The Economic Value of Old-growth Forests in BC

Analysis of Old-growth Management Scenarios in Two Timber Supply Areas

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ESSA

Table of Contents

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Summary

This report evaluates old-growth forests' broader economic value to British Columbians, focusing on the Prince George and Okanagan Timber Supply Areas (TSAs). It extends the results of our 2020 Port Renfrew pilot study, which found that it makes more economic sense to keep old-growth trees in the ground when a broader suite of ecosystem services – not just timber production – are considered. In this case we wanted to see how results might differ in more fire-prone parts of the province.

Our model simulations show that fully protecting old growth forests in the Prince George TSA could yield an additional **$33 billion in net economic benefits** compared to our business-as-usual case (no extra deferrals). Similarly, in the Okanagan TSA, the **net benefit could be $10 billion**. These results were primarily driven by carbon storage benefits mitigating global climate change and account for losses from timber production. Our modelling assumed average historical wildfire rates (1920-2020), which is likely optimistic given future climate change projections. We also note that our study only considered a very small subset of all ecosystem services provided by old growth forests and therefore represents an under-estimate of their total economic value.

Combined, our findings emphasize a critical need for a broader evaluation approach to support decision-making about BC's forests and reinforces calls for a paradigm shift in how these forests are managed – one that considers a wide range of long-term benefits from healthy, resilient forests. This includes a need in the study region for increased protection of old growth and primary forests, improved forest wildfire management, and conservation finance mechanisms that can support the economic transition away from old-growth harvesting.

Study Overview

Intact old-growth forests are coveted timber producers, but they also provide many other ecosystem services free-of-charge that would be costly or impossible to replace. When decisions are made to log, these ecosystem services are not typically considered on equal footing with timber harvest revenues. The purpose of this study was to extend a novel pilot study we completed in 2020 for the Ancient Forest Alliance at a smaller site (Port Renfrew) in the Arrowsmith Timber Supply Area (TSA) on Vancouver Island. That study demonstrated that when additional ecosystem services are included in the math, **it can make more economic sense to keep old-growth trees in the ground**. We wanted to know if the same result would occur in other parts of BC, so we began with two large-scale test areas - the Prince George and Okanagan TSAs.

> *This analysis is needed to close gaps in our knowledge, shift the focus from industrial forest sector economic value in decision making to the economic imperative to manage for ecosystem health, and help First Nations exercise their rights and determine next steps for at-risk old-growth forests as well as all forest stewardship overall.*
>
> *-BC Union of Indian Chiefs (with permission)*

We focused on these two TSAs because we wanted to capture different ecosystems and ecological disturbance regimes to see how these factors impacted our results, and to better prepare for a province-wide assessment. Combined, these two TSAs cover about 10% of the provincial land mass.

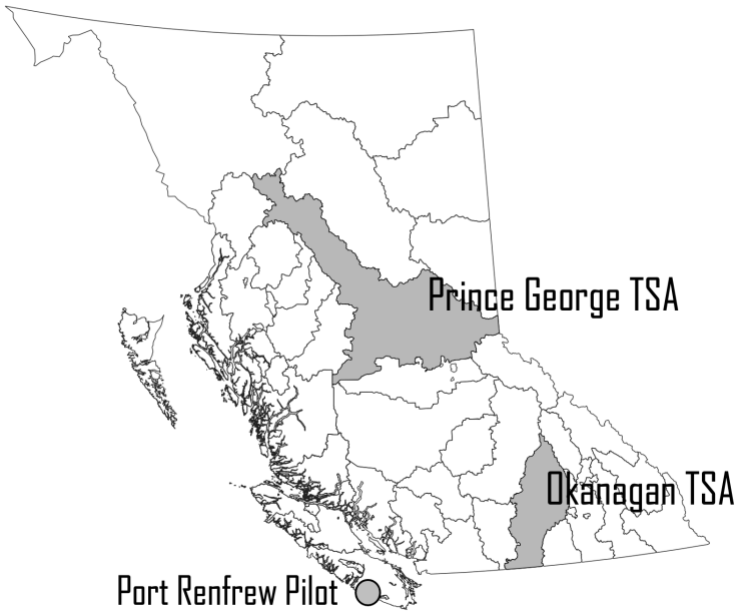


Figure 1. Study area map

Our simulation modelling compared a business-as-usual case ("no extra deferrals") with 3 different old-growth protection scenarios. For the **first scenario ("BC policy deferral")**, we used the province's 2021 deferral recommendation for the two TSAs, which was part of its deferral of 2.6 million hectares of priority old-growth stands in BC. For the **second scenario ("Enhanced deferral")** we deferred harvest of all priority old-growth stands in the two TSAs identified by the provincial Old-growth Technical Advisory Panel (three of whom were also science advisors during the study). For the **third scenario**

No Extra Deferral

The provincial business-as-usual case prior to the 2021 recommendation to defer 2.6 million hectares of old-growth forest province-wide.

BC Policy Deferral

The provincial 2021 harvest deferral of 2.6 million hectares of priority old-growth forests province-wide, as applied to the Prince George and Okanagan Timber Supply Areas using provincial maps of proposed

Enhanced Deferral

Harvest deferral of all priority old-growth forests in the Prince George and Okanagan Timber Supply Areas using provincial maps of priority deferral areas.

