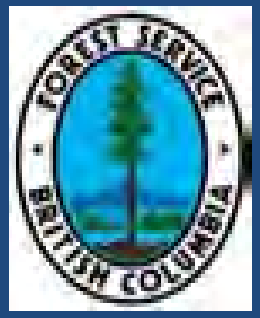
Salmon research extension case studies: i) Flocs and marine-derived nutrients and ii) Small stream riparian management

Water – Climate Change- Salmon
Workshop Series
QRRC Likely, BC
November 24, 2011



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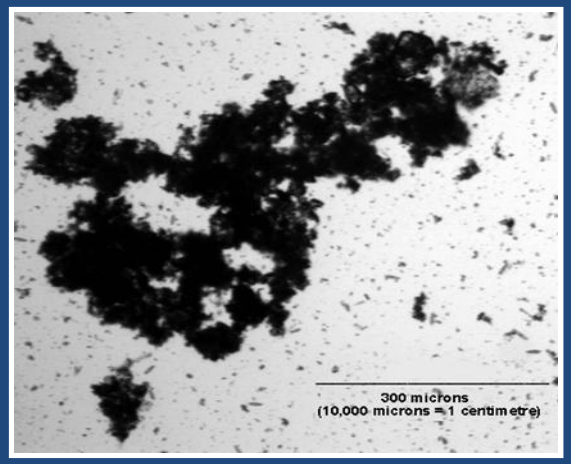
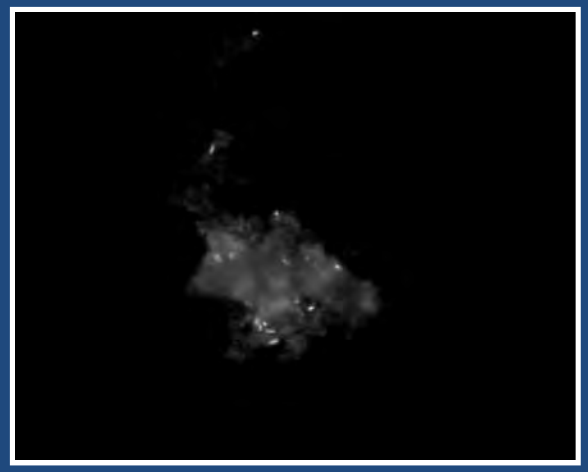
Outline

- Overview of two habitat research programs
  - i) Flocs and marine derived nutrients
  - ii) Small stream riparian management
- Research extension and application
  - Identifying and engaging end-users
  - Influencing policy

