Informing Land-use Planning with Science: Towards Sustainability

Science Alliance for Forestry Transformation

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Who are we?

We are **scientists** and applied science forest professionals wit**h expertise and experience** in terrestrial and riparian ecology, biodiversity, wildlife, disturbance dynamics, forestry, climate change, land-use planning, risk assessment, cumulative effects, resilience and landscape analysis (including timber supply). We are not social scientists or economists. We have worked on collaborative land-use planning around the province and are intimately familiar with barriers to success as well as potential pathways through the gauntlet of vested interests to the greater public interest.

Our big ask: reform forest management to sustain ecosystems and communities

1. **Update land use planning**, with an increased emphasis on protection of primary and old-growth forests;
2. **Adjust timber harvesting levels**, supported by more realistic determinations of allowable annual cuts to promote sustainable forestry practices;
3. **Reform forest tenure**, with greater community and indigenous control of forest management to increase social, environmental and economic resilience.

Approach: base decisions on science and acceptable risk

Forest management often ignores or obfuscates science that conflicts with short-term economic objectives, thus threatening ecosystem and community sustainability.

Sufficient scientific knowledge does not exist within the ministry. A changing baseline, poor institutional memory, continuance of business-area silos, innumeracy, senior bureaucrats with limited vision, and naïve young staff lacking mentors mean that lessons are lost and issues remain unresolved. A culture of "getting to yes" means that problems are swept under the rug.

Splitting the ministry provides the opportunity to introduce science-based decision-making, for example via a Chief Ecologist/Scientist and Independent Scientific Panels. Land-use planning provides opportunities to prioritize goals that bring long-term benefits to society, biodiversity and climate. Incorporating science in planning is critical to ensuring that management strategies work towards the goals.

Context: climate and biodiversity crises

We live in a time of unprecedented global crisis: the climate is almost out of control,[1] we are participating in a great extinction event,[2] and our societal systems have increased human vulnerability.[3]

At the same time, a social awakening to inequality and push for change led by youth provides an opportunity to act.[4]

The set of suggestions outlined below follow in the wake of our "Big Ask" as critical action items to address the climate and biodiversity crises.

Challenge: legal and policy direction prioritizes timber

BC's existing land-use plans have been, for the most part, ignored. As planning moves through the system, public intent is lost because industry speaks loudest. Many consensus objectives remain in the non-legal realm and subject to professional reliance…which has failed: rather than meeting intent, implementation aims to extract the most resources. Existing plans are out-dated, excluding climate change, new resource activities, and current science; many lack substantive First Nations' engagement.[5]

Suggestion: use land-use planning to retain more old growth forest

BC's primary forests,[6] particularly productive old growth ecosystems, are critical for mitigating climate change, adapting to climate change and maintaining biodiversity and ecological integrity. Land-use planning provides a mechanism for considering the well-documented importance of old forest and improving management accordingly.

Scientific Rationale:

- **Old forests store vast amounts of carbon**.[7] Retaining carbon-dense old forest is the most effective natural climate solution, far superior to planting trees, and critical to meeting 2050 emissions targets designed to prevent catastrophic change. Ecosystems with infrequent disturbance that grow large trees (i.e., coastal and inland temperate rainforest) are most important to protect.
    - **Harvesting old forests releases carbon**.[8] From 40 – 66% of carbon is lost to the atmosphere after harvest. More is lost through processing, meaning that "long-lived wood products" store a quarter or less of the carbon in a standing forest. Harvesting forests for bioenergy emits more carbon than using fossil fuel sources.
    - **Replacing old forests with young does not recover stores**.[9] It takes 100 to > 250 years to recover the stored carbon after logging; shorter rotation (<80 years) managed stands never recover the carbon of a natural forest. Carbon sequestration cannot replace carbon stores.
- **Old growth resists wildfire and flooding**. [10] Despite increased biomass, old growth burns less, due to buffered air temperature, stored moisture and structure that resists wildfire. Hydrology changes following harvest. Harvested stands are more vulnerable to the changed precipitation patterns, including intense storm events and droughts driven by climate change.
- **Intact primary forests maintain biodiversity and provide a suite of ecosystem services**.[11] These forests are critical for biodiversity, ecological integrity and services people need and care about.
    - **Old growth provides wildlife habitat**.[12] Intact forest at multiple scales supports population growth and dispersal and provides climate refugia.
    - **Intact forest buffers water flow and temperature**.[13] Forests act as sponges, releasing water slowly to buffer extreme low flows. They also shade streams from increased air temperature, protecting sensitive fish.