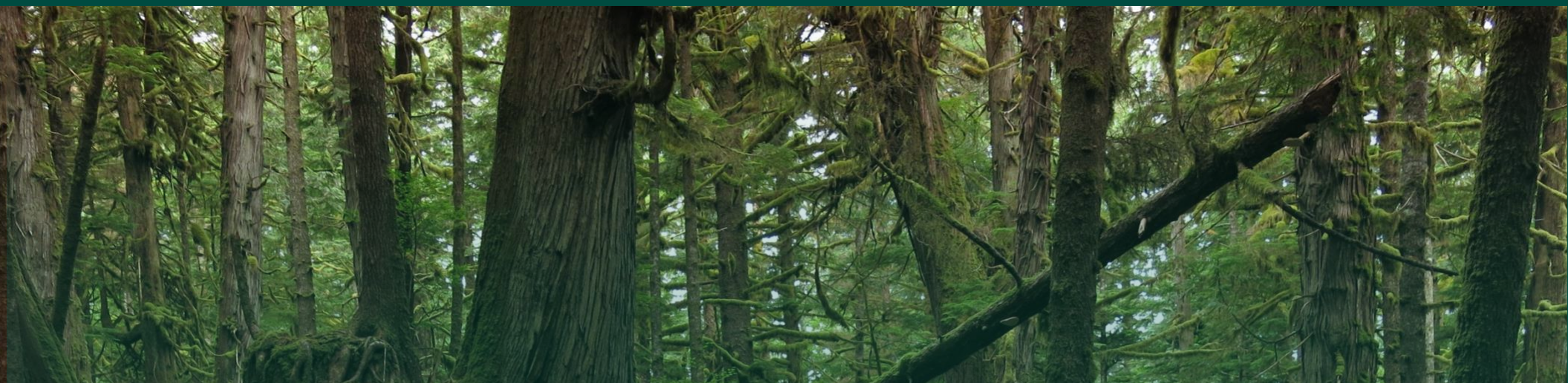
100% Old-growth Deferral

Harvest deferral of all old-growth forests in the Prince George and Okanagan Timber supply areas.

(“100% OG deferral”), we deferred harvest of all old-growth. Given the significance of wildfire in the two TSAs, as a sensitivity analysis we also tested the 100% old-growth deferral case with a twofold increase in wildfire disturbance. Lastly, in each TSA we tested a supplementary scenario with zero harvest of the entire timber harvest land base to understand the current working forests’ full ecosystem service potential.

In all cases except the increased wildfire scenario, our results suggest society would be better off protecting old-growth than logging it, largely because these forests provide significant climate change mitigation services from carbon storage and sequestration.

Over the next 100 years, compared to business-as-usual, fully protecting old-growth forests in the Prince George TSA would contribute an additional **$33.1 billion in net economic benefit**, accounting for net losses from timber production totaling about $2.9 billion. The same protection in the Okanagan TSA would contribute an additional **$6.8 billion in net economic benefit**, accounting for net losses from timber production of about $1.2 billion.



Unlike our Port Renfrew pilot study, relative to carbon storage and sequestration, we observed a reduced role for forest-based recreation and tourism, but this different proportional distribution still reflects significant absolute benefits at about $300 million in the Prince George TSA and $491 million in the Okanagan TSA under full old-growth protection over the 100-year period (compared to business-as-usual). The proportional difference compared to the pilot study stems from biophysical site differences (e.g., area of forest) and because the Port Renfrew pilot study site was in a region with a higher annual rate of recreational use specific to old-growth forests.

If the **BC policy deferral** scenario were fully implemented, logging of 32% and 24% of old-growth eligible for harvest would be curtailed in the Prince George and Okanagan TSAs respectively. In Prince George, this deferral would result in about $8.7 billion in net economic benefit, accounting for net timber losses of about $0.9 billion. In the Okanagan, the deferral would result in about $2.2 billion in net economic benefit, accounting for net timber losses of about $0.33 billion.

Our results are based on only a subset of old-growth ecosystem services: carbon sequestration/storage, recreation/tourism opportunities, timber production, commercially sold non-timber forest products like floral greenery and mushrooms, and education/research opportunities. During future studies, we hope to include additional ecosystem services, such as water quality regulation, water supply, flood mitigation, air quality regulation, wildfire mitigation, and biodiversity/habitat provision. This subset of ecosystem services means **our assessment represents an *underestimate*** of the total economic value provided by old-growth forests.

If the province fully protected old-growth it would result after 100 years in over **$43 billion** more value from the Prince George and Okanagan Timber Supply Areas than if there were no extra deferrals

Not Just Timber

Understanding the economic value of old-growth forests is important for decision-making about how to manage these forests sustainably for the benefit of all. No comprehensive province-wide study has ever attempted to estimate this value outside timber production, which makes it difficult for decision-makers to understand critical tradeoffs associated with timber harvest. In addition, inventorying and estimating the economic value of natural capital, like old-growth forests, is fast becoming a prerequisite in Canada toward securing financing for its conservation and maintenance.

All forests generate ecosystems services that we enjoy free of charge, but old-growth forests are unique in the quality of services they provide and in their increasing scarcity. **Indigenous traditions** like carving large ocean-going canoes and totem poles require large and old cedar trees (>400yrs). **Tourists and recreationists** are drawn to old forests because they supply an experience that cannot be replicated elsewhere, and this can bring real economic benefits to communities from tourist dollars and health improvements.

Old-growth forests can help mitigate climate change because they **store particularly large amounts of carbon** above and below ground. They also provide unique opportunities for **harvesting non-timber forest products** like floral greenery, and wild edibles, medicinals, landscaping and restoration products, materials for arts and crafts, and ingredients for essential oils and soaps. These products can

provide socio-economic benefits through commercial revenue, recreational harvesting, food supply, and cultural value.

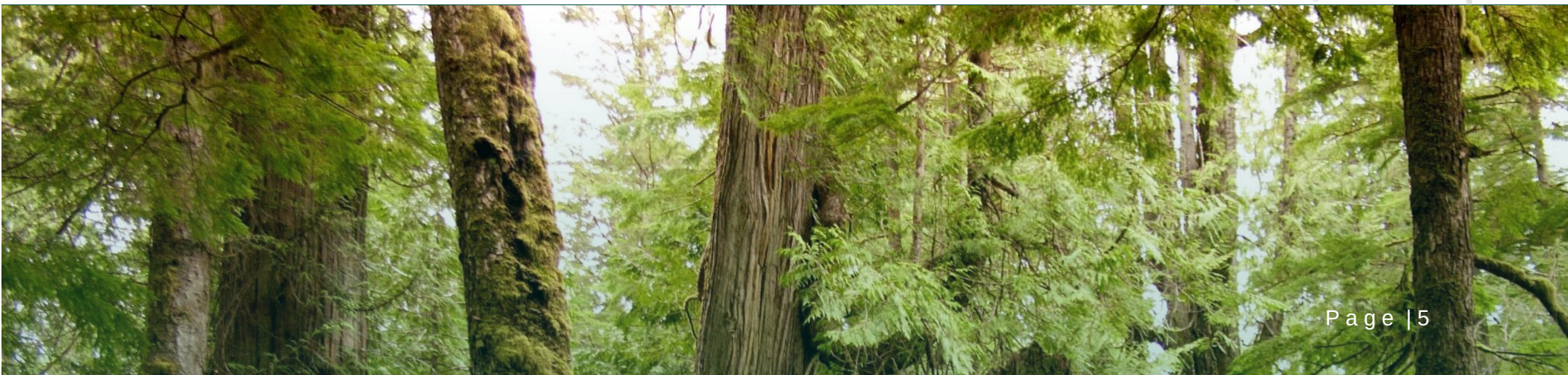
Harvesting old-growth can reduce **critical habitat**, decreasing the benefits people enjoy from commercial and sport activities that rely on species such as caribou. Such species also provide 'non-use' benefits, including well-being derived from knowing a habitat exists and its species will not be extirpated. BC hosts **at-risk species** like the Northern Goshawk, Marbled Murrelet, and Fisher, which are specially adapted to, and depend upon, old-growth forests.

