

Evaluating the status of Fraser River sockeye salmon and role of freshwater ecology in their decline

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Overview

- Importance of freshwater environment
- Report objectives
- Fraser River sockeye salmon
- Salmon life cycle, freshwater habitats, and human activities
- Analyses and key findings of individual stressors
- Weight of evidence regarding role of freshwater stressors
- Core recommendations

Importance of freshwater habitat

- Humans can harm watershed processes and freshwater habitats for sockeye salmon
- Variability in freshwater habitats is good!
⇒ diverse life histories, populations, genetics, behaviour
- Biological diversity supports resilience of Pacific salmon & people:
 - stable inputs of water & nutrients for food webs
 - human communities by stabilizing catch

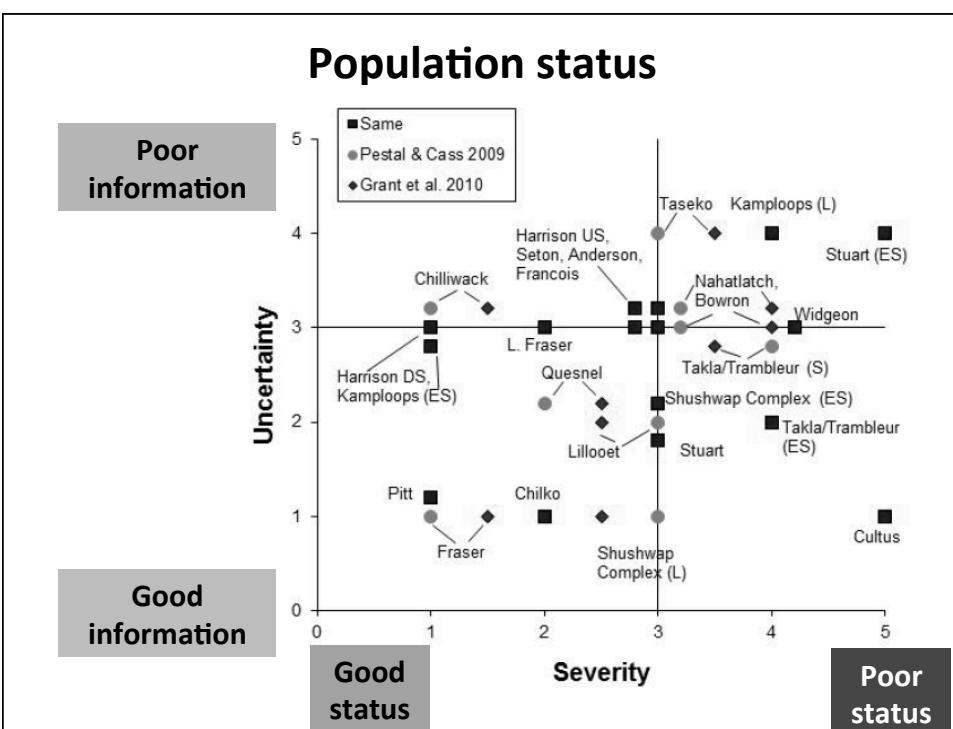
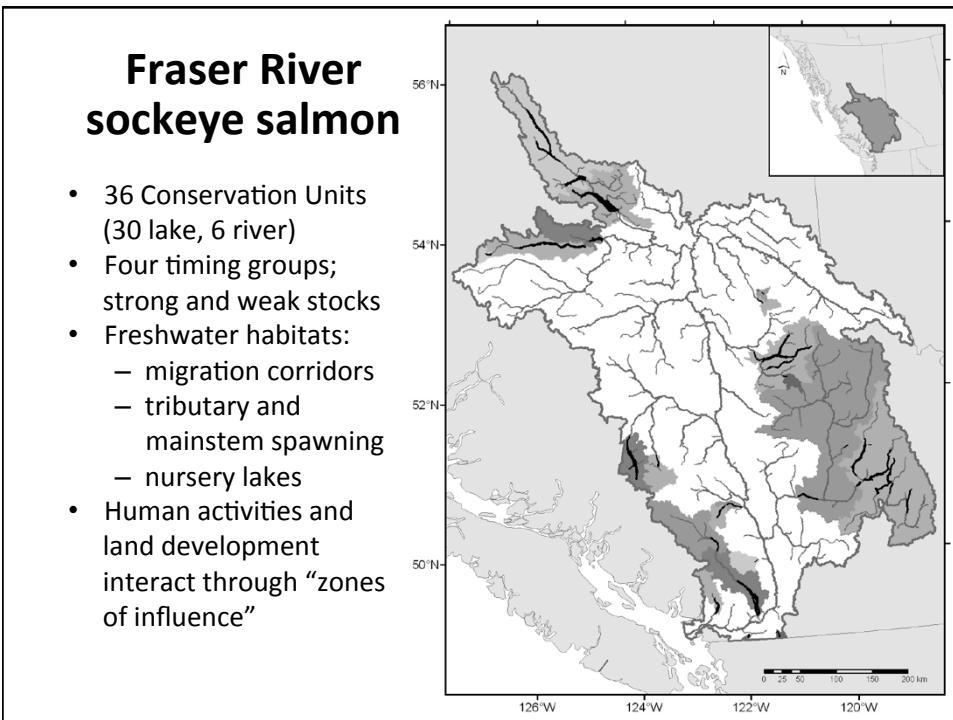


