysis” of the economic impacts of the marbled murrelet LTCS, which could mean a full cost-benefit analysis or something narrower. Given this ambiguity and the tight timeline, **DNR focused this analysis on the employment and wage impacts of the LTCS as well as the impacts on DNR and trust revenue.** These are by no means the only impacts that matter; rather, they are the core impacts that HB 2285 tasked the Solutions Table (which it calls the marbled murrelet advisory committee) with addressing, and modelling them was achievable with the time and resources available. Future iterations of this analysis could build from this core work to comprehend more impacts, if desired. Future elaborations of this analysis may include:

- benefits of the regulatory certainty the LTCS will provide to forest trust management;
- benefits of marbled murrelet conservation itself, or of important ecosystem services;
- potential changes to economic activities *outside* of those contemplated by the LTCS itself, such as the potential to promote increased recreation or join carbon markets;
- tax implications to counties or trusts;
- probability-weighted estimates of possible or likely outcomes via simulation.

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Appendix 1 - County by industry tables

Table A1: Employment impacts - county by industry (real, annual, Decade 1)

Industry	County	Direct Employment	Indirect Employment	Induced Employment	Total
Logging	Clallam	12.6	3.6	4.7	20.8
Sawmill	Clallam	6.0	2.8	1.7	10.4
Pulp & paper	Clallam	1.2	1.1	0.6	2.8
Logging	Clark	0.0	0.0	0.0	0.0
Sawmill	Clark	-0.2	-0.1	-0.1	-0.3
Logging	Cowlitz	0.2	0.0	0.1	0.3
Sawmill	Cowlitz	-0.7	-0.3	-0.3	-1.2
Sawmill	Ferry	-0.1	0.0	0.0	-0.1
Logging	Grays Harbor	5.7	1.1	1.7	8.5
Sawmill	Grays Harbor	1.0	0.5	0.4	1.8
Veneer & plywood	Grays Harbor	2.5	1.0	1.0	4.5
Pulp & paper	Grays Harbor	0.8	0.9	0.4	2.1
Logging	Jefferson	-3.4	-0.3	-2.0	-5.7
Pulp & paper	Jefferson	2.1	1.5	0.9	4.5
Sawmill	Klickitat	0.0	0.0	0.0	0.0
Veneer & plywood	Klickitat	0.0	0.0	0.0	0.0
Logging	Lewis	0.5	0.1	0.2	0.8
Sawmill	Lewis	0.2	0.1	0.1	0.3
Logging	Mason	0.4	0.1	0.0	0.5
Sawmill	Mason	-0.1	-0.1	-0.1	-0.2
Logging	Pacific	-3.2	-0.5	-1.7	-5.4
Sawmill	Pacific	-1.0	-0.4	-0.2	-1.6
Logging	Pierce	0.1	0.0	0.1	0.2
Sawmill	Pierce	1.4	0.5	0.5	2.4
Veneer & plywood	Pierce	-0.2	-0.1	-0.1	-0.4
Pulp & paper	Pierce	0.0	0.0	0.0	0.1
Logging	Skagit	-2.0	-0.2	-1.5	-3.7
Sawmill	Skagit	-4.6	-1.2	-1.3	-7.1
Logging	Skamania	0.0	0.0	0.0	0.0
Sawmill	Skamania	0.0	0.0	0.0	0.0

Industry	County	Direct Employment	Indirect Employment	Induced Employment	Total
Logging	Snohomish	-4.2	-0.3	-3.8	-8.2
Sawmill	Snohomish	-4.8	-1.0	-1.2	-7.0
Logging	Whatcom	-4.4	-0.8	-1.5	-6.8
Sawmill	Whatcom	-0.7	-0.3	-0.3	-1.3
Logging	King	0.0	0.0	0.0	-0.1
Logging	Kitsap	0.0	0.0	0.0	0.1
Logging	Thurston	1.6	0.3	0.7	2.5
Logging	Wahkiakum	-1.3	-0.3	-0.1	-1.7
Total		5.4	7.9	-1.3	12.0

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Table A2: Output impacts - county by industry (real, annual, Decade 1)