Rivers and streams shaded by old-growth trees also provide important **spawning and rearing habitat** for different salmonids, which are an important part of BC's commercial and recreational fishery, a source of food for many households, and a culturally significant species.

Like forests more broadly, intact old growth forests also help **regulate water quality**, provide important **flood and erosion mitigation** benefits during storms, and can regulate **air quality** not only as direct pollution filters, but also by mitigating wildfire risk.

Education and research activities are also supported by old-growth forests in unique ways compared to other types of forests. In BC, this potential is high given the relatively large number of research institutions that host forestry and/or natural resource management departments.

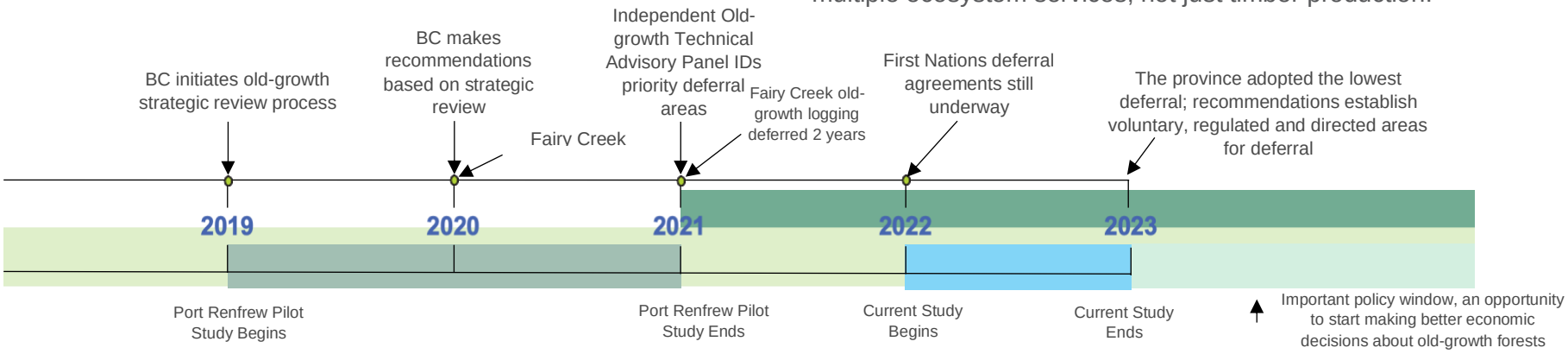
> *One of the areas were [we] found significant information gaps was an economic valuation of the range of values derived from old forests and old ecosystems. We tried to gather information and even tried to get information produced but were relatively unsuccessful.*
>
> *-Gary Merkel, Old-growth Strategic Review (with permission)*



An Opportunity for Better Old-growth Management

Now is the time to change how old-growth forests are managed in BC. In July 2019 the province initiated an Old-growth Strategic Review with an independent two-person panel appointed to engage with BC residents and learn about their perspectives on the **ecological**, **economic**, and **cultural** importance of old-growth forests. The panel's findings and recommendations, released in September 2020, emphasized the need for a paradigm shift in old-growth management. Acting on these recommendations, the province convened a Technical Advisory Panel (TAP), which mapped and identified priority old-growth areas province-wide and made recommendations to immediately defer logging in these areas as a temporary measure. The province adopted the recommendation to defer logging of old-growth forest most at risk (2.6 million hectares) and began working with Indigenous governments to establish areas for deferral. These efforts are still underway in 2025. Other opportunities to support old-growth protection have emerged, such as BC's draft Biodiversity and Ecosystem Health Framework and the Tripartite Framework Agreement on Nature Conservation, both released in November 2023. The former was issued for public comment (closed January 2024) in response to recommendations from the Old Growth Strategic Review, while the latter directs over $1 billion in government funds toward protecting 30% of BC's lands by 2030. Additionally, Forest Landscape Planning is being piloted in BC's Timber Supply Areas (TSAs) as a new collaborative decision-making approach with First Nations.

The analyses we completed for this study show how the historic policy window created by these opportunities can be seized to start making better-informed economic decisions about old-growth forests that increase BC's prosperity from multiple ecosystem services, not just timber production.



How We Estimated Economic Value

To estimate the economic value of old-growth forests under different deferral scenarios, we used a coupled model system that integrates forest simulation with economic valuation methods. The model was implemented in the cloud so multiple scenarios could be processed simultaneously. For each TSA over a 100-year simulation period, the system outputs tonnes of carbon, volume of timber, and area of forest. These are the physical units of production to which we then assign dollar values using economic methods.

How did we simulate forests?

We used the Carbon Budget Model of the Canadian Forest Sector (CBM-CFS3) to simulate change in forest carbon stock for three different old-growth deferral scenarios and two supplementary scenarios. To aid in estimating the value of timber production, we converted CBM-CFS3 outputs in tonnes of stored carbon per forest stand to cubic meters of timber. For all other ecosystem services, we estimated ecosystem service value using the change in area of old growth. The CBM-CFS3 model simulates tree growth, disturbance from wildfire, pests, and harvest, and carbon dynamics based on input data from provincial Timber Supply Reviews (TSRs) and the provincial forest inventory. We also worked closely with a scientific advisory team to adjust the model's default settings to adequately represent growth, disturbance, harvest, and carbon dynamics (including soil carbon) for the two study areas. We simulated tree growth using growth curves from the Variable Density Yield Projection (VDYP) software. We used provincial Timber Supply Reviews (TSRs) for harvest assumptions.