i) Flocs and MDN



Droppo et al., 2000

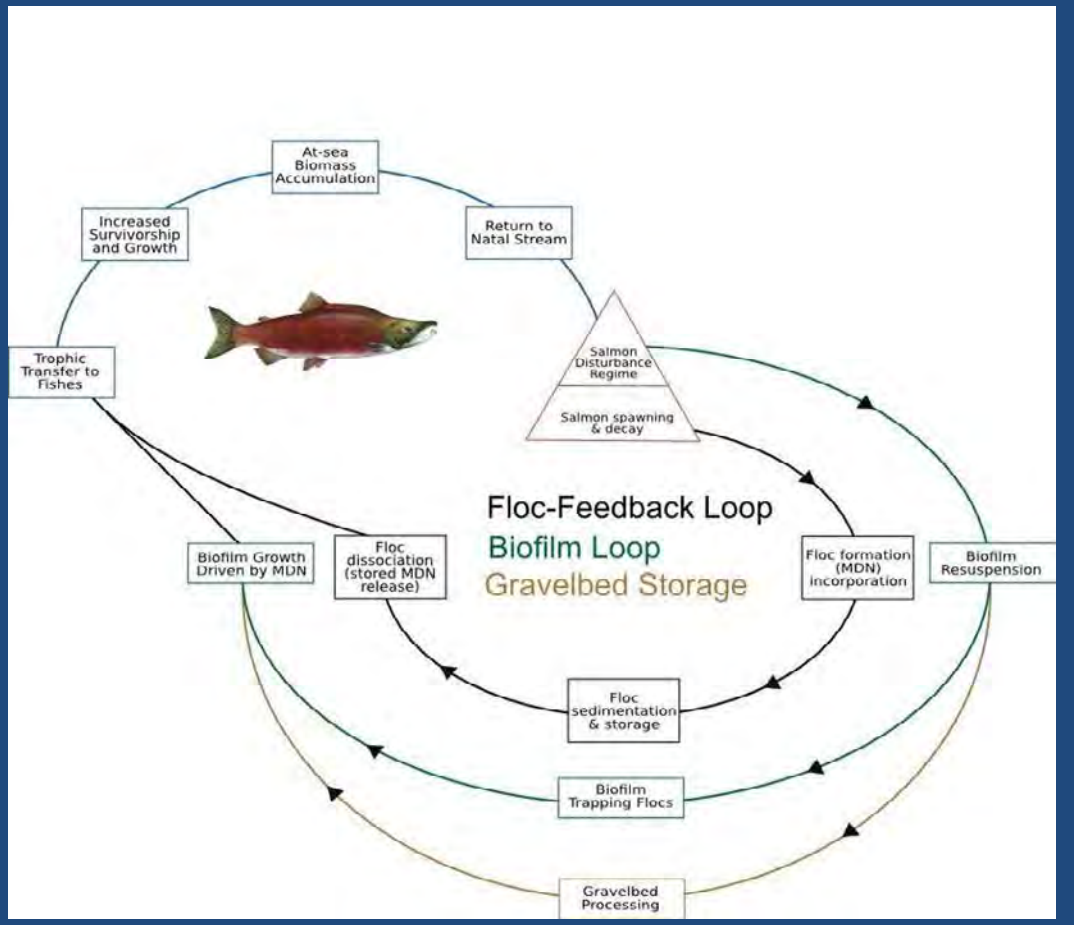


- What are flocs?
- How do they form?
- How can they influence MDN delivery & retention?

Source: University of Washington

Research Question

Do flocs enhance delivery and retention of marine derived nutrient (MDN) and subsequent cycling within BC interior salmon streams?



2010 Flume Study

Ellen Petticrew, Sam Albers, Neil Williams, Alex Koiter

- Determine generation time & distance for water column floc development and then gravel bed capture of flocs.
- Determine residence time of nutrients captured in the bed.
- Determine differences between active and post-spawn MDN delivery.

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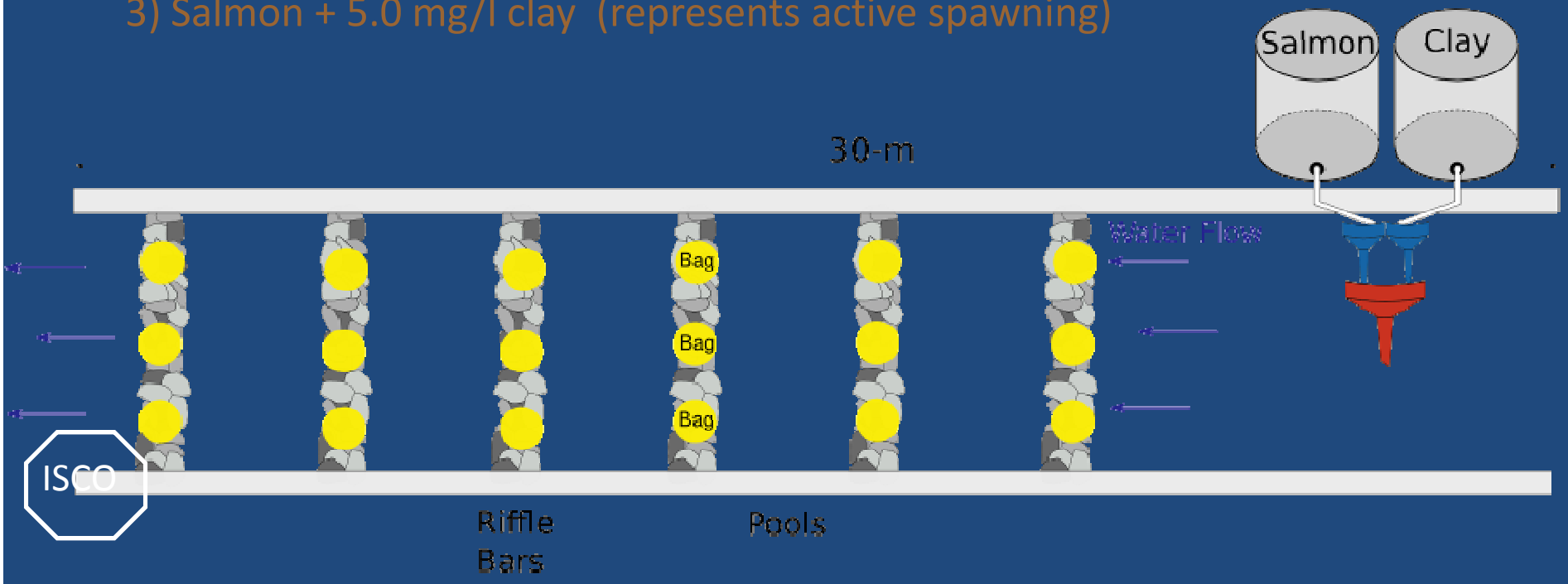
2010 Study Design