Report objectives

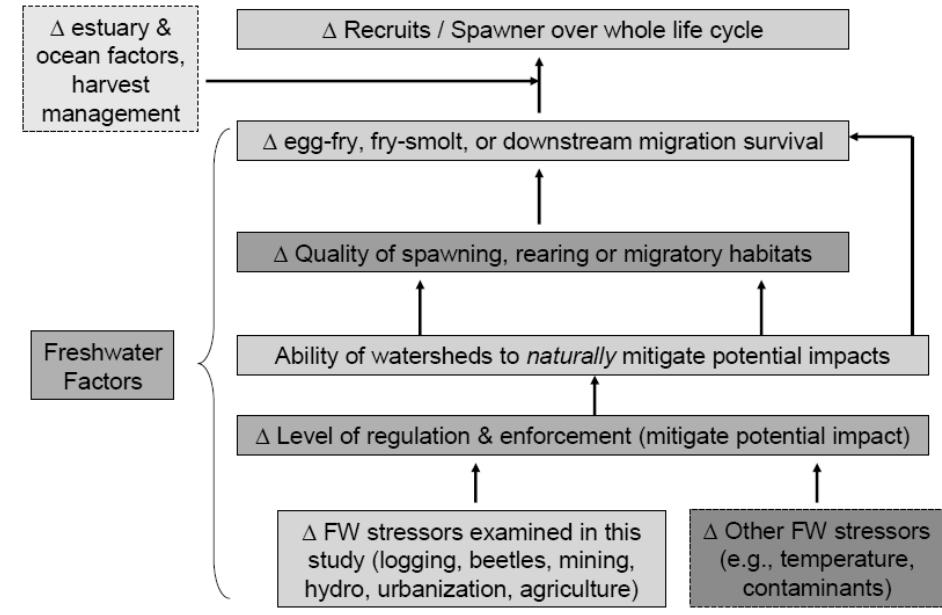
- Assess current status of Fraser River sockeye salmon
 - delineate populations by Conservation Units (CUs)
 - evaluating DFO's methods for assessing conservation status
 - determine status of Fraser River sockeye salmon CUs
- Evaluate changes in freshwater ecology and its role in recent Fraser sockeye salmon declines
- Have logging, hydroelectricity, urbanization, agriculture, and mining had habitat impacts that could explain recent declines?



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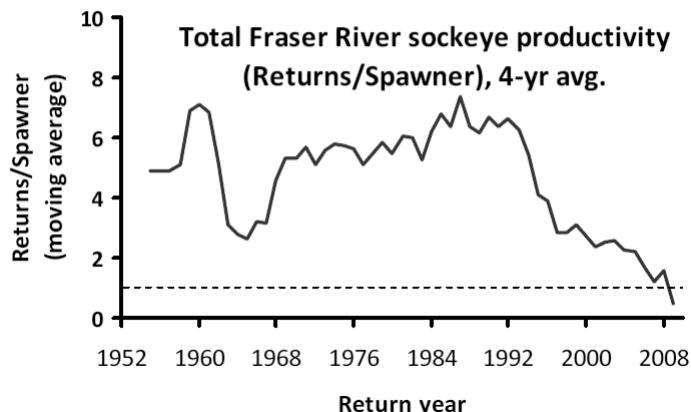
Conceptual model of FW habitat impacts