Policy Rationale:

- **Works towards international protected area agreements** and federal commitments to 30% by 2030. Currently BC is not meeting agreements to protect 17% of representative terrestrial ecosystems.
    - **BC has a global responsibility for biodiversity and carbon**, particularly because of its rare and productive coastal and inland temperate rainforests.
- **Implements the Old Growth Panel recommendations** as specified in mandate letter.[14]
- **Addresses multiple foundational principles and directives** in mandate letters.[15]

Supporting Actions

Supporting actions to increase forest protection include the following:

- **Shift paradigm from timber to ecological integrity** (i.e., implement Old Growth Panel recommendation #2);[16]
    - Change legal requirements to **remove "*without unduly impacting timber supply*"** clause (i.e., complete FRPA update #2).[17]
- **Implement Old Growth Panel recommendations** in their entirety;
- **Update carbon accounting** to properly value storage in old forest as compared with validated managed stand contributions;
- **Increase conservation and wildlife habitat protection in land use plans;**
    - Conservation science knows how much of each representative ecosystem to retain in order to have a high probability of maintaining ecological function.
- **Empower First Nations to develop interim moratoria** on timber harvest in their traditional territories to evaluate ecological and cultural values, and ensure collaboration.
- **Emphasize long-term sustainability for communities** by shifting the reliance on limited primary forest that will be gone within a decade.

Examples

Land-use planning provides the regional-scale mechanism to increase protection of primary forest. Here are a few models.

- **Omineca Environmental Stewardship Initiative**. Carrier Sekani First Nations and the Province have mapped biodiversity management areas for conservation. These agreed-upon areas should have been included in the government's deferral areas.
- **Gitanyow Land Use Plan.** This plan, which increased conservation for biodiversity, cultural values and water management, has been incorporated into legal objectives. Gitanyow asked the province to decrease the AAC on their territory because modeling shows it is not sustainable from an economic perspective (let alone ecological). The province has not yet agreed.
- **Great Bear Rainforest.** Many complexities here. A better process and targets than most other plans,[18] but implementation remains a challenge as industry still high-grades the biggest trees.
- **Clayoquot Sound Scientific Panel.** The province's first collaborative science/traditional ecological knowledge panel with recommendations accepted by the province.

Additional Suggestions

- **Increase in-stand retention** to increase the probability of maintaining biodiversity and ecosystem function.

    - Addresses biodiversity, climate mitigation, refugia, wildlife, water protection
    - The science is well developed, with regional examples (e.g., Date Creek Research Forest in Kispiox Valley)
- **Increase diversity in tree species** to address uncertainty and climate change.

Challenge: optimistic models overestimate timber supply

BC's timber supply has reached its fall-down and rural communities are in crisis.[19] Using optimistic models to set allowable annual cut levels has driven forest management in perverse directions, leading to overharvest, community instability and biodiversity declines. Growth and yield models have overestimated stand growth, by underestimating the effects of natural disturbances and ignoring climate change.[20] This optimism, coupled with a lack of monitoring and operational scale model validation that could have corrected course, has led to unsustainable harvest rates.

In many parts of BC, little old growth remains available for harvest.[21] This timber supply fall-down has been anticipated for decades, but not addressed. Because harvest focused on productive stands,[22] what remains often has low volumes and high costs, which exposed many BC mills to collapse and shutdown when lumber prices fell in 2019. A long-term future for communities can only be based on diverse rural economies that meet the global demand for low-carbon products rather than focusing on high-carbon resource extraction.

