ECOSYSTEM SERVICES Assessment Project

TIMBER PRODUCTION & CARBON STORAGE REPORT

OVERVIEW

Ecosystem services are the benefits provided by nature that contribute to our health and wellbeing. Despite the essential role that ecosystem services play in our lives, they're often ignored in decision-making because we don't recognize their value. This project aims to change that by measuring and valuing these services.

The Ecosystem Services Assessment (ESA) project assesses and maps ecosystem services across Alberta. In the first phase of the project (2012-2015), we developed a set of spatially explicit models that can be used to map their supply and economic value, starting with five ecosystem services:

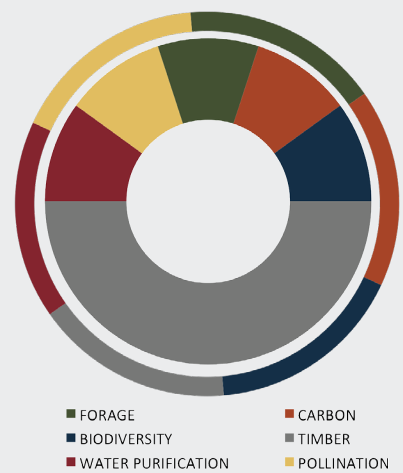
- Water purification
- **Timber production**
- Forage production
- Pollination
- Carbon storage

We've also mapped the ABMI's Biodiversity Index, drawing from the ABMI's extensive province-wide biodiversity data, to estimate how plant and animal species respond to varying amounts of human footprint.

We're interested in how these ecosystem services interact with humans: how they are affected by human activities and change with land management, both positively and negatively. The second phase of the project, beginning in 2015, will demonstrate applications of ecosystem service information for use by land managers, and incorporate this knowledge into marked-based instruments that use monetary incentives and fees to promote desired environmental outcomes, and discourage adverse impacts.

Powered with this information, Albertans can make the best possible decisions about how to manage our landscape and natural resources. Improved knowledge about the provision and value of ecosystem services can support better environmental management through regional planning, market-based approaches, and sustainability reporting.

INTEGRATED PLATFORM



Ecosystem services are linked to one another and do not respond independently to changes in land-use or management practices. Integrating ecosystem service models in a single platform is essential to a comprehensive assessment of ecosystem services – so that the effects of a single management action on multiple ecosystem services can be represented.

> **For example, forest harvesting simultaneously affects carbon storage, water purification, and biodiversity; only by integrating these services in a modelling environment can the inherent trade-offs be understood.**

TIMBER PRODUCTION AND CARBON STORAGE

In turns out, money does grow on trees! Or, rather, in them. Alberta's forests play a vital role in both our environment –by sequestering carbon, producing oxygen and providing species' habitat– and in our economy, accounting for nearly a third of Alberta's total GDP in 2014.[1]

Accounting for the economic value of Alberta's timber and carbon allows decision makers to understand how activities like logging for lumber and pulp affect the amount of carbon that's stored in forests. The ESA timber production and carbon storage models simulate forest growth and carbon storage to assess these two ecosystem services in Alberta's forests.[2]

We estimated forest growth based on standardized yield curves as a function of stand age, obtained from Natural Resources Canada (2006).[3] Forest growth was calculated for five forest types: spruce-dominated coniferous; pine-dominated coniferous; spruce-dominated mixedwood; pine-dominated mixedwood; and deciduous. Each of the five forest types was further differentiated by the two primary forested ecozones in Alberta, the Boreal Plains and the Montane Cordillera, for a total of 10 forest types. The amount of coniferous vs. deciduous trees in each forested area, as well as the initial stand ages, were obtained from ABMI's enhanced vegetation layer, which in turn is based on the Alberta Vegetation Inventory (AVI) and provincial forest fire records.

Most lumber and pulp mills in Alberta are supplied with wood from surrounding public lands under various legal agreements with the provincial government.[4] In the timber production model, each mill is assumed to prioritize the harvesting of trees greater than 80 years old and that have the lowest transportation cost to reach the mill. In each annual time step, each mill harvests trees based on this prioritization until it reaches its annual harvest limit or quota.

Once harvested, the wood is sent to the mill for processing, and the transportation cost is calculated based on the quality of roads present. Paved roads are able to transport timber more quickly, and therefore more cheaply, compared to unpaved roads.

The revenue for each mill is determined based on the volume and type of wood products (including lumber, pulp and paper, oriented strand board, or veneer) typically produced at each mill, and the market price of each product. The value of timber is represented by the profit from each mill, calculated as revenue minus minus transportation and operational costs. The profits from each mill are then mapped back to the landscape, based on how much wood was sent to the mill from that area in a given time period.

