



Direct and Indirect Costs of Wildfires- a Canadian Cost Accounting Framework

Nirmal Subedi PhD, Bryan Bogdanski PhD, and Brad Stennes PhD
Western Forest Economists Meeting, May 22, 2024, Victoria, BC Canada



Natural Resources
Canada

Ressources naturelles
Canada

Canada

Outline

- Research background
- Literature Review
- Present a direct and indirect cost accounting framework for wildfires
- Apply the framework to assess the known costs of five recent extreme wildfire seasons
- Results
- Discussions- data gaps and challenges
- Conclusions

Research Background

Economic impacts of catastrophic w

Chapter 2: The Economic Effects of the 1998 Florida Wildfires

David T. Butry, D. Evan Mercer, Jeffrey P. Prestemon,
Thomas P. Holmes, and John M. Pye

 United States
Department
of Agriculture

Forest Service

Rocky Mountain
Research Station

General Technical
Report RMRS-GTR-114

September 2003

Hayman Fire Case Study

Russell T. Graham, Technical Editor

2002

Province of British Columbia

**Incremental Economic/Financial Impacts of the 2003
Forest Fires and Drought Conditions in British Columbia**

Grant Thornton 

2009 &
2010



**Ministry of Forests,
Lands and Natural
Resource Operations**

Assessment of the Cost impact
of Wildfires on British
Columbia

NIST Special Publication 1215

The Costs and Losses of Wildfires A Literature Survey

2017

Douglas Thomas
David Butry
Stanley Gilbert
David Webb
Juan Fung
*Applied Economics Office
Engineering Laboratory*



Economic footprint of California wildfires in 2018

Daoping Wang¹, Dabo Guan^{2,3,4}, Shupeng Zhu⁴, Michael Mac Kinnon⁴, Guannan Geng⁵,
Qiang Zhang⁶, Heran Zheng⁶, Tianyang Lei⁶, Shuai Shao⁷, Peng Gong² and Steven J. Davis⁸

RECOVERING & REBUILDING FROM
OREGON'S 2020 WILDFIRES



KEY FINDINGS & RECOMMENDATIONS

Report Presented by the Governor's Wildfire
Economic Recovery Council

January 4, 2021

Literature Review

- Economic Impacts studies tend to address issues important to
 - a particular wildfire (2002 Hayman fire, Colorado) or wildfire season (BC 2003, California 2018) or
 - the agency (State of Oregon 2021)
- Lack of a unified coherent accounting framework to assess the economic impacts
- Although, the National Institute of Standards and Technology enumerated all possible direct and indirect costs plus losses from wildfires, it was silent on accounting stance (e.g., cost for whom ?)
- Kreibich et al (2013) reviewed the reported costs across natural hazards globally and reported that most assessment only accounted for direct costs and even these costs were thought to be at least 50% higher than internationally reported

Literature Review

Cochrane (2004) critically evaluated past studies on the economic impact assessment of disasters and reported that these studies suffer from

1. Double counting;
2. Failure to clearly state the accounting stance (i.e., losses to a particular region- at a national level or a regional level- versus losses to a party, such as government, private sector, including the insurance industry, individual households, and non-profits);
3. Ignoring non-market losses;
4. Challenges to identify whether the post-disaster economic trends are a product of the event or some unrelated factor; and
5. Use of a too-limited timeframe included for employment data (and other lagged data) that is too short to reflect the full range of outcomes.

Canadian Cost Accounting Framework for the Wildfire Disaster



Our Cost Accounting Stance

- A regional approach (Davis 2007) used
 - The changes in employment, income and production to the impacted region including any disutility or additional social costs to the people included
- A bottom-up approach- used to identify economic, social and environmental impacts of significant wildfire events within the region
- Changes in the flow of goods or services preferred to changes in stocks
- The “best available science information (BASI)” - guiding principle for compiling the estimates of wildfire costs plus losses and damages.