Industry	County	Direct Output	Indirect Output	Induced Output	Total
Logging	Clallam	\$1,167,500	\$260,000	\$498,900	\$1,926,400
Sawmill	Clallam	\$1,528,300	\$381,000	\$177,400	\$2,086,700
Pulp & paper	Clallam	\$788,500	\$157,700	\$59,500	\$1,005,600
Logging	Clark	\$100	\$0	\$0	\$200
Sawmill	Clark	-\$44,300	-\$7,300	-\$5,700	-\$57,300
Logging	Cowlitz	\$15,400	\$3,000	\$9,100	\$27,500
Sawmill	Cowlitz	-\$175,700	-\$48,500	-\$30,800	-\$255,100
Sawmill	Ferry	-\$3,800	-\$800	-\$700	-\$5,300
Logging	Grays Harbor	\$488,700	\$97,200	\$190,100	\$776,000
Sawmill	Grays Harbor	\$266,500	\$76,100	\$39,900	\$382,500
Veneer & plywood	Grays Harbor	\$756,400	\$167,400	\$108,300	\$1,032,100
Pulp & paper	Grays Harbor	\$518,100	\$153,500	\$40,800	\$712,400
Logging	Jefferson	-\$577,500	-\$28,800	-\$190,000	-\$796,300
Pulp & paper	Jefferson	\$1,433,800	\$219,400	\$88,500	\$1,741,600
Sawmill	Klickitat	\$0	\$0	\$0	\$0
Veneer & plywood	Klickitat	\$0	\$0	\$0	\$0
Logging	Lewis	\$37,900	\$6,600	\$16,300	\$60,900
Sawmill	Lewis	\$53,300	\$11,600	\$7,900	\$72,800
Logging	Mason	\$18,500	\$5,100	\$3,700	\$27,300
Sawmill	Mason	-\$42,100	-\$8,100	-\$5,400	-\$55,500
Logging	Pacific	-\$476,600	-\$20,600	-\$166,900	-\$664,100
Sawmill	Pacific	-\$246,900	-\$51,900	-\$22,800	-\$321,600
Logging	Pierce	\$19,100	\$1,400	\$9,700	\$30,200
Sawmill	Pierce	\$372,500	\$69,700	\$58,800	\$501,100
Veneer & plywood	Pierce	-\$63,500	-\$11,100	-\$9,600	-\$84,200
Pulp & paper	Pierce	\$25,000	\$4,500	\$3,000	\$32,500
Logging	Skagit	-\$404,000	-\$17,700	-\$170,500	-\$592,300
Sawmill	Skagit	-\$1,227,300	-\$172,600	-\$141,500	-\$1,541,400
Logging	Skamania	\$0	\$0	\$0	\$0
Sawmill	Skamania	\$0	\$0	\$0	\$100
Logging	Snohomish	-\$1,073,400	-\$26,600	-\$429,100	-\$1,529,100
Sawmill	Snohomish	-\$1,291,300	-\$113,700	-\$134,800	-\$1,539,800
Logging	Whatcom	-\$358,700	-\$71,700	-\$169,900	-\$600,300

Industry	County	Direct Output	Indirect Output	Induced Output	Total
Sawmill	Whatcom	-\$179,300	-\$43,200	-\$31,200	-\$253,700
Logging	King	-\$9,200	-\$600	-\$4,700	-\$14,500
Logging	Kitsap	\$4,800	\$400	\$2,300	\$7,500
Logging	Thurston	\$138,300	\$26,300	\$78,200	\$242,800
Logging	Wahkiakum	-\$81,500	-\$23,100	-\$16,300	-\$120,900
Total		\$1,377,900	\$994,700	-\$137,700	\$2,234,900

* Note: rounded to the nearest \$100.

ⁱ In the financial analysis, Alternative A is paired with each the following options for acreage harvest: harvest 702 MMBF of arrearage volume, harvest 462 MMBF of arrearage volume, and set harvest levels without specifying arrearage quantity, and each of the following riparian thinning options: thin up to 10 percent of the total riparian area in a decade, or thin an area less than or equal to 1 percent of the acres thinned or harvested in non-riparian areas (refer to the October 2018 financial analysis for more information about arrearage and thinning options). The sustainable harvest draft environmental impact statement considers environmental impacts (DEIS) due under Alternative A paired with the 702 MMBF of arrearage volume option and the riparian option to thin an area less than or equal to 1 percent of the acres thinned or harvested in non-riparian areas. In the sustainable harvest DEIS, this version of Alternative A (labeled Alternative 1) also includes modifications to represent the current authorizing environment. Specifically, the harvest level is set to 5.5 billion board feet for the planning decade to represent the continuation of the sustainable harvest level set by the Board of Natural Resources in 2007, and the inclusion of constraints that represent the Settlement Agreement (King County Superior Court No. 04-2-26461-8SEA, dismissed April 7, 2006). The Settlement Agreement terminates “the BNR approves a sustainable harvest calculation extending beyond FY 2014, but no earlier than June 30, 2014.” None of the scenarios in this analysis or in the financial analysis include the Settlement Agreement.

ⁱⁱ Sorenson, C., Keegan, C., Morgan, T., McIver, C., and Niccolucci, M. (2016) Employment and Wage Impacts of Timber Harvesting and Processing in the United States, *Journal of Forestry*, 114(4), 474-482