Data analyses

Dependent variables:

- Trend in total life cycle productivity (residuals from Ricker curve of Recruits/Spawner, based on Selbie et al. 2010)
- Trend in Juvenile productivity (residuals of Fry/Spawner)



Data analyses across 17 stocks

Independent variables:

- Intrinsic habitat vulnerability (**migration distance**, area of nursery lakes, ratio of lake influence to total spawning extent)
- Forestry (harvested area, **MPB area**, **road density**, number of road crossings)
- Mining (#, type of mines)
- Hydroelectricity (# of run of river, effects of large scale operations)
- Urbanization (area, human population size)
- Agriculture (area)
- Water use (allocations, number of licenses, number of restrictions)
- Cumulative effects (aggregation of all human activities)

Migration distance and **MPB area** showed strongest negative correlations with total productivity trends across stocks, but are also correlated with each other.

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Key findings

Forestry

- Level of forest harvesting within the last 15 years has been less than 10% of sockeye watersheds
- Riparian zones in upslope areas tend to be more heavily disturbed than riparian areas
- Road activity is highly variable; highest interaction in areas adjacent to mainstem spawning and along migration corridors



Key findings

Forestry

- MPB disturbance increased dramatically since 2003; up to 90% in some interior watersheds
- Intensity of log storage in lower Fraser varies more across reaches than across seasons / years; past studies show no significant impacts on juvenile salmon

Cumulative Area Affected by Mountain Pine Beetle

Key findings

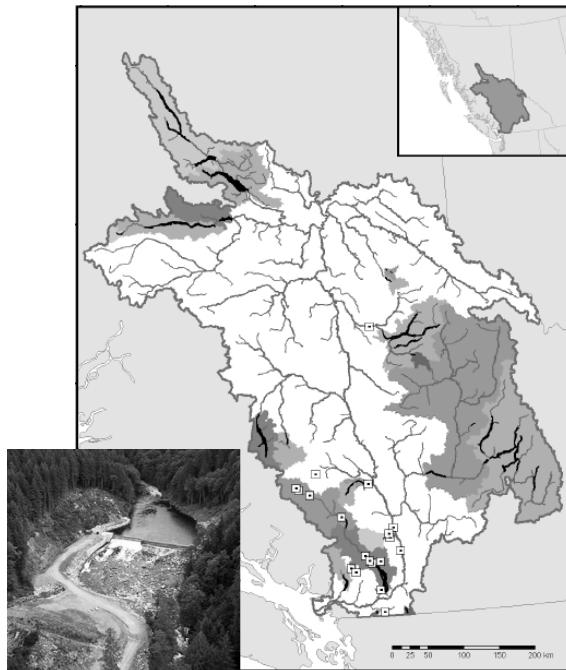
Mining

- Mining activity varies substantially; placer mining most dominant and has greatest potential to reduce early freshwater survival
- Impacts on sockeye small, difficult to detect since contrasts among stocks and strength of effect is low relative to other factors

Key findings

Hydroelectricity

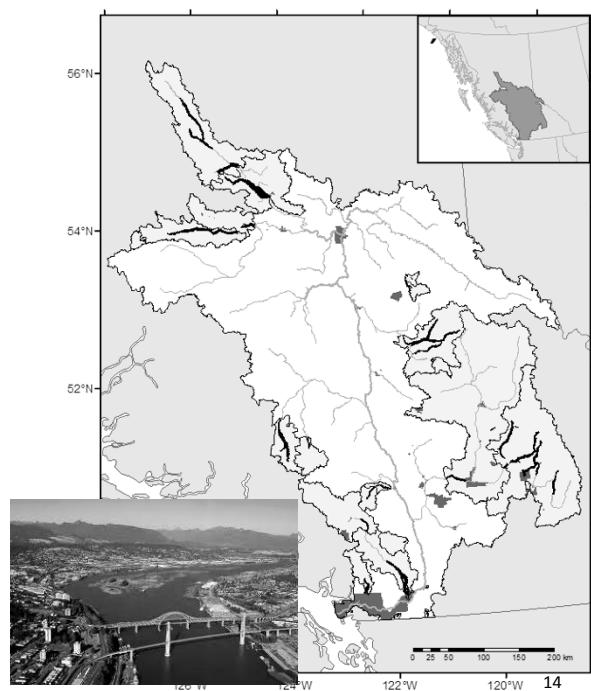
- Large scale hydro (e.g., Bridge-Seton, Kemano) affect smolts and adults, but adverse effects have been largely mitigated on Seton and Nechako Rivers
- History of interaction between IPPs and sockeye salmon is very short and limited in number and spatial extent



