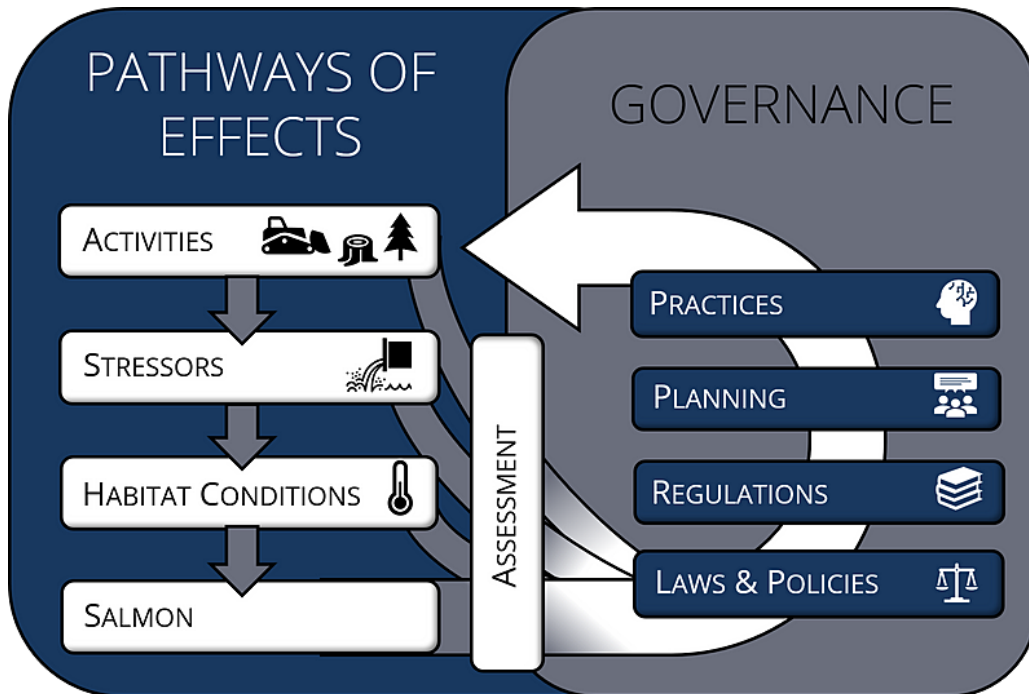


# CUMULATIVE EFFECTS IN SALMON WATERSHEDS



WATERSHED FUTURES  
INITIATIVE  
PROBLEMATIQUE

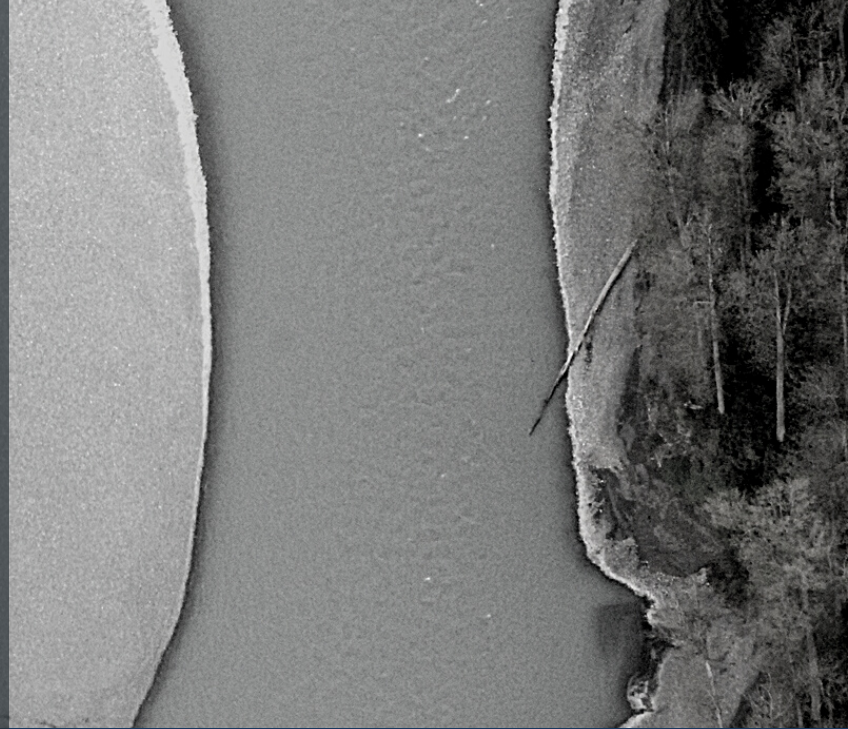
People live in, and extract resources from, the watersheds that salmon call home. The cumulative impacts of these resource extraction, and other human land-use activities—as well as climate change—modify habitat conditions, and potentially harm salmon (Fig. 1). Different parts of the salmon life-cycle depend on different habitats, which may be impacted by diverse stressors. These stressors are caused by a variety of activities, which are governed by a mix of laws, policies, regulations, and planning processes. Underlying this governance system is a complex network of different institutions, organizations, and processes, connected by flows of information. There is an urgent need to improve both the science and governance of cumulative effects in British Columbia's salmon-bearing watersheds before they are damaged beyond feasible repair.



**Fig. 1.** Cumulative effects and their management can be visualized as a pathway of effects from activities, to habitat, to salmon (grey arrows), and the feedback (white arrows) that potentially connects the state of the system to the governance of activities.

## CONTEXT IS NOT STATIC

Salmon watersheds are rapidly changing. Many salmon populations in BC are at risk of extirpation and many fisheries have been closed in efforts to try to recover salmon. While some watersheds are still relatively pristine, other systems are now heavily stressed by decades of land use change. Climate change is rapidly warming air temperatures, altering patterns of precipitation and hydrology, and further changing BC's salmon habitat conditions.