Treatments:

1) Salmon Only

2) Salmon + 0.5 mg/l clay (represents post-spawning)

3) Salmon + 5.0 mg/l clay (represents active spawning)



Set of 6 riffles and pools,
Concentrations, flow and gravel
to simulate natural spawning conditions

Stock Solutions
Steady delivery over 4 days
Filtered twice through 63 um mesh

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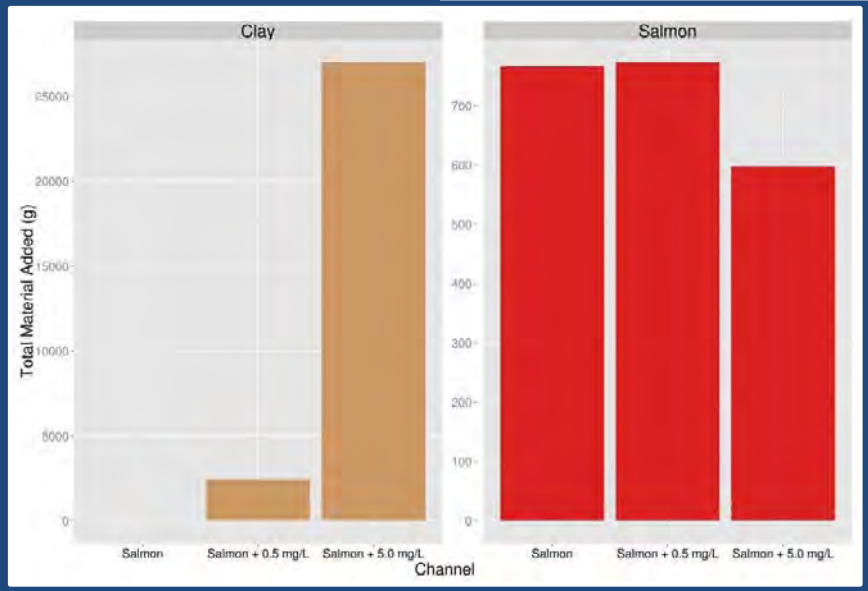
Salmon+ 0.5 mg/l clay

Salmon+ 5.0 mg/l clay

Drip rate: 135 ml/min
Stock delivered for 4 days

Flume flow rate: ~ 0.10 m/s



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Stock delivery drip to flume channel