Suggestion: develop a realistic annual allowable cut

A realistic allowable annual cut (AAC) is a prerequisite for a strong sustainable economy, for environmental sustainability, for reconciliation and for fighting climate change.

- **Use a realistic approach to model timber supply** that includes current science on growth rates, disturbance and mortality.[23] Update models based on improved inventory and extensive monitoring of stand health and growth.
- **Account for climate change in models.** Future tree mortality will increase due to increased drought, wildfire and storm disturbance, insect outbreaks and pathogens.[24]
- **Expand inventory to validate and calibrate models.** Base harvest levels on inventory and monitoring rather than uncertain forecasts.
- **Ensure that high productivity sites are not preferentially harvested**; do not leave only high-cost, low-value forests for future generations.

Examples

- **Quebec forestry** has changed from using simulation models to set AAC (as BC does now) to using inventory plots to monitor growth rates and help set AAC level. This seems to be a positive change.[25]
- **Gitanyow Hereditary Chiefs** have conducted an independent timber supply review on their territory that considers the best knowledge about mortality and growth, and incorporates climate impacts. The methods estimate the probability of different harvest levels being sustainable and allow determination of a sustainable AAC based on risk tolerance. To date, the province is considering their input, but has not changed the AAC.[26]

Challenge: short-term economics vs. resource-dependent communities

The industrial status-quo threatens rural communities.[27] Many rural communities in BC depend upon resource extraction for jobs. Over recent decades, many mills have closed and forest jobs have declined as large corporate industry works to maximize short-term profit and invest profits in mills elsewhere while liquidating BC's old growth.

The current model puts industrial timber economics above local economies and employment as well as above community health (e.g., clean water, clean air, recreation and spiritual experiences). Foresters face a conflict of interest when managing forest tenures directly tied to mills that are linked to corporations and shareholders.

Economic and productive systems need to be transformed to power the shift to sustainability.[28]

Suggestion: tenure reform

Reform the forest tenure system to reduce emphasis on an oligopoly of multinational corporations and place control in collaborative organizations that embrace sustainability and indigenous rights. For example, regional forest trusts and community governance bodies can determine important values (such as ecological sustainability, clean water, diversity of jobs), acceptable risk levels, and suitable harvest amounts and patterns. Timber companies can then design logging plans or bid on open log markets and focus on manufacturing, where their expertise lies, rather than on forest management.

Rationale

- **Regional log markets provide timber to small manufacturers.**
- **Local residents find jobs** in forest trusts or community-based authorities and manufacturing.
- The traditional business model of forest companies no longer applies; new models have little to do with sustainability and much to do with highly mobile transboundary capital, lowest cost investment and little place-based accountability.[29]
- Changing tenure provides opportunities for ENGOs such as The Nature Conservancy to manage and/or purchase and protect land.[30]

Examples

- **Community forests and First Nations' woodland licences** in BC have a variety of management approaches. Some are focused on providing economic benefit to communities; many aim to achieve sustainable management certification.
- The **Algonquin Forest Authority** provides a business structure model that manages landscape as a public tenure ownership.[31]
- **Quebec forestry** has shifted from industrial to government control of forest management. This has had unexpected consequences, with government foresters less inclined to follow outside recommendations; perhaps a mixed model might be best.[32]
- The First Nations owned **Menominee Forest** in Wisconsin has been sustainably harvested for more than 150 years, prioritising removal of low-quality trees and keeping vigorous trees, guided by ecology but still highly profitable.[33]

- **Wildwood Ecoforestry Institute Society** on Vancouver Island has continued Merv Wilkinson's legacy of ecologically and economically sustainable forestry.[34]

[1] **International Panel on Climate Change**. https://www.ipcc.ch/. Any recent reports.