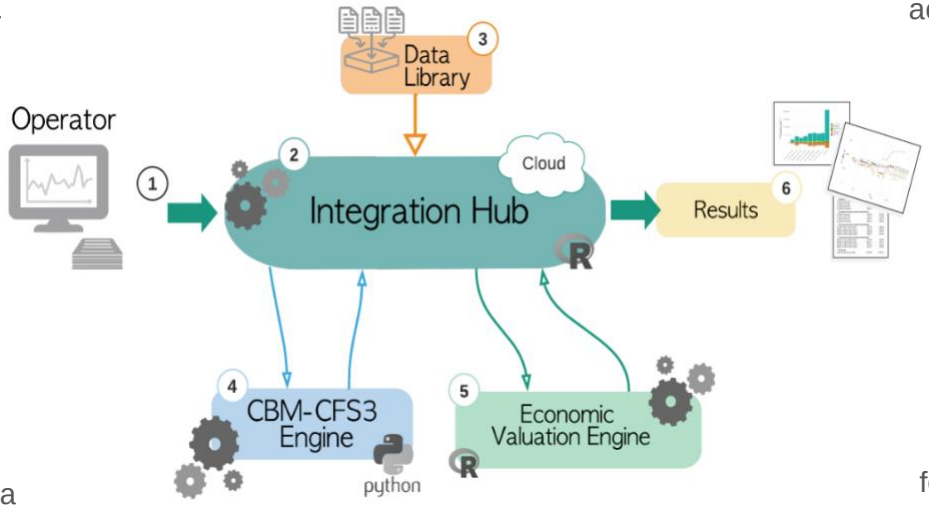


Figure 2. Simulation modelling system used for economic valuation

Our simulations only harvested in areas designated by BC as part of the timber harvest land-base (THLB) and sequentially prioritized stands for harvest based on greatest to least stand volumes above a minimum threshold of 140 m^3/ha in the Prince George TSA, and 156 m^3/ha in the Okanagan TSA. We simulated harvest until the annual allowable cut (AAC) was achieved. For the "no extra deferrals" (base) case, we estimated the AAC in the Prince George Timber Supply Area (TSA) at 6,600,000 m^3/yr and in the Okanagan TSA at 2,462,800 m^3/yr, lowering this volume in the latter TSA to 2,290,000 m^3/yr after 10yrs per the TSR. We assumed this volume decreased proportionally with increasing old-growth deferral for the other scenarios. We also accounted for wildfire and included a low level of salvage logging of recent snags from burned and beetle-killed stands (Mountain Pine Beetle).

All stands classified as old growth (>140 years) in 2023 were likely natural disturbance origin (i.e., not previously harvested). Some stands that were not old-growth in 2023 but that escaped

harvest or natural disturbance during the simulation recruited into the >140 years old age class. These were mostly in unharvestable areas and thus likely of natural disturbance origin.

What economic valuation methods did we use?

If a decision is made to log based solely on the dollar value of timber, we are implicitly placing a very low value on other ecosystem services, which can lead to negative overall consequences for society even while generating benefits from forestry revenues and jobs. It is therefore important to compare impacts to benefits across as many ecosystem services as possible. When the net benefits of a decision are calculated based on an inclusive recognition of multiple ecosystem services it is more likely to support overall societal welfare.

To do such comparisons, units of each service first need to be converted to a common scale. Economists use dollars because they are a widely understood metric of exchange. Some services like timber production and food production (e.g., fish) are bought and sold, so their value in dollars is relatively easy to estimate. Services that have no explicit market value, like recreation opportunities, or air quality regulation, need to be converted from biophysical measures into dollar units based on the benefits they provide to people.

Economists do valuation of non-market ecosystem services using a range of methods that require primary research to either elicit stated values (e.g., in a survey) or revealed values (e.g., indirect expenditures). These methods can be costly, so it is often preferable to use "benefit transfer" by transferring values determined in other primary studies elsewhere.

We used benefit transfer as part of a **cost-benefit analysis (CBA)**, which compares the costs and benefits of different old-growth management actions to determine overall net benefits to society. CBA is the primary economic approach applied worldwide to examine a project's public interest contribution in economic terms.

While we can never monetize the full value of an intact old-growth forest, estimating some non-timber benefits can help balance the scales – not by putting a price tag on nature so it can be bought and sold, but by communicating more of its true value for better informed decisions that make society better off.

The graphs on this page show, in hectares, how much old-growth versus younger trees exist in the two study areas and what proportion of old-growth was removed from harvest in each deferral scenario.

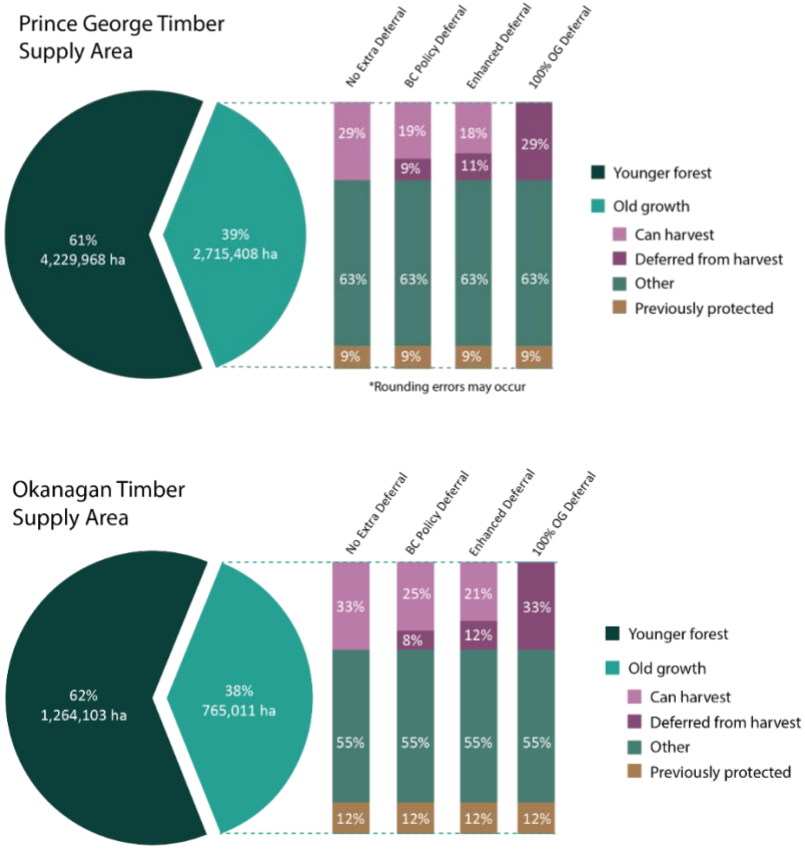


Figure 3. Area of old-growth (ha) in each study area and harvest deferral scenarios