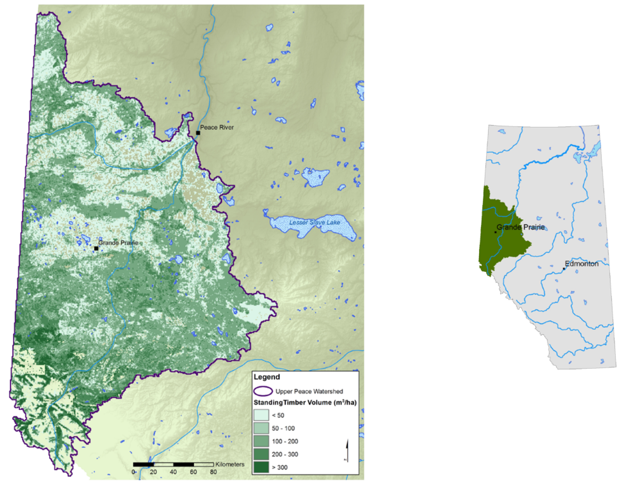
We estimated the value of timber production in the Upper Peace region of Alberta at $6.2 billion over 20 years of simulated harvest activities (Fig 2, top).

For the carbon model, an external carbon budget model relates the age of the forest to how much carbon is stored in it, per hectare. This is done for each of the 10 forest types based on a published forest carbon model.[5] The total stock of stored carbon (both above- and below-ground) at any point in time is influenced by timber harvesting activities, as harvested trees are no longer storing additional carbon. The economic value of stored carbon can be estimated based on a user-defined carbon price. Using Alberta's carbon price of $20/tonne,[6] the value of forest carbon in Alberta's Upper Peace region (estimated at 4.8 billion tonnes) would be $144 billion!

In addition to total carbon storage, the model also calculates the change in carbon storage over the simulated time period as forests sequester additional carbon, and carbon is removed from the landscape through harvesting. Under the simulated harvest described above, the model estimates that an additional 236 million tonnes of carbon would be sequestered in forested areas of the Upper Peace region over the next 20 years (Fig 2, bottom).

The timber and carbon models are highly flexible and allow for a lot of interaction with the models: the model user can adjust all cost and price variables. This includes the cost of operating the mills, timber product prices, and carbon prices. Visit our mapping portal to try out the models yourself! http://mapping.ecosystemservices.abmi.ca

FIGURE 1: *Standing timber volume (in m^3 per hectare) in the Upper Peace watershed. Inset: boundary of Upper Peace watershed.*



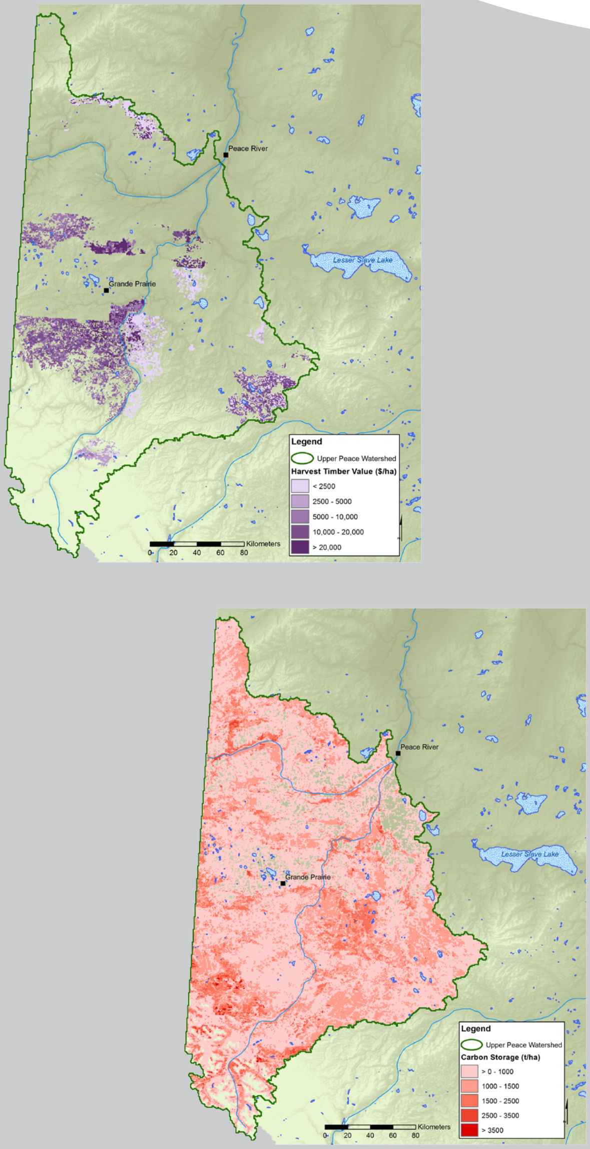


FIGURE 2: *Timber harvest value in $/ha after 20 years of simulated harvest activities in the Upper Peace watershed (top). Carbon storage in tonnes/ha after a 20-year harvest simulation (bottom).*