Key findings

Urbanization

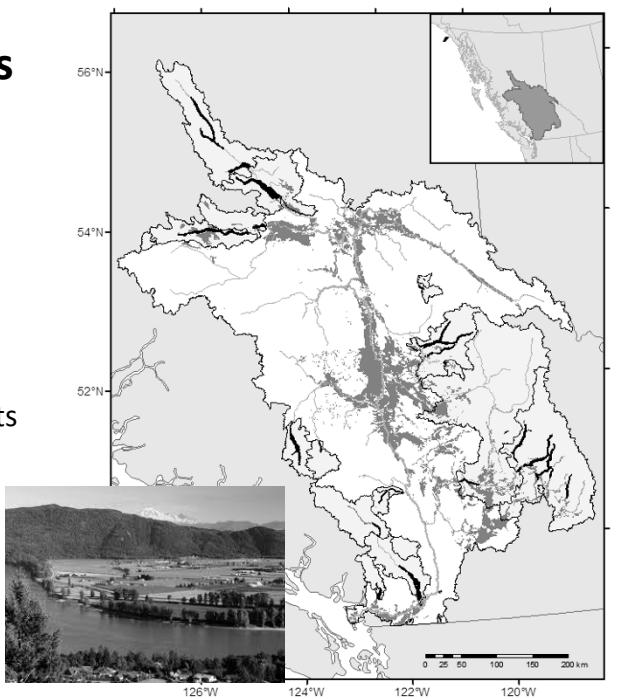
- relatively small footprint within watersheds and riparian zones that influence sockeye salmon
- intense interaction along migration corridors
- humans also concentrated along migration corridors



Key findings

Agriculture

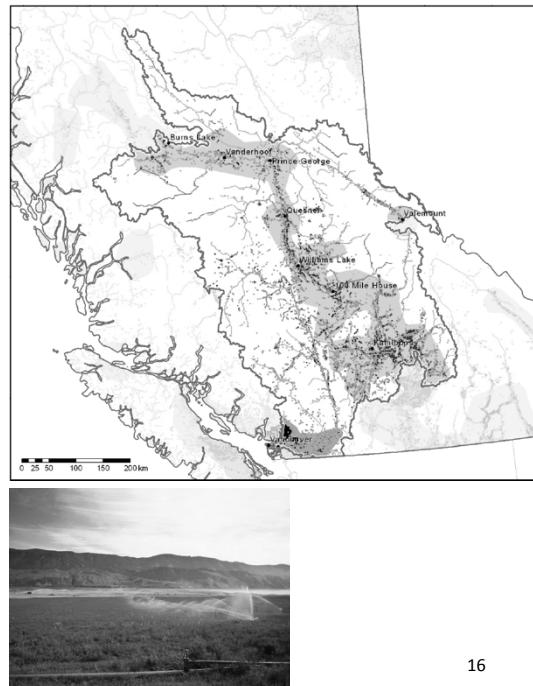
- relatively small footprint within watersheds and riparian zones that influence sockeye salmon spawning and rearing habitats
- larger interaction along migration corridors