[2] **Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services**. https://www.ipbes.net/

[3] For example, **IBPES Pandemics Report**: Escaping the Era of Pandemics. https://www.ipbes.net/pandemics. **UNEP 2021.** delves into humanity's triad of emergencies: climate, biodiversity and pollution. It synthesises global environmental assessments produced by the Intergovernmental Panel on Climate Change, Intergovernmental Science-Policy Platform for Biodiversity and Ecosystems Services, and the United Nations Environment Program.

[4] For example, **Moore, P., Noonan, D., & Woodward, E. 2020**. Juliana v. United States and the global youth-led legal campaign for a safe climate. In *Standing up for a Sustainable World*. Edward Elgar Publishing.

[5] https://www2.gov.bc.ca/gov/content/industry/crown-land-water/land-use-planning/modernizing-land-use-planning

[6] Primary forest is forest of any age that has not been disturbed by industrial activities. Not all primary forest is old, but all old growth is primary forest. Old growth forest reflects a landscape's natural disturbance regime. In wet regions, where disturbance is rare, old growth forest replaces itself over time as small gaps open and fill, providing a complex, dynamically stable environment for centuries. Where disturbances are more frequent, old growth forest is more uniform, with veteran trees representing legacies of past disturbance.

[7] **Smith RB 2020.** Enhancing Canada's Climate Change Ambitions with Natural Climate Solutions. Vedalia Biological Inc. http://doi.org/10.13140/RG.2.2.18243.02088/ Protection of the most carbon-dense ecosystems, under imminent threat, would remove 10Mt $C0_2$per year from the atmosphere immediately to over 175 Mt CO_2 per year by 2030. Emissions of 586 Mt CO_2 would be avoided by maintaining stores under imminent threat. This would increase to 1.8 to 11 billion tonnes of CO_2 by 2030 and to 35 – 186 Gt of CO_2 e by 2050. In BC, remaining high-productivity old growth forests store 200 – 470 Mt of carbon (lower estimate excludes soil carbon). Remaining area of these forests from **Price et al. 2020.** BC's Old Growth Forests: A Last Stand for Biodiversity. **Luyssaert, S., Schulze, E. D., Börner, A., Knohl, A., Hessenmöller, D., Law, B. E., ... & Grace, J. 2008.** Old-growth forests as global carbon sinks. *Nature*, *455*(7210), 213-215.**Law, B. E., Hudiburg, T. W., Berner, L. T., Kent, J. J., Buotte, P. C., & Harmon, M. E. 2018.** Land use strategies to mitigate climate change in carbon dense temperate forests. *Proceedings of the National Academy of Sciences*, *115*(14), 3663-3668. "Here, we demonstrate this approach in a high biomass region, and found that reforestation, afforestation, lengthened harvest cycles on private lands, and restricting harvest on public lands increased net ecosystem carbon balance by 56% by 2100, with the latter two actions contributing the most. Forest sector emissions tracked with our life cycle assessment model decreased by 17%, partially meeting emissions reduction goals. Harvest residue bioenergy use did not reduce short-term emissions. Cobenefits include increased water availability and biodiversity of forest species. Our improved analysis framework can be used in other temperate regions."

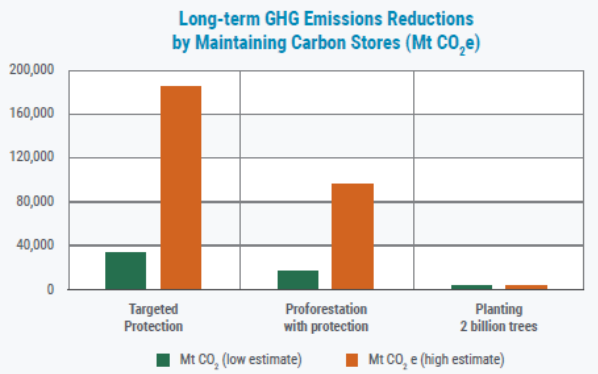

FIGURE 2: Emission reductions are also achieved by avoiding releases of stored carbon. Estimates of stored carbon vary, depending on a variety of factors including assumptions of the researcher, whether soil carbon as well as biomass is included, the ecosystem type, geography and climate. This graph shows the GHG emission savings resulting from full implementation of the recommendations, and including savings from protection of targeted ecosystems that are at risk from human activities, but the risk may or may not be imminent. For targeted protection, boreal forests over 200 years are reflected in the calculations.