- We successfully assessed and mapped five ecosystem services across Alberta. We're now integrating our five models with a biodiversity model into a single interactive platform – available on our website soon! www.ecosystemservices.abmi.ca

- We have completed a preliminary assessment of how rangeland forage production and soil carbon storage may be impacted by climate change, and evaluated the potential costs and benefits of specific adaptation strategies to respond to those changes. Once complete, this information can support the evaluation and implementation of community climate change adaptation strategies.[7]

- Our research on biodiversity offset priorities was published in Conservation Biology. The goal of biodiversity offsets is to counter the loss of biodiversity from development by conserving or restoring the same type of biodiversity elsewhere. We evaluated alternative offset policies in northern Alberta as a case study. Our work suggests that flexible offset systems tailored to regional conservation priorities (e.g., caribou habitat), can achieve better conservation outcomes at a lower cost compared to systems focused strictly on offsetting the exact same types of ecosystems and biodiversity that were affected by the development.[8]

- We have contributed to initiatives focused on sustainable beef production, including the Food & Agriculture Organization at the UN and the Canadian Roundtable on Sustainable Beef. Our capacity to assess ecosystem services supports sustainable livestock by providing a more complete assessment of the environmental performance of a given piece of land than past approaches.[9]

APPLICATION – PHASE 2

The goal of the second phase of the project (2015-2017) is to promote environmental innovation and competitiveness in Alberta's leading natural resource industries by demonstrating how to apply the systems developed in Phase 1 for assessing ecosystem services and biodiversity.

Understanding the provision of ecosystem services is an essential first step in developing market approaches to conservation, like offsets, sustainability reporting, and certification. We need a full assessment of the benefits we're receiving from the landscape before we can begin to accurately value these services in the marketplace. The ESA project offers Albertans that potential.

This project is part of a province-wide initiative, the Ecosystem Services Research and Innovation Roadmap, funded and led by Alberta Innovates – Bio Solutions, and also receives funding from the Alberta Livestock and Meat Agency. This project is a collaboration with the University of Alberta, Alberta Innovates – Technology Futures, Silvacom, the University of Guelph, and the Alberta Land Institute.

Visit our project website for the most recent reports, products and updates from the project: www.ecosystemservices.abmi.ca

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[1] *Natural Resources Canada (2014). Key Facts and Figures on the Natural Resources Sector. http://www.nrcan.gc.ca/publications/key-facts/16013*

[2] *Kennedy, M., A. Wandenbroeck, & J. Wilson. (2014). Timber and carbon geosimulation modelling platform. Prepared for the ABMI Ecosystem Service Assessment Project.*

[3] *Natural Resources Canada. (2006). Canada's National Forest Inventory: Area, Gross Total Volume by Forest/Non forest, Forest Type, Age Class. https://nfi.nfis.org/home/php?lang=en*

[4] *Alberta Environment and Parks. Forest Management Agreements. http://esrd.alberta.ca/lands-forests/forest-management/forest-management-agreements/default.aspx*

[5] *Kull, S.J. et al. (2011). Operational-scale Carbon Budget Model of the Canadian Forest Sector (CBM-CFS3) version 1.2: user's guide. Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre.*

Kurz, W.A., et al. (2009). CBM-CFS3: a model of carbon dynamics in forestry and land-use change implementing IPCC standards. Ecological Modelling, 220(4): 480-504.

[6] *Alberta's carbon price is set to increase to $20/ton in January 2017, and rise to $30/ton in January 2018. For more information: http://alberta.ca/climate/carbon-pricing.cfm.*

[7] *Nixon, A.E. et al. (2015). Climate change and the provision of ecosystem services in Alberta. ABMI.*

[8] *Habib, T.J., D.R. Farr, R.R. Schneider, & S. Boutin (2013). Economic and ecological outcomes of flexible biodiversity offset systems. Conservation Biology 27(6): 1313-1323.*

[9] *LEAP FAO Principles for the Assessment of Livestock Impacts on Biodiversity. Available at: http://www.fao.org/3/a-av154e.pdf*

Canadian Roundtable on Sustainable Beef: http://www.crsb.ca