Separate funnels with 63 um screen

Combination funnel to enhance mixing

Underwater view of mixed salmon and clay solutions

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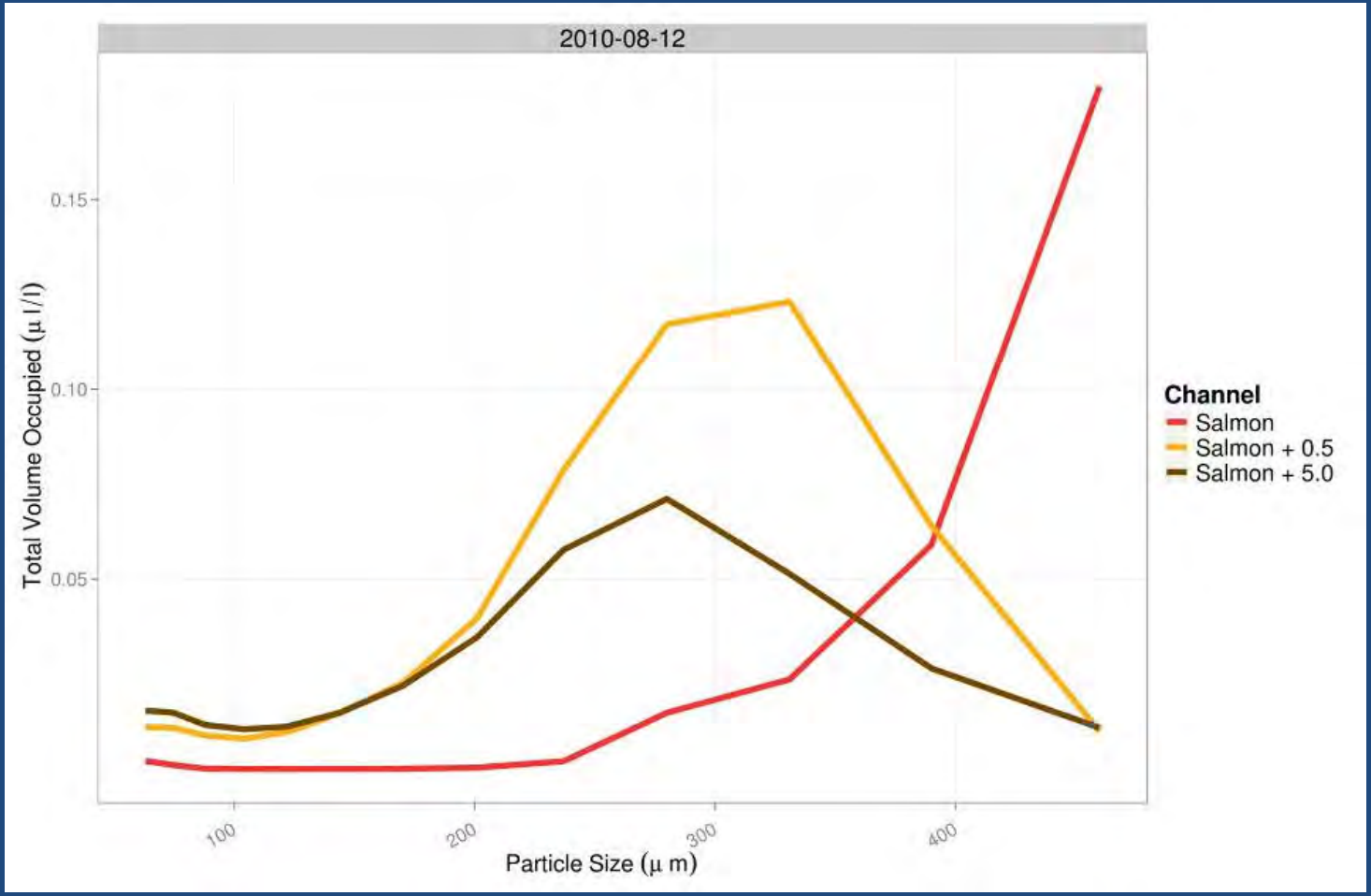
Floc Formation