[8] **Pojar 2019.** Forestry and carbon in BC: 7 forest carbon myths, misconceptions, or oversimplifications **Smith 2020. Law et al. 2018**.

[9] **Pojar J 2019**. Forestry and carbon in BC: 7 forest carbon myths, misconceptions, or oversimplifications; **Smith 2020**.

[10] **Frey SJ, Hadley AS, Johnson SL, Schulze M, Jones JA, Betts MG. (2016).** Spatial models reveal the microclimatic buffering capacity of old-growth forests. Science Advances 2(4): e1501392. **Bradley, C.M., Hanson, C.T. and DellaSala, D.A., 2016.** Does increased forest protection correspond to higher fire severity in frequent-fire forests of the western United States? *Ecosphere*, *7*(10), p.e01492. **Zald, H. S., & Dunn, C. J. 2018.** Severe fire weather and intensive forest management increase fire severity in a multi-ownership landscape. *Ecological applications*, *28*(4), 1068-1080. **Watson, J. E., Evans, T., Venter, O., Williams, B., Tulloch, A., Stewart, C., ... & Lindenmayer, D.2018).** The exceptional value of intact forest ecosystems. *Nature ecology & evolution*, *2*(4), 599-610.

[11] **Watson, J. E., Evans, T., Venter, O., Williams, B., Tulloch, A., Stewart, C., ... & Lindenmayer, D. 2018.** The exceptional value of intact forest ecosystems. *Nature ecology & evolution*, *2*(4), 599-610. **Thompson, I., Mackey, B., McNulty, S., & Mosseler, A. 2009.** Forest resilience, biodiversity, and climate change. In *Secretariat of the Convention on Biological Diversity, Montreal. Technical Series no. 43. 1-67.* (Vol. 43, pp. 1-67).

[12] **Watson et al. 2018.** ibid

[13] **Watson et al. 2018**. Ibid. **Klamerus-Iwan A., Link T.E., Keim R.F., Van Stan II J.T. 2020** Storage and Routing of Precipitation Through Canopies In: Van Stan, II J., Gutmann E., Friesen J. (eds) Precipitation Partitioning by Vegetation. Springer, Cham. https://doi.org/10.1007/978-3-030-29702-2_2

[14] https://www2.gov.bc.ca/assets/gov/government/ministries-organizations/premier-cabinet-mlas/minister-letter/conroy_mandate_2020.pdf

[15] https://www2.gov.bc.ca/assets/gov/government/ministries-organizations/premier-cabinet-mlas/minister-letter/conroy_mandate_2020.pdf; https://www2.gov.bc.ca/assets/gov/government/ministries-organizations/premier-cabinet-mlas/minister-letter/cullen_mandate_2020.pdf

[16] **Gorley, A., and Merkel, G. 2020**. A new future for old forests: a strategic review of how British Columbia manages for old forests within its ancient ecosystems. Prepared for the Minister, BC Ministry of Forests Lands Natural Resource Operations and Rural Development. Available from https://engage.gov.bc.ca/app/uploads/sites/563/2020/09/STRATEGIC-REVIEW-20200430.pdf

[17] **Forest & Range Practices Act**, Forest Planning and Practices Regulation, Objectives Set by Government. https://www.bclaws.gov.bc.ca/civix/document/id/lc/statreg/14_2004#section5

[18] **Price, K., Roburn, A., & MacKinnon, A. 2009.** Ecosystem-based management in the Great Bear Rainforest. *Forest Ecology and Management*, *258*(4), 495-503.