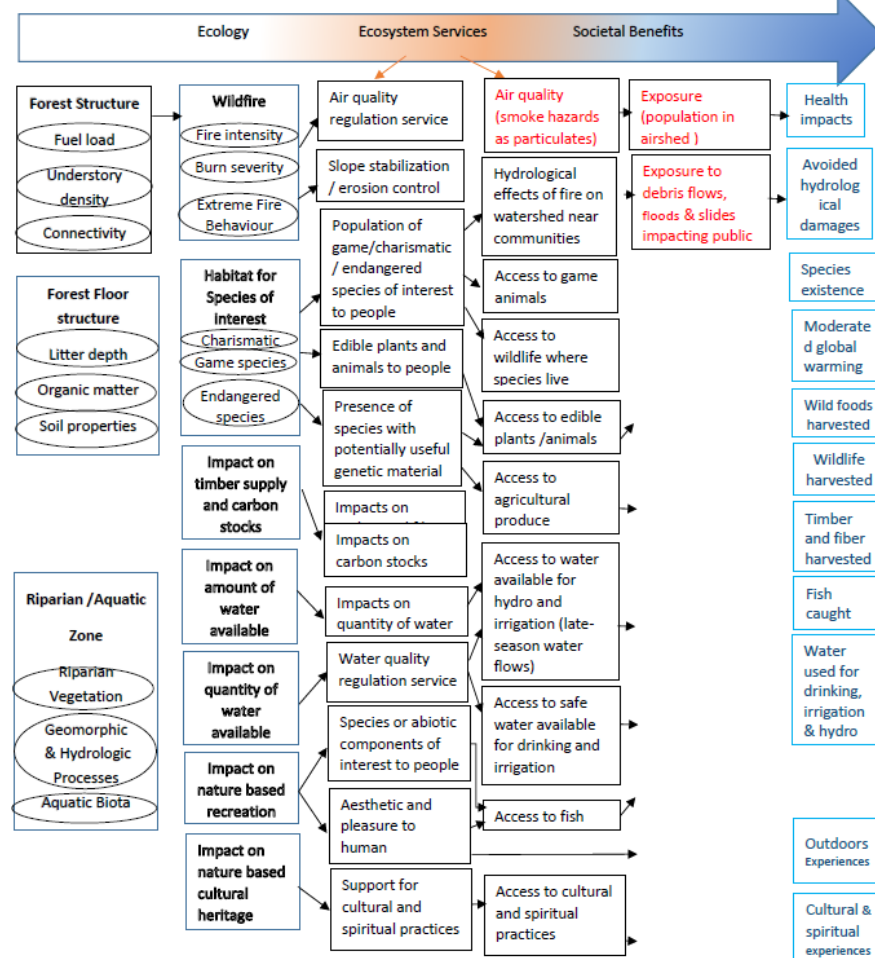
Direct, Indirect and Risk Mitigation Cost Categories

Category	Cost Component	Duration	Cost-type
Direct	Fire Protection and Preparedness	Short and On-going	Tangible
	Emergency Response	Short	Tangible
	Human Injury and Mortality	Short/Medium	Intangible
	Property Loss or Damage	Short/Medium	Tangible
	Damage to Infrastructure	Short/Medium	Tangible
	Damage to Forest	Short/Medium/Long	Both

Category	Cost Component	Duration	Cost-type
Indirect	Disturbance to Landbase	Medium/Long	Both
	Damage to Ecosystem Function	Long	Intangible
	Business Interruption	Short/Medium	Tangible
Risk Mitigation	Wildfire Prevention Education	On-going	Tangible
	Fuel Hazard Assessment	On-going	Tangible
	Fuel Hazard Abatement	On-going	Tangible
	Other Risk Mitigation Actions	On-going	Tangible
	Research	On-going	Tangible

Post-fire changes in Societal Benefits

- A conceptual diagram with causal chains for an ecosystem services assessment of a wildfire event at Interior of British Columbia.
- Attempts made to assess the changes in Benefit Relevant Indicators (BRIs), in the diagram right side – **blue box**



Study Area

Socio-economic information for the study area

	Northwest Territories	Saskatchewan	British Columbia	Alberta
Area (sq. km)	1,143,794	588,244	922,503	640,330
Forest area (sq. km)	283,520	200,430	579,100	277,180
GDP-2015 (\$ billion, chained 2020 \$)	4.56	77.04	254.33	331.40
Census population (2016)	41,786	1,098,352	4,648,055	4,067,175
Population density (per sq. km)	0.04	1.87	5.04	6.35
Median household income-2015 (Real \$ 2020)	\$126,806	\$81,255	\$75,418	\$101,105
Unemployment rate (%)	10.6	7.1	6.7	9