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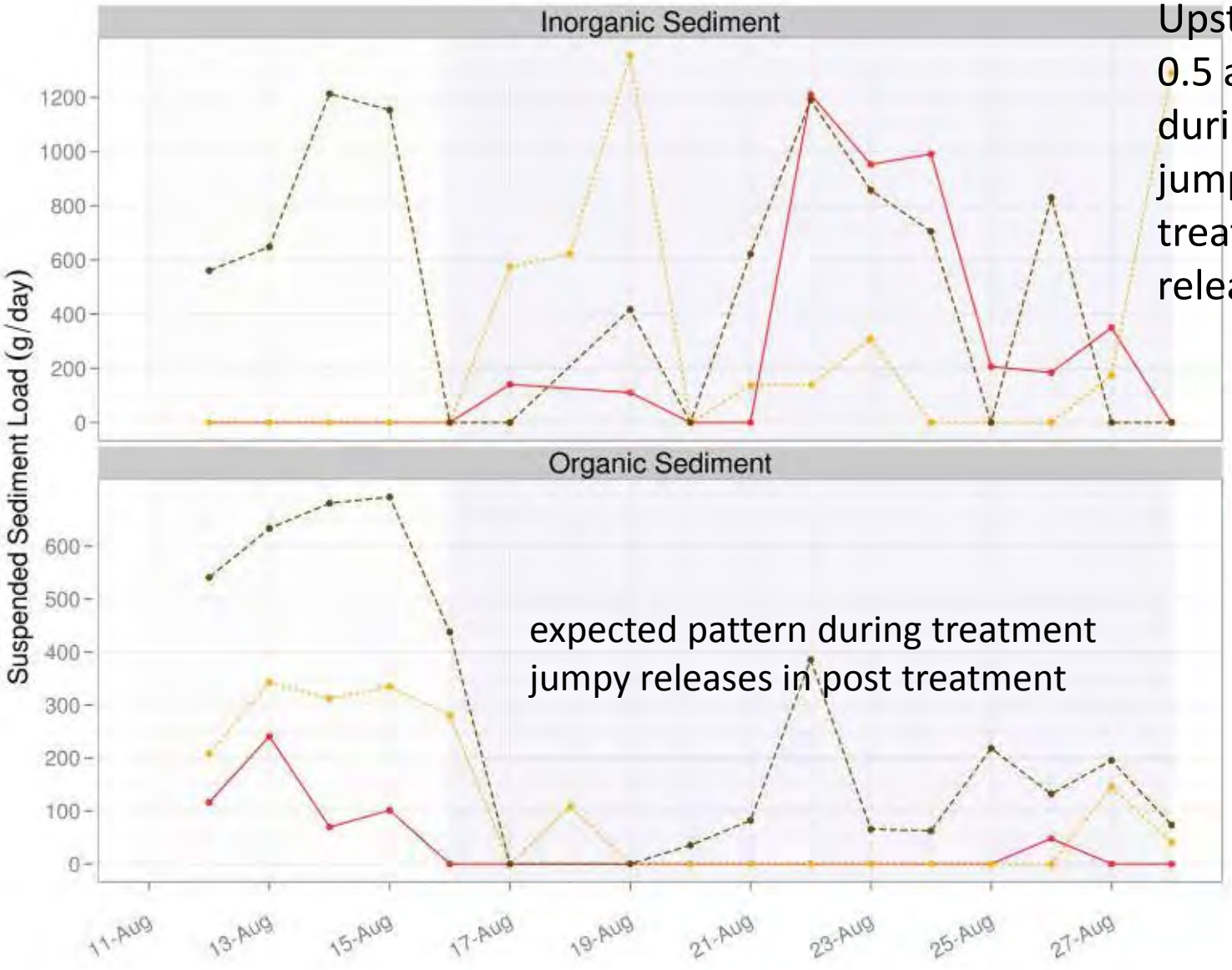
Suspended Sediment Export and Retention



Upstream storage of 0.5 and S-only during treatment, jumpy releases in post-treatment, suggesting releases from storage

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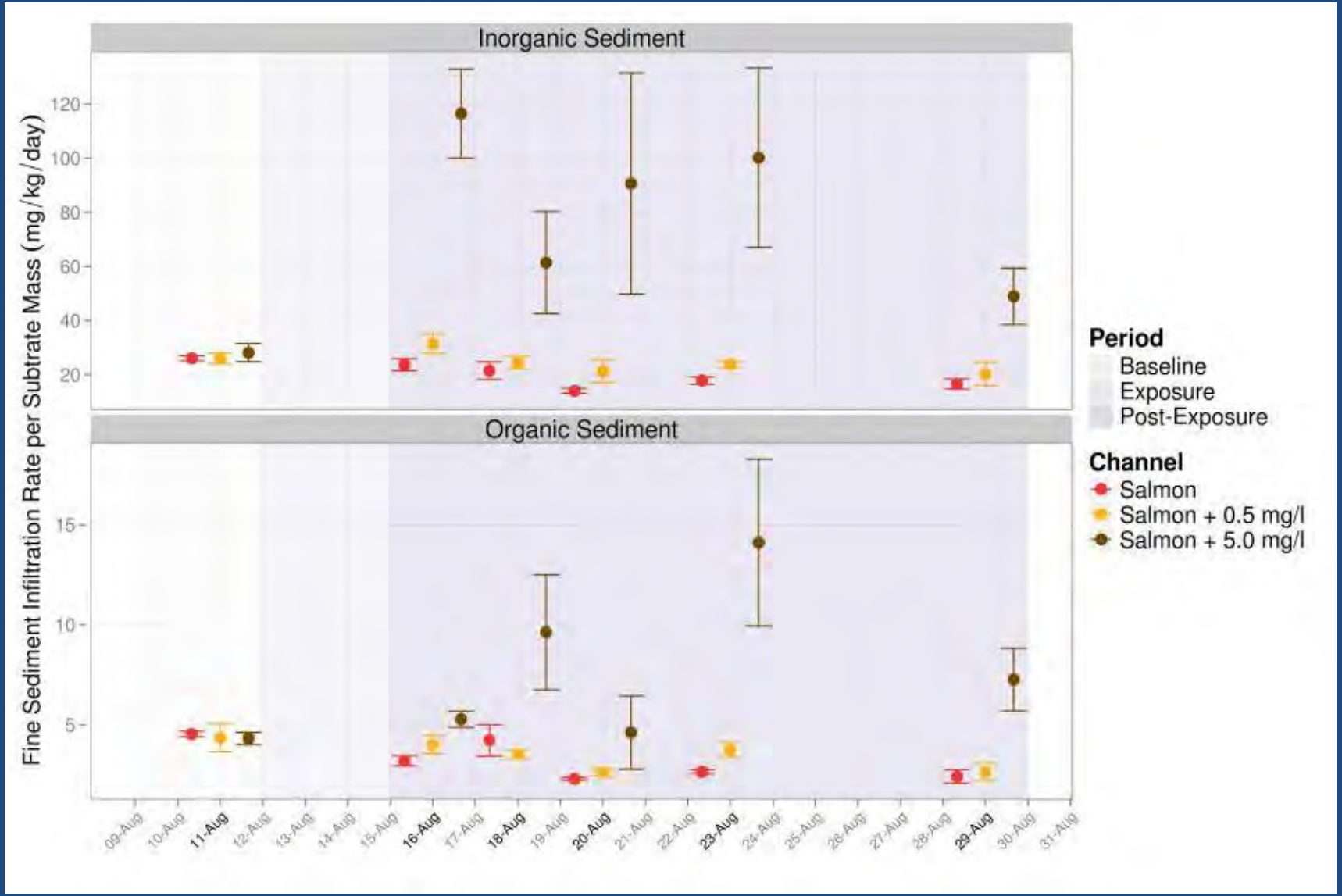
Sediment Deposition