Prince George Timber Supply Area

Like all forests in BC, the forests of the Prince George Timber Supply Area (TSA) have cultural significance to many First Nations, with the Carrier Sekani peoples' traditional territories covering the largest portion of the area. About 3 million hectares of forest are designated by the provincial government as harvestable in the TSA (2017). This TSA is large covering 8% of the province (nearly 8 million hectares). It has a vast rolling plateau, steep mountains, warm summers, cold winters with deep snow, and cold, clear rivers and lakes. Its timber species include lodgepole pine and spruce in the plateau region, spruce and subalpine fir at higher elevations of the Rockies, western redcedar and western hemlock in the foothills of the Rockies, and pine, spruce and subalpine fir to the northwest. The forests supply a range of timber products, non-timber forest products, fish and wildlife habitat, and recreation/tourism opportunities. The TSA experiences high levels of disturbance from insects (e.g., Mountain Pine Beetle) and wildfire. The Prince George TSA hosts several forest-dependent species-at-risk including mountain caribou, moose, fisher, marten, and grizzly bear.

Compared to the Okanagan region, we considered the Prince George region to be more economically vulnerable to old-growth deferrals because it has a less diversified economy. As of 2017 the TSA had 13 large lumber mills, 3 pulp mills, 1 small lumber mill, 4 wood pellet operations, 2 cogeneration facilities, a bioenergy facility, a log home operation, and a utility mill.

Over the next 100 years, our modelling estimates that the current area of old-growth (older than 140yrs) in the Prince George TSA will *increase* for all scenarios, even with no extra deferrals. The business-as-usual increase in old-growth is about 49% (1,323,312 ha) with additional increases of 2.6% (106,654 ha), 3.2% (129,173 ha), and 8.3% (336,614 ha) for the three deferral scenarios respectively.

Under each deferral scenario we lowered the annual allowable cut (AAC) in proportion to the area of harvestable forest deferred, for a reduced AAC of 6,043,712 m^3 (92%), 5,938,119 m^3 (90%), and 4,782,196 m^3 (72%) respectively. Harvest composition in the Prince George TSA would be dominated by spruce to 2080, giving way to pine by 2100. Some Douglas-fir, fir, western hemlock, western redcedar, and hardwood species would be harvested in smaller amounts, with mainly fir increasing toward the end of the time series we simulated.

The land base in the Prince George TSA acts as a **net carbon sink** across the 100-year period under all scenarios. This sink status would contribute to mitigating both local and non-local consequences of climate change and occurs because trees located outside the THLB sequester enough carbon to offset long-term carbon removals from the harvested land base.

Net benefits* for selected ecosystem services after 100-yrs (2022 CAD billions)

	No extra deferral	BC policy deferral	Enhanced deferral	100% OG deferral
Carbon sequestration	$101.99	$111.38	$113.37	$137.61
Timber production	$10.41	$9.48	$9.32	$7.46
Forest recreation	$7.71	$7.91	$7.93	$8.01
Forest tourism	$0.19	$0.19	$0.20	$0.20
Other**	$1.57	$1.58	$1.59	$1.65
Total net benefits/costs	**$121.9**	**$130.6**	**$132.4**	**$154.9**
Improvement		**$8.7**	**$10.5**	**$33.1**

**Indicator of societal welfare. All results in net present value; discount rate of 3%*
***Non-timber forest products; education & research opportunities*

Employment and provincial GDP contribution* from timber harvest and recreation-based tourism (2022 CAD millions)

	No extra deferral	BC policy deferral	Enhanced deferral	100% OG deferral
Full-time equivalent jobs/yr				
Timber harvest	2,333	2,127	2,091	1,674
Forest tourism	111	115	115	118
GDP contribution/yr				
Timber harvest	$290	$264	$260	$209
Forest tourism	$5.6	$5.8	$5.8	$5.9

**Indicators of economic impact from expenditures (direct and indirect effects)*

Standing old-growth after 100-yrs ('000s ha)

Starting old-growth in 2022	No extra deferral	BC policy deferral	Enhanced deferral	100% OG deferral
2,715	**4,039**	**4,145**	**4,168**	**4,375**

Consequently, carbon sequestration benefits drive the overall net benefit results for this TSA regardless of the scenario, easily counterbalancing any losses in timber production benefits. Compared to the "no extra deferral" baseline, each deferral scenario would increase total net benefits by about $8.7 billion, $10.5 billion, and $33.1 billion respectively. These amounts account for a loss in timber production benefits of $0.9 billion, $1.1 billion, and $2.9 billion respectively, and a gain in net carbon benefits from sequestration by $9.4 billion, $11.4 billion, and $35.6 billion (using the federal government's social cost of carbon). All other ecosystem services combined would provide additional improvement in net benefits of about $210 million, $250 million, and $390 million, driven primarily by forest-based recreation benefits. Therefore, based on our *societal welfare* metrics, **BC residents would be better off the more old-growth is protected in the Prince George TSA**.