Cost Components and Data Availability

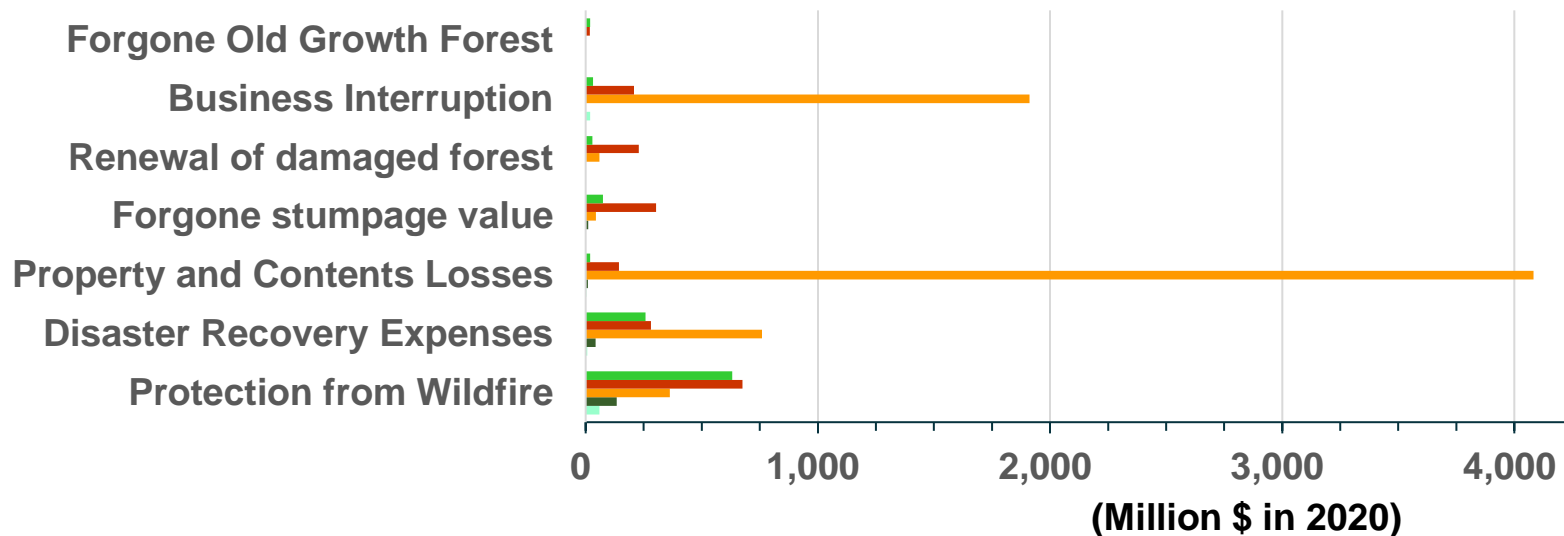
Direct Cost Categories	Is BASI available ?	Indirect Cost Categories	Assessed
Fire Protection and Preparedness	Full	Disturbance to Landbase	Medium
Emergency Response	Full	Damage to Ecosystem	Partial
Human Injury and Mortality	Partial	Business Interruption	Medium
Property Loss and Damage	Medium		
Damage to Infrastructure	Medium		
Damage to Forest	Full		

- Lack of BRIs on human health and ecosystem services including water supply, secondary hazard impacts such as landslides and floods, and wildlife habitat prevented the monetization of intangible costs.
- The risk mitigation costs- not included in this study.