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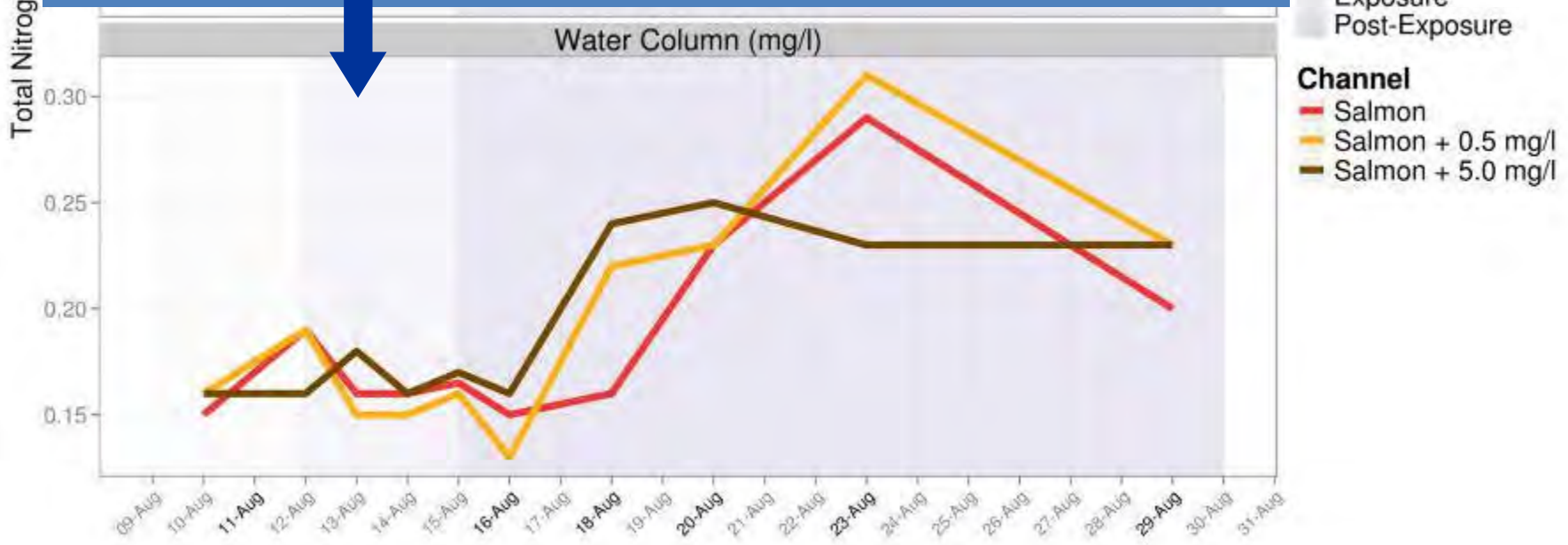
Nitrogen Exchange and Storage

~100 mg/l TN dripped in at 135 ml/min = 0.27 mg/s



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Floc Study Summary

- Floc formation and settling
- Floc migration and retention
- MDN delivered in active and post-spawn with a stronger signal in the former.