We also assessed *economic impact* metrics (e.g., jobs, GDP). There would be 2,333 full-time equivalent (FTE) direct and indirect jobs in BC supported annually by timber harvest in the Prince George TSA under the baseline, and each deferral scenario would result in a reduction of 206, 242, and 659 of these jobs respectively. Recreation-based tourism in forests would provide a much smaller employment contribution at only 111 FTE jobs under the baseline, and an increase of 4, 4, and 7 FTE jobs respectively. These results show that while BC residents would be better off overall with more old-growth protected, one tradeoff is that with increasing old-growth protection there would be fewer jobs in the province supported by timber harvest in this TSA (9-28% reduction from 2,333) than are gained from tourism (4-6% of 111). We did not consider potential job increases/decreases in other sectors. Some proportion of individuals employed in timber harvest

sector would move to other jobs. Similarly, the Prince George TSA's annual contribution to the provincial GDP of $290 million from timber harvest would decrease by 9%, 10%, and 28% for each respective scenario while tourism's smaller $5.62 million contribution would increase to $5.8 million (2.6% increase), $5.8 million (3%), and $5.9 million (4%). While these tradeoffs are relevant and important to highlight, our assessment of societal welfare metrics suggests that these economic impacts will be counterbalanced by overall *net benefits* (benefits minus costs) to BC residents from other ecosystem services, particularly climate change mitigation from carbon sequestration *under current wildfire disturbance rates*. See further down for discussion about the importance of managing old forests for wildfire mitigation.

If fully implemented, the province's recommended old-growth deferrals would result in **$8.7 billion** more value for BC residents from the Prince George Timber Supply Area than if no extra deferrals were implemented.

Okanagan Timber Supply Area

The forests within the Okanagan Timber Supply Area (TSA) are the home to Sylix, Secwepemc, and Nlaka'pamux First Nation groups. In this TSA, about 0.8 million hectares of forest are designated as harvestable (2022). This TSA is smaller than the Prince George TSA, covering 2% of the province (nearly 2.5 million hectares). The region is mountainous with drier low elevation basins, and wetter high elevations. It hosts a variety of tree species with western hemlock and redcedar common in the wetter northern portion, and Douglas-fir, ponderosa pine and lodgepole pine further south. Other common species include spruce and subalpine fir. The Shuswap Lake system in this TSA is one of the most important salmon-producing areas in BC. The Okanagan's dry climate and rapidly growing population means water stewardship is of special concern. This TSA hosts 30 forest-dependent species-at-risk including mountain caribou, Williamson's sapsucker, and the western screech owl.

The Okanagan TSA is more densely populated than the Prince George TSA - home to over four times more people in an area over three times as small. This density is accompanied by a more diverse economy that includes agriculture/vinitculture, tourism, retail trade, manufacturing, forestry, range, construction, film, aviation, health care and technology. In 2017, the Okanagan TSA had 4 large sawmills, 10 small sawmills, 2 wood chipping facilities, 2 wood pellet operations, a pole mill, and a shake and shingle mill.

Net benefits* for selected ecosystem services after 100-yrs (2022 CAD billions)

	No extra deferral	BC policy deferral	Enhanced deferral	100% OG deferral
Carbon sequestration	($4.16)	($1.83)	($0.66)	$6.61
Timber production	$3.55	$3.22	$3.12	$2.36
Forest recreation	$8.37	$8.51	$8.55	$8.87
Forest tourism	$0.52	$0.53	$0.53	$0.56
Other	$0.50	$0.50	$0.50	$0.48
Total net benefits/costs	**$8.78**	**$10.93**	**$12.03**	**$18.87**
Improvement		**$2.2**	**$3.3**	**$10.1**

**Indicator of societal welfare. All results in net present value; discount rate of 3%*
***Non-timber forest products; education & research opportunities*

Employment and provincial GDP contribution* from timber harvest and recreation-based forest tourism (2022 CAD millions)

	No extra deferral	BC policy deferral	Enhanced deferral	100% OG deferral
Full-time equivalent jobs/yr				
Timber harvest	879	813	785	601
Forest tourism	283	291	294	316
GDP contribution/yr				
Timber harvest	$111	$102	$99	$76
Forest tourism	$16.3	$16.6	$16.7	$17.4

**Indicators of economic impact from expenditures (direct and indirect effects)*

Standing old-growth after 100-yrs ('000s ha)

Starting old-growth in 2022	No extra deferral	BC policy deferral	Enhanced deferral	100% OG deferral
765	**760**	**793**	**810**	**906**

Under today's harvest practices, over the next 100 years overall forest age would decline over time with forests getting significantly younger in the TSA. Our modelling estimates that the current area of old-growth stands (older than 140yrs) in the Okanagan TSA will *decrease* with no extra deferrals. The decrease is about 0.7% (5,000 ha) with increases from this baseline of 4.3% (33,000 ha), 6.6% (50,000 ha), and 19.2% (146,000 ha) for the three deferral scenarios respectively. The BC policy deferral results in an *increase* in the current area of old-growth by 28,000 ha. About 42% more old-growth would exist in high productivity stands and 7% less in low productivity stands compared to the business-as-usual case if old-growth were fully protected ("100% OG deferral").

Under each deferral scenario we lowered the annual allowable cut (AAC) in proportion to the area of harvestable forest deferred, for a reduced AAC of 2,303,269 m^3 (94%), 2,231,395 m^3 (91%), and 1,788,769 m^3 (73%) for each scenario respectively. Harvest composition in the Okanagan TSA would be dominated by spruce, pine, and Douglas fir, with Douglas fir harvest dominating the first 20yrs, giving way to spruce and then pine before returning to a Douglas fir with spruce/pine mix in the 2080s. Some fir, hemlock, cedar, and hardwood would be harvested in smaller amounts throughout the 100 years.

The land base in the Okanagan TSA would act as a **net carbon source** across the 100-year period unless further deferrals are made beyond the current BC policy deferral. Both the business-as-usual case ("no extra deferrals") and the BC policy deferral cases result in net losses from carbon sequestration, but the latter scenario offers significant improvement, reducing those losses by about $2.3 billion in net benefits. The resulting reduction of carbon from the atmosphere, or a flip to sink status from full deferral would contribute to mitigating both local and non-local consequences of climate change.

Like for the Prince George TSA, because of the large impact of deferrals on carbon sequestration, that ecosystem service drives the overall net benefit results for this TSA regardless of the scenario, easily counterbalancing any losses in timber production benefits. Compared to the "no extra deferral" baseline, each deferral scenario would increase total net benefits by about $2.2 billion, $3.3 billion, and $10.1 billion respectively. These amounts account for a loss in timber production benefits of $0.3 billion, $0.4 billion, and $1.2 billion respectively, and a gain in net carbon benefits from sequestration of $2.3 billion, $3.5 billion, and $10.8 billion (using the federal government's social cost of carbon). All other ecosystem services combined would provide additional improvement in net benefits of $139 million, $183 million, and $510 million, driven primarily by forest-based recreation benefits. Therefore, based on our *societal welfare* metrics, **BC residents would be better off the more old-growth is protected in the Okanagan TSA**.