[19] **Britneff A. 2020.** Comment: we must improve how BC forests are managed. Op-ed Times Colonist Victoria BC December 29

[20] **Watts M and Britneff A 2020.** Uncertainties of timber supply estimates used for allowable annual cut determinations. Report for David Broadland.

[21] **FLNRORD 2020**. Current condition report for old growth forest in the Stuart-Nechako District, Omineca Region. 2019 Analysis. **Forest Practices Board 2020**. Management of biodiversity in the PG TSA. FPB/IRC/235.

[22] **Price K, Holt R and Daust D 2020.** BC's Old Growth Forests: A Last Stand for Biodiversity.

[23] For example, modelled yields underestimate mortality-related volume losses by up to 30%. **Woods, A.J. and Watts, M. 2019**. The extent to which an unforeseen biotic disturbance can challenge timber expectations. Forest Ecology and Management 453: 117558. **Woods, A.J., Coates, K.D., Watts, M., Foord, V. and Holtzman, E.I., 2017.** Warning signals of adverse interactions between climate change and native stressors in British Columbia forests. Forests, 8: 280. **Woods, A.J., 2003**. Species diversity and forest health in northwest British Columbia. The Forestry Chronicle, 79: 892-897. Even without mortality, projected volumes from models are higher than predicted from "young stand monitoring). **Watts and Britneff 2020**. **Burton, P.J. 2019**. The precautionary principle as a framework for resilience in forest planning and practice. International Union of Forest Research Organizations (IUFRO) Congress XXV, 2 October 2019, Curitiba, Brazil. Abstract published in Pesquisa Florestal Brasileira, Special Issue, 39: e201902043, p. 151. http://iufro2019.com/wpcontent/uploads/2019/10/Anais_Iufro_Final_reduzido-1.pdf

[24] **Daust D and Price K. 2013**. Natural disturbance. In: a climate change vulnerability assessment for BC's manged forests. Edited by D Morgan and D Daust.

[25] Personal communication between **Dave Coates and Christian Messier** (Scientific Director, Institut des Sciences de la Forêt Tempérée; Canada Chair on forest resilience to global change)

[26] **Daust D and Price K 2020**. Toward sustainable timber harvesting in Gitanyow Territory. For copies, please ask Tara Marsden, Office of the Gitanyow Hereditary Chiefs.

[27] **Britneff A. 2020.** Comment: we must improve how BC forests are managed. Op-ed Times Colonist Victoria BC December 29

[28] **UNEP 2021** United Nations Environment Program

[29] **Stein, P. R. 2011.** Trends in forestland. *Forest History Today*, *17*, 83-86. **Bliss, J. C., Kelly, E. C., Abrams, J., Bailey, C., & Dyer, J. 2010.** Disintegration of the US industrial forest estate: Dynamics, trajectories, and questions. *Small-Scale Forestry*, *9*(1), 53-66.

[30] **Stein, P. R. 2011.** Trends in forestland. *Forest History Today*, *17*, 83-86. **Bliss, J. C., Kelly, E. C., Abrams, J., Bailey, C., & Dyer, J. 2010.** Disintegration of the US industrial forest estate: Dynamics, trajectories, and questions. *Small-Scale Forestry*, *9*(1), 53-66.

[31] Personal communication, **Len Vanderstar**.

[32] Personal communication between **Dave Coates and Christian Messier** (Scientific Director, Institut des Sciences de la Forêt Tempérée; Canada Chair on forest resilience to global change)

[33] **Menominee Tribal Enterprises.** Maeqtekuahkihkiw Kew Kanahwihtahquat "The Forest Keepers". 1997. https://archive.epa.gov/ecopage/web/pdf/menominee-forest-keepers-1997-25pp.pdf. **Burgess D. 1995.** Forests of the Menominee—a commitment to sustainable forestry. Forest Chronical 72: 268-275.

[34] https://www.ecoforestry.ca/the-legacy-of-merv-wilkinson Wildwood tree farm: 50 years of selection forestry. https://www.for.gov.bc.ca/hfp/publications/00092/note_03.pdf