Application: Build a conceptual model of nutrient cycling within streams due to saltation of MDN-laden sediment in a downstream direction – more research to follow.

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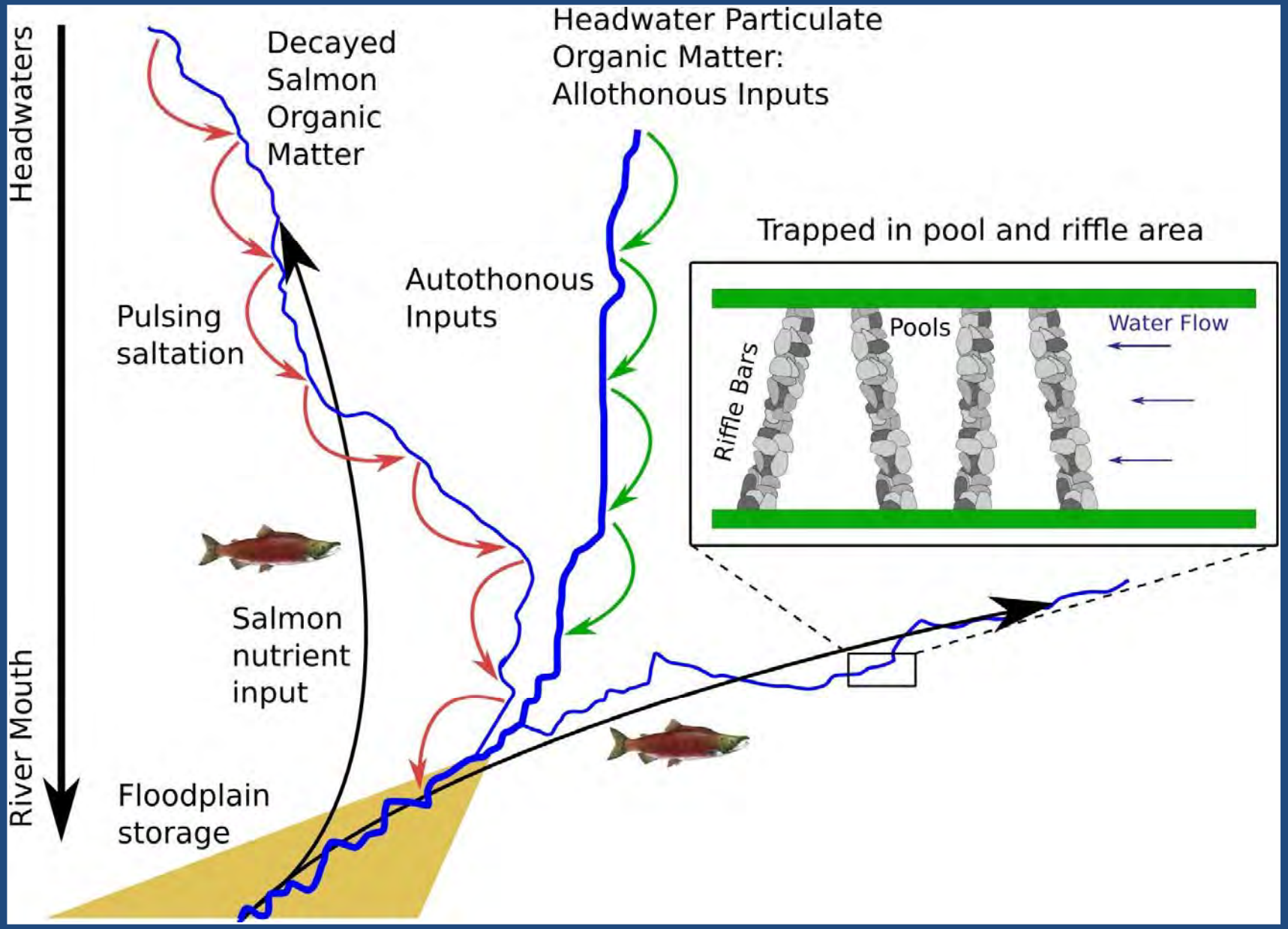

Hyporheic Image: Riparian Areas: Functions and Strategies for Management National Academies Press

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ii) Small Stream Riparian Management

- Why small streams:
  - Small streams (<1.5M BFW) make up 70-80% of channel length in a watershed.
  - They have no prescribed buffers.