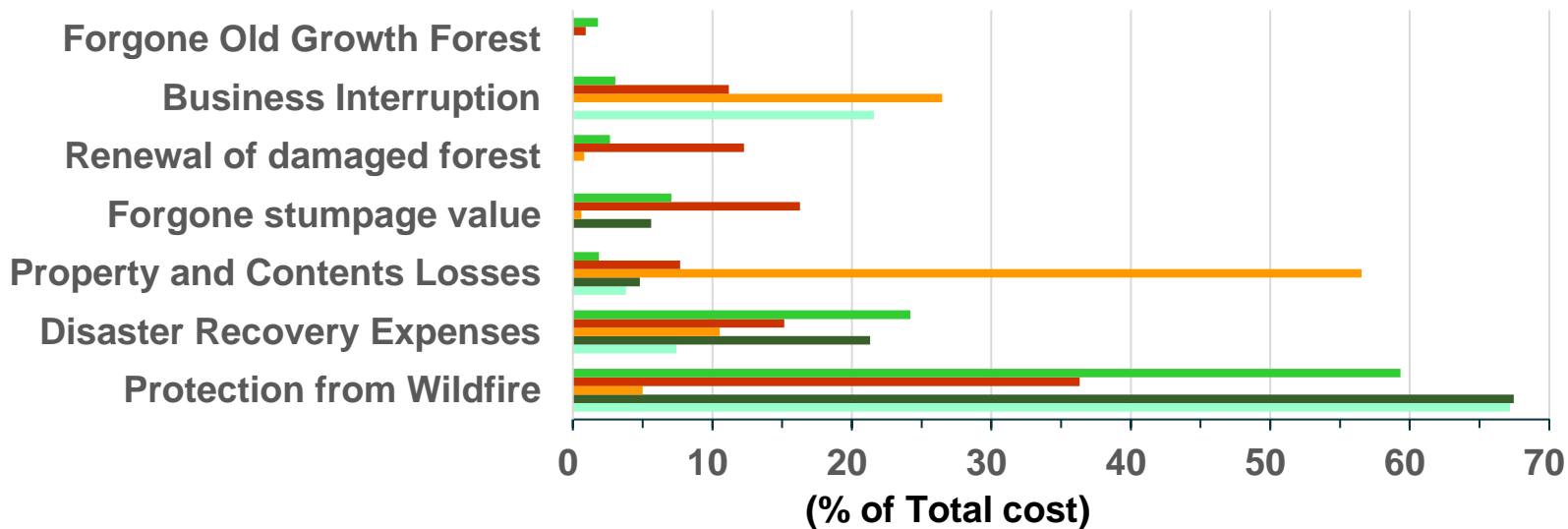
 Full Medium Partial

Direct and Indirect Costs of Wildfire Seasons



- Northwest Fire, BC 2018 (\$1.06 B)
- Interior Fire, BC 2017 (\$1.86 B)
- Horse River Fire, AB 2016 (\$7.21B)
- La Ronge Fire, SK 2015 (\$0.19 B)
- Kakisa Fire, NWT 2014 (\$ 0.09 B)

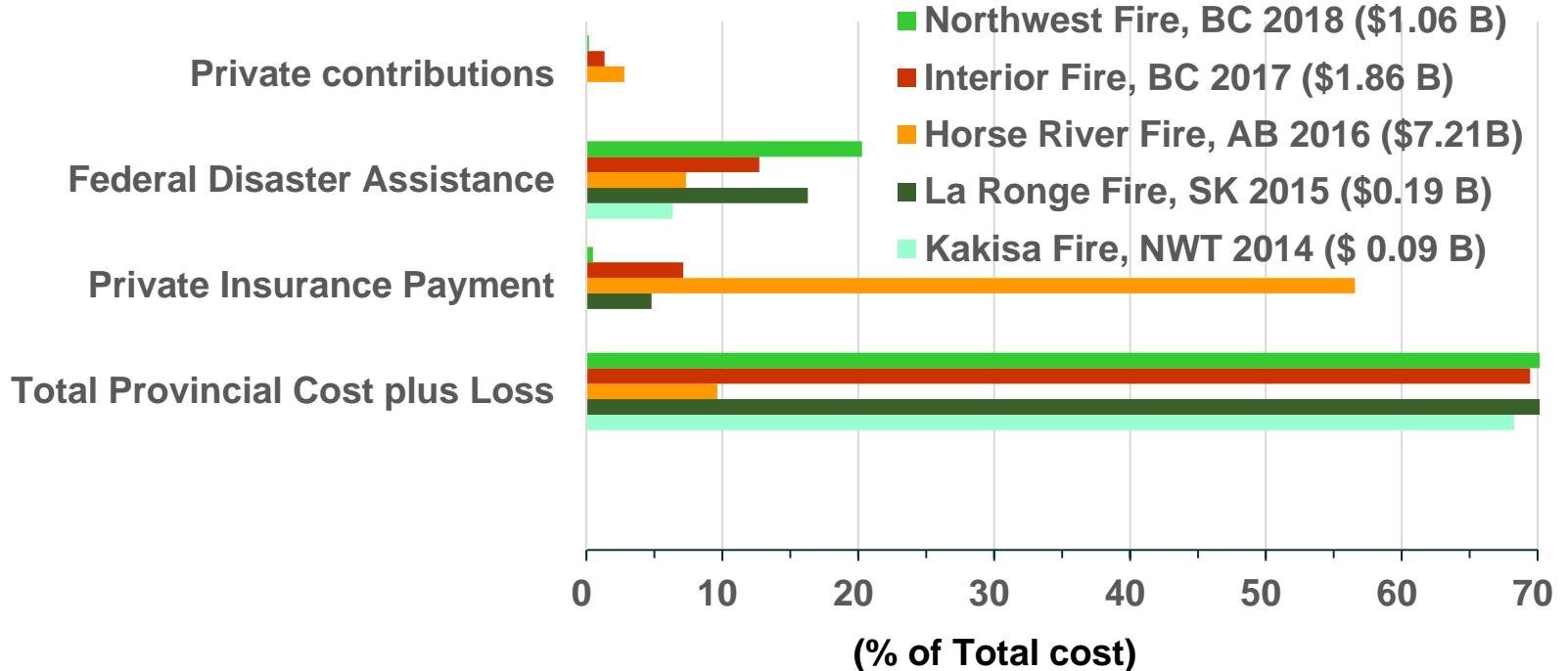
Direct and Indirect Costs of Wildfire Seasons