We also assessed *economic impact* metrics (e.g., jobs, GDP). There would be 879 full-time equivalent (FTE) direct and indirect jobs in BC supported annually by timber harvest in the Okanagan TSA under the baseline and each deferral scenario would result in a reduction of 66, 94, and 278 of these jobs respectively. Recreation-based tourism in forests would provide a smaller employment contribution but twice that of the Prince George TSA at 283 FTE jobs under the baseline, and an increase of 8, 11, and 33 FTE jobs respectively. Like the Prince George TSA, these results show that while BC residents would be better off overall with more old-growth protected, one tradeoff is that

with increasing old-growth protection there would be fewer jobs supported by timber harvest in the TSA (8-32% of 879) than are gained from tourism (3-12% of 283). We did not consider potential job increases/decreases arising from people moving to other sectors. Some proportion of individuals employed in the timber harvest sector would move to other jobs. Similarly, the Okanagan TSA's annual contribution to the provincial GDP of $111 million from timber harvest would decrease by 8%, 11%, and 32% for each respective scenario while tourism's smaller $16 million contribution would increase by 2%, 2.5%, and 7%. While these tradeoffs are relevant and important to highlight, our assessment of societal welfare metrics suggests that these economic impacts will be counterbalanced by overall *net benefits* (benefits minus costs) to BC residents from other ecosystem services, particularly climate change mitigation from carbon sequestration *under current wildfire disturbance rates*. See further down for discussion about the importance of managing old forests for wildfire mitigation.

If fully implemented, the province's recommended old-growth deferrals would result in **$2.2 billion** more value for BC residents from the Okanagan Timber Supply Area than if no extra deferrals were implemented.

Special Focus on Forest Carbon

Old-growth forests can help mitigate climate change because they **store particularly large amounts of carbon** above and below ground.

We accounted for carbon in above- and below-ground biomass of the simulated forests, as well as in soils. Our results suggest that forests in the Okanagan TSA will act as an overall **net carbon source** (more carbon emitted than sequestered) over the next 100-years unless all old growth harvest is deferred. Forests in the Prince George TSA will act as a **net carbon sink** (more carbon sequestered than emitted). In both TSAs, increasing old growth deferrals improves the net benefit from carbon sequestration. In the Okanagan TSA, it mitigates the source status, while in the Prince George TSA, it increases the sink status.

Under the business-as-usual case (No Extra Deferral) forests in the Okanagan TSA would sequester a net of -20M tonnes of carbon over 100-years (i.e., net loss), with improvements of 5M, 7M, and 22M tonnes for each of the deferral scenarios respectively (BC Policy Deferral, Enhanced Deferral, 100% Old Growth Deferral). Forests in the Prince George TSA would sequester a net of 154M tonnes of carbon over 100-years, with increases of 23M, 27M, and 75M tonnes for each of the deferral scenarios respectively.

Harvesting old-growth forests unlocks carbon stored in foliage, fine woods, and duff for rapid release into the atmosphere, much more than is gained by planted young trees. Younger trees, once well established, have high carbon sequestration rates and start to rebuild stores after 20-30 years, but regaining equivalent levels to old-growth forests requires centuries.

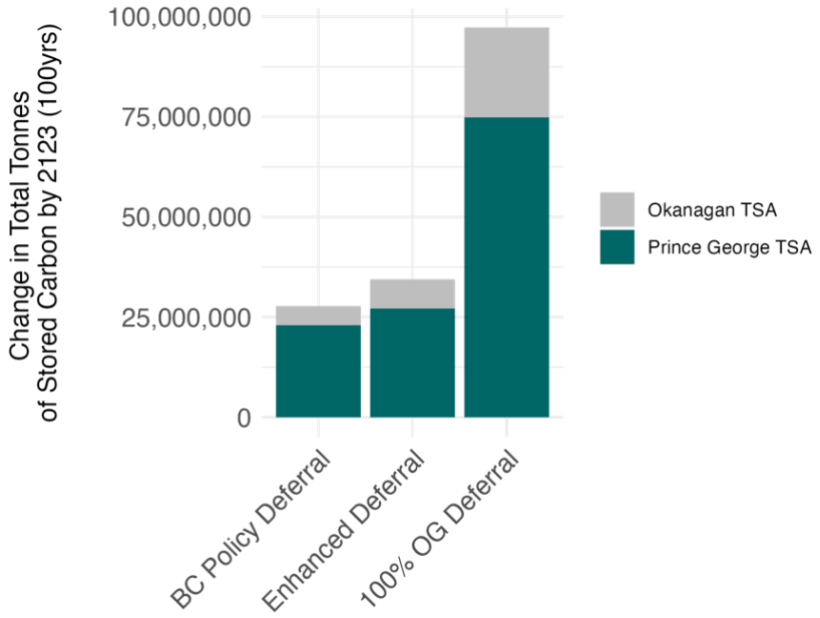
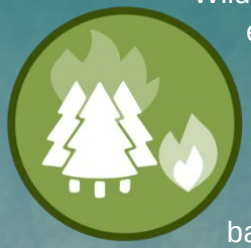


Figure 4. Change in Total Stored Carbon Compared to the No Extra Deferrals (Business-as-usual) Scenario

Young trees are typically re-harvested well before achieving equivalent levels of storage in the landscape. This decrease in ecosystem carbon is partially offset by the transfer of carbon into harvested wood products, which range from short-lived paper to long-lived products like furniture. However, the proportion of ecosystem carbon transferred into harvested wood products is relatively small (about 25%) and decreases over time as the wood products decay over comparatively short time periods.

If fully implemented in the Okanagan and Prince George Timber Supply Areas, the province's recommended old-growth deferrals would result in keeping **28 million tonnes** more carbon out of the atmosphere compared to no extra deferrals.

Special Focus on Wildfire



Wildfires release a lot of carbon in the fire prone ecosystems of Prince George and Okanagan and wildfires are projected to increase with climate change.