## THE 'WICKED PROBLEM' OF CUMULATIVE EFFECTS

Cumulative effects are a complex and multidimensional problem. As part of the Watershed Futures Initiative, we sought input from 80 cumulative effects experts in a Nov 18, 2020 online workshop. Those experts identified a diversity of challenges with the effective treatment of cumulative effects in salmon watersheds, which can be roughly divided into two linked topics.



### SCIENTIFIC GAPS & UNCERTAINTIES

The science underpinning cumulative effects assessment and management is a real challenge. We often don't know the answer to the basic question—how much is too much? A single activity may have many different direct and indirect pathways of impact, and multiple activities can interact with each other in complex and unexpected ways. The different activities also occur across diverse landscapes, ranging from high desert plateaus, to interior boreal forests, to coastal rainforests. These different salmon systems likely have different sensitivities or tolerances, which challenge accurate predictions of impacts. Further, watersheds are inherently complex and dynamic systems, making it difficult to parse natural variation from human-caused damage. Some of what we may think we know may no longer be true. Thus, there are major gaps in our scientific understanding.



### GOVERNANCE OF CUMULATIVE EFFECTS

The effective governance of cumulative effects management is also an enormous challenge. Many different agencies, laws, and policies regulate specific activities, but they may not consider other interacting activities and their impacts. With the potential for silos across these many different agencies and jurisdictions, salmon and their habitats may be 'falling through the jurisdictional cracks'. Though assessment processes can provide insights into the state of the ecosystem, there may be gaps in the application of this information. Furthermore, rather than being forward-looking and holistic, decision making related to cumulative effects has often been characterized as reactive and piecemeal. There are positive examples of forward-looking initiatives but, for the most part, integrating cumulative effects initiatives with on-the-ground planning and decision-making remains challenging.

# OPPORTUNITY FOR IMPROVEMENT

The challenge of cumulative effects is urgent. However, there is good news. Now is a key time for making progress on both science and governance. Many different initiatives and programs are addressing this problem in various ways. Over recent years, scientists and practitioners have continued to build a foundation of different cumulative effects assessment methodologies and tools, many of which show promise. Large data on the state of ecosystems are now available. There are also a growing number of examples of innovative strategies and approaches used to assess cumulative effects and identify management options from which we can draw lessons and insights. New versions of laws, ranging from the Fisheries Act to the Impact Assessment Act now incorporate language regarding cumulative effects and there is on-going work to translate these laws and their associated policies and regulations into practices on the ground. Perhaps most significantly, the fundamental rights of Indigenous groups to steward natural resources in their own territories is also gaining greater recognition and acceptance, strengthening incentives for action, and offering new opportunities for collaboration and partnership.



## WATERSHED FUTURES INITIATIVE

### THE WATERSHED FUTURES INITIATIVE

Based out of Simon Fraser University, under the direction of Dr. Jonathan Moore, the Watershed Futures Initiative (WFI) seeks to improve the effective management and governance of cumulative effects via two groups of activities:

- 1) Facilitating Networking and Connections; and
- 2) Undertaking Research Projects.

Across these activities, we recognize there is a need to engage with policy-makers, regulatory agencies, community leaders, and rightsholders to help shape our research and networking activities and facilitate the uptake of WFI outputs. Ultimately, improving management of cumulative effects will depend on people working together in new and more effective ways. We are also aware that the work needed to improve the management of cumulative effects in BC's watersheds will be an on-going effort and should evolve with shifting opportunities and based on input from partners and advisors. We anticipate that these intertwined activities will lead to positive change as follows.



## FILLING KEY KNOWLEDGE GAPS

Some of WFI's Research Projects will provide novel analyses on a specific linkage within pathways of effects (grey arrows, Fig. 1). Clarifying the science of a key linkage can improve local decision-making and refine potential thresholds or benchmarks within policies. For example, one WFI project has identified how much water Chinook salmon need to thrive and this information could be incorporated into watershed-level water-use planning. This data could also help inform Provincial-level benchmarks for water. For effective uptake, there is also a need to connect Research Projects and associated deliverables with key organizations and individuals, such as regulatory agencies and local community leaders and rightsholders.



## IMPROVING CUMULATIVE EFFECTS ASSESSMENTS

There is a need and opportunity to elevate and implement effective tools that assess cumulative effects and provide the basis for effective management. There is also an opportunity to showcase existing tools that are proving to be effective and elevate others' work to increase uptake and collaboration. For example, the Nov 18, 2020 workshop featured experts who presented different cutting-edge approaches for assessing cumulative effects (Networking and Connections). However, there are also opportunities to improve the assessment tools themselves. One forthcoming WFI Research Project will also identify the key pathways of impacts that people are concerned about across different regions.



## PROACTIVE WATERSHED PLANNING & STEWARDSHIP

The overarching aim of WFI is to empower and enable forward-looking watershed planning and governance that effectively stewards salmon and their habitats. Networking and Connection events aim to facilitate cross-talk between different agencies and jurisdictions. As a final synthetic Research Project, WFI also aims to deliver a tool for watershed planning (the Salmon Futures Model) to facilitate collaborative scenario planning. This tool is being developed in cooperation with Provincial and Federal scientists and managers and we aim to implement this in a focal location with ongoing watershed planning processes.



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## CONTACT THE WATERSHED FUTURES INITIATIVE

Do you have feedback on this Problematique, questions about WFI, or an interest in being involved?

Contact us via the form on our website: [www.watershedfuturesinitiative.com](http://www.watershedfuturesinitiative.com)