- Northwest Fire, BC 2018 (\$1.06 B)
- Horse River Fire, AB 2016 (\$7.21B)
- Kakisa Fire, NWT 2014 (\$ 0.09 B)

- Interior Fire, BC 2017 (\$1.86 B)
- La Ronge Fire, SK 2015 (\$0.19 B)

Payment for damages and losses



Discussion

- Risk Mitigation Costs- not included in the assessment of total cost of wildfires
- Only known Business Interruptions costs were included
- Lack of information on impacts such as health, including smoke related and mental health, drinking water supply, potential secondary hazard impacts such as landslide and floods prevented quantification and monetization of these impacts
- The case studies included can be used to construct the loss or damage scenarios for wildfire risk analysis
- While no attempt was made to place a value on greenhouse gas emissions, although it is possible. The reason behind this are:
 - The scope of accounting exercise is regional and social costs of Carbon are global.
 - If these costs are to be included, then the full carbon dynamics (immediate and delayed emission as well as future sequestration as forest recovers) over the time horizon needed, which is beyond the scope of this study.

Conclusion

- A framework for assessing the direct and indirect economic costs/losses of significant wildfire seasons was developed using a regional approach.
- The total known costs of the wildfire case studies largely involved adding:

Costs of Wildfire Protection	Renewal Costs of Damaged Forest
Disaster Recovery Expenses	Business Interruption Losses
Property and Contents Losses	Value of Forgone Old Growth Forest
Forgone Timber Stumpage Value	

- Ex-post economic impact analysis of five case studies completed using the framework.
- Overall, the wildfire economic impact assessment framework is found to be robust and flexible enough to estimate the cost-plus losses from wildfires.
- Data gaps on indirect and intangible losses related to human health and ecosystem services limited the quantification of these costs. More efforts are needed in this area.

Conclusion

- The known total costs of selected studies = $[1.5, 20]$ x the costs of wildfire protection
 - In case of the 2018 California fire this multiplier was 192 times the wildfire protection costs. In 2018, there were multiple WUI fires including Camp fire, Mendocino Complex Fire, and Woolsey fire caused 100 confirmed loss of lives and over 24,200 structures were destroyed in California.
- The total costs of wildfire varied depending on **the socio-economic characteristics of the hardest hit area(s) including the number and size of communities, the scale of business interruption, the spatial extent of damages to built-in capital, and post-fire changes in social benefits and recreational and cultural values** that are important to the affected communities.
- With exception of 2016 Horse River Fire, Provincial and Territorial Government covered about two thirds of the identified costs. Federal government played a larger role, contributing a range from 6% to 20% of known costs.
- The payment from private insurance company ranged from nil in regions with no insured properties loss to a high of 57% in our five case studies.



Thank you !
Nirmal Subedi
Canadian Forest Service,
Pacific Forestry Centre
250-298-2404
nirmal.subedi@nrcan-rncan.gc.ca