We accounted for wildfire in our simulations by applying an average areal wildfire rate based on 1920-2020 fire occurrence data from the Canadian National Fire Database, adjusting for "skips" (unburned patches in a fire scar) using the 1984-2020 National Burned Area Composite. We only calculated wildfire rates for the forested land base.

To explore the sensitivity of these ecosystems to wildfire rates in the model, we doubled the rates for the 100% old-growth deferral scenario. Our simulations showed that the forest would almost immediately become a net carbon source and society would lose substantial timber harvest and carbon sequestration benefits from the two TSAs, emphasizing a critical need for improved forest wildfire management in the region's second-growth managed forests. We would expect a similar effect for the other scenarios, suggesting large uncertainty about the effect of future fire disturbance rates.

Solutions to climate change must consider the multiple benefits of intact old growth ecosystems and primary forests, some of which are important for adaptation (e.g., air quality regulation).

There is increasing interest in restoring resilient landscape patterns, which would benefit overall landscape health and decrease the risk of large fires that are more costly and difficult to control. Fires in these regions, especially the Okanagan, were historically of mixed severities, which means that many small fires occurred that would have volatized fine surface fuels but generally left a patchwork of unburned forest and large fire-adapted trees – trees that stored the highest amounts of carbon.

One limitation of our modelling approach is that because we used average fire rates over the landscape and assumed only stand replacing fires, we were unable to capture the effect of mixed severity fire disturbances or targeted wildfire management practices. If we had been able to model, for example, a transition in the region to alternative fire management (e.g., increasing fires but guided), our results would likely show a smaller negative effect.

Aside from model limitations, the adverse impacts of fire can be minimized through forest management that aims to restore more natural wildfire disturbance, including prescribed burning practiced for millennia by First Nations, and maintaining deciduous ecosystems within the landscape mosaic. These efforts should aim to retain old-growth forests and large trees, which store the highest carbon.

Our sensitivity analyses with wildfire underscores the need to not only increase protection of old and primary forests, but also to resolve uncertainties and develop more integrative planning and management for conservation and wildfire in the study region.

Financing Conservation

A natural question after determining that society would be better off leaving old-growth trees in the ground is how to pay for old-growth's long-term protection? Protecting old-growth forest comes with restoration and stewardship costs. Our results also show clear trade-offs with the forest industry. While forest sector costs would be counterbalanced by overall net benefits from old-growth ecosystem services, individuals and firms will feel these costs more acutely than other BC residents. Governments *can* decide to defer based simply on the greater societal good, but it would be even more beneficial if costs were minimized. Our analysis shows covering at least some of these costs is a worthwhile investment.

Conservation financing may offer ways to compensate individuals and firms in the forest sector while also meeting other community priorities *in addition to* ecological preservation. Conservation financing is the practice of raising and managing funds for the stewardship of nature. But there are complex relationships between the economy, nature, and community wellbeing, all of which are needed for successful stewardship. As these dynamics have become clearer, conservation financing has evolved to include various socio-economic supports in addition to direct funds for environmental restoration and stewardship.

In recent decades, governments, industry, and the charitable sector have all mobilized large sums of money around conservation targets in what is now commonly referred to as the "conservation economy". A recent study by Coast Funds (with support from ESSA) highlights three stages of Indigenous conservation financing: 1) initial capital expenditure, 2) short-term finance, and 3) long-term finance. At all stages, there are Indigenous community priorities like employment, infrastructure, housing, and cultural values linked to conservation efforts that need to be addressed for restoration and stewardship efforts to be successful.

Different types of conservation financing vary in their ability to meet this broader range of community priorities. To mitigate risks and ensure adequate coverage of these priorities, it can be useful to develop diverse portfolios. Government and philanthropic grants are a commonly recognized form of conservation financing. Other options include conservation trusts like Coast Funds, as well as various market-based options like enterprise income (e.g., tourist access fees), revenue sharing from timber harvest, carbon markets, payments for ecosystem services, conservation offsetting, and debt-based instruments.

The Future of Forestry in BC

In response to the 2020 Old Growth Strategic Review's (OGSR) recommendations, which called for the conservation of ecosystem health and biodiversity of forests as an "overarching priority" to be supported by legislation that "legally establishes this priority for all sectors," the BC government released a draft Biodiversity and Ecosystem Health Framework for public comment in November, 2023 (closed January 2024) The draft emphasizes ecosystem-based management (EBM), which has been successfully applied in the Great Bear Rainforest including legal objectives to retain >30% old growth within each landscape unit as part of a broader approach to support ecological integrity and human well-being.

Starting in 2021 the province launched a new forest planning regime for Timber Supply Areas (TSAs) called Forest Landscape Planning (FLP). FLP's will be co-developed by the BC government and First Nations for all TSA's. While this planning tool is still in its pilot phase, each process is expected to produce a plan that uniquely aligns with the values and interests of impacted First Nations and may incorporate EBM, non-timber values, and cumulative effects considerations depending on the preferences of the planning tables. This study and the Port Renfrew pilot support the inclusion of non-timber values in the analysis of trade-offs during FLP processes.

Tripartite Framework Agreement on Nature Conservation

In November 2023, First Nations, BC, and Canada ratified a Tripartite Framework Agreement on Nature Conservation (the Framework Agreement) that includes over $1 billion in funds for protecting 30% percent BC lands by 2030, restoring ecosystems, improving stewardship, and creating Guardian programs. The agreement emphasizes following through on existing commitments relevant to old growth forests such as the Old Growth Strategic Review (OGSR), the Boreal Caribou Protection and Recovery Plan, and Spotted Owl recovery. It also includes an Old Growth Nature Fund with seed funding from third-party organizations that will be matched by the provincial and federal government up to $50 million and that is intended to grow over time through additional government and philanthropic contributions. This fund will support working in partnership with First Nations for the permanent protection and conservation of 0.4 to 1.3 million hectares of high priority at-risk old-growth forest ecosystems by 2025 (i.e., permanent protection of up to half of the 2.6 million high-priority hectares currently only deferred from harvest).

Where to Learn More

This study was an extension of a pilot study completed for the Ancient Forest Alliance in 2021. You can read the reports for that study here:

Economic Valuation of Old-growth Forests on Vancouver Island – Full Report

Economic Valuation of Old-growth Forests on Vancouver Island - Summary

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