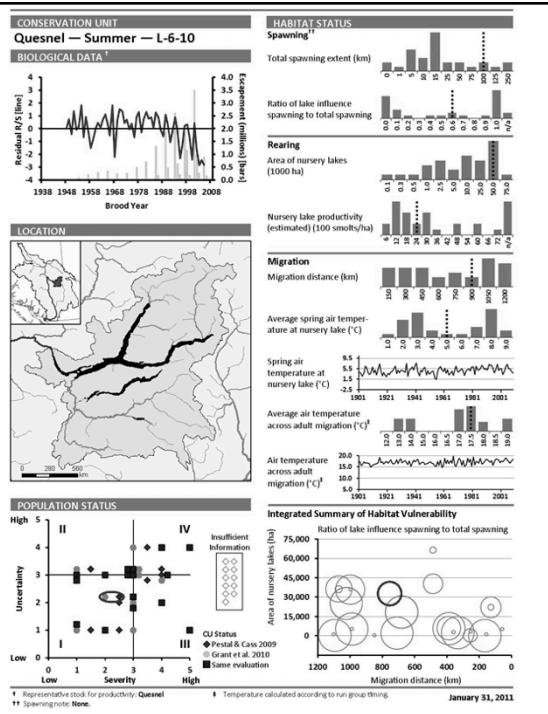
Key findings

Water use

- High water demand associated with the highest concentrations of people across Fraser basin
- Migration corridors have greatest allocation of water and greatest density of water allocation restrictions, mostly agriculture
- CUs of the Lower Mainland have the highest water allocations



Indicator dashboards



Weight of evidence: 7 questions

1. How plausible is the hypothesized causal mechanism?
2. What is the strength of the estimated effect?
3. Does the consistency of direction, magnitude, and duration of observed effects lend credibility to a particular mechanism?
4. Are life stages affected by the proposed mechanism affected whereas others are not?
5. Did the timing of observed changes coincide with a change in the state variable of the proposed causal mechanism?
6. Is there a similarity or coherence of responses across space, time, populations, etc that strengthens the case for a mechanism?
7. Are there natural gradients or contrasting conditions that result in outcomes consistent with the proposed mechanism?

From Stewart-Oaten 1996

Conclusions

- Pattern of decline in total salmon productivity did not coincide with level of variation of individual or cumulative stressors **across CUs**
- Pattern of decline in juvenile survival has remained relatively stable across CUs (compared to life cycle survival), even though there is substantial variation in stressor intensity across CUs
- These and other observations contributed to the conclusion that **recent declines in Fraser River sockeye salmon are unlikely the result of changes in the freshwater environment**
- However, **protection of freshwater habitats remains important** to the conservation of Fraser River sockeye salmon because they contribute to their overall diversity and resilience

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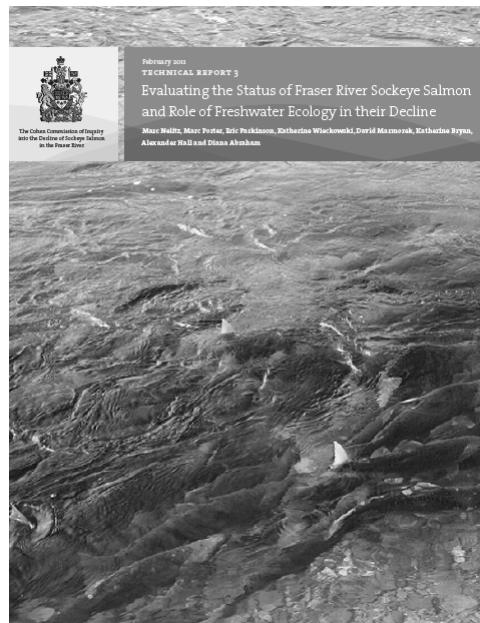
Core recommendations

1. **Survival:** better estimates of juvenile abundance, overwinter survival, and mortality during smolt outmigration.
2. **Population status across CUs:** data on abundance and distribution of small lake CUs and all river CUs.
3. **Habitat status across CUs:** monitor habitats consistently on a regular basis across a larger number of rivers and nursery lakes.
4. **Population level effects of stressors:** better estimates of biological consequences of disturbance as stress increases.
5. **Improve transparency in science and decision making:** make information more accessible, with collection and organization integrated across federal and provincial agencies.

All of these recommendations were included in Justice Cohen's report, though in a slightly different form.

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Thanks! Questions?



Nelitz, M., M. Porter, E. Parkinson, K. Wieckowski, D. Marmorek, K. Bryan, A. Hall and D. Abraham. 2011. Evaluating the status of Fraser River sockeye salmon and role of freshwater ecology in their decline. ESSA Technologies Ltd. Cohen Commission Tech. Rept. 3: 222p. Vancouver, B.C.
www.cohencommission.ca