Fisheries and Oceans Canada | Pêches et Océans Canada

P. Beaudry and Associates Ltd.
Watershed Management Services

FIA
Forest Investment Account
Forest Science Program

PG DM Policy & Objectives

- The DM policy (1999) has five riparian management objectives, namely :
  - Maintain 50 to 70% of shade,
  - Maintain long and short-term supply of large woody debris (LWD),
  - Maintain natural root structure and minimize soil disturbance by keeping a 5-m machine free zone,
  - Prevent overloading the stream with fine organic debris,
  - Concentrate retention (both patch and single tree) in the 10-15m closest to the stream.

Question: Is the *Minimum Retention PG DM* prescription sufficient to meet these objectives and maintain small stream function?

Study Areas: Tagai, Bowron, and Chuchinka

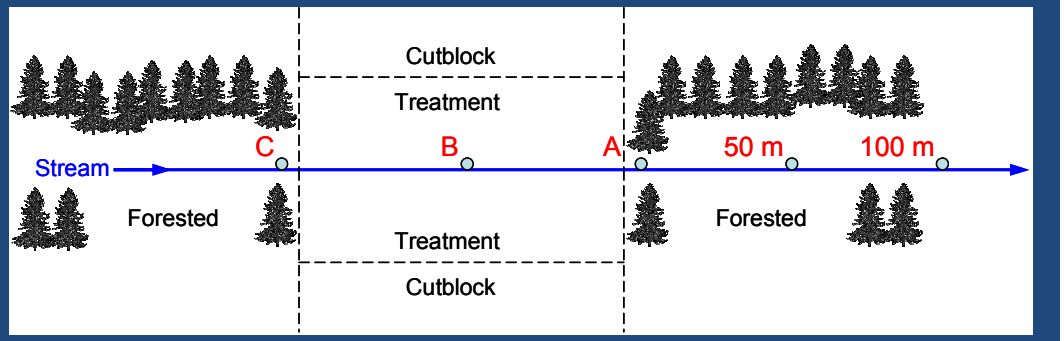
- BEC zone - SBSdw2
- Tag-13 Active stream width 0.8m, gradient 3%. Tag 12 1.1m, 5%
- Elevation: 900-1000m
- Aspect: NE
- Tag 13-March 2004 Tag-12 July 2004 - BCTS (operator)

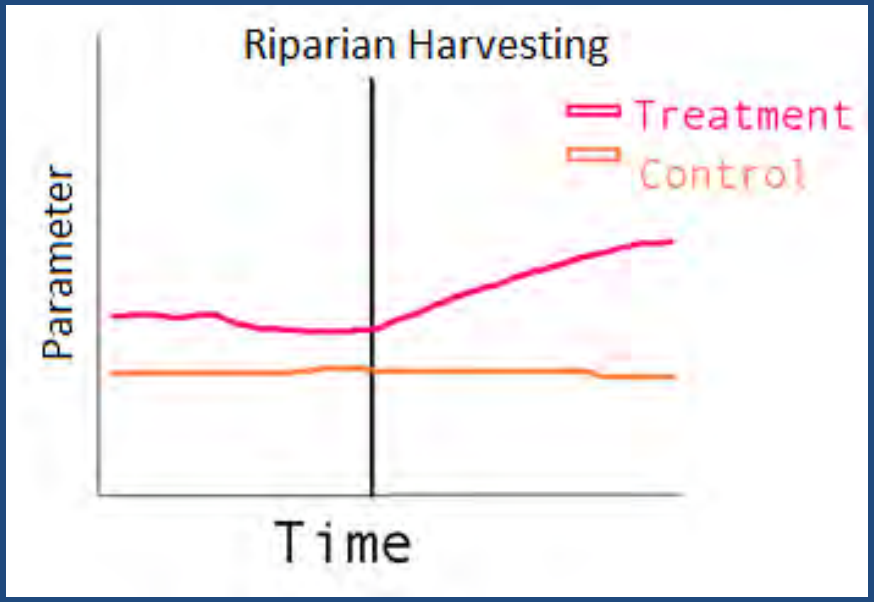
- BEC zone - SBSvk
- Active stream width 1m, gradient 4%
- Elevation: 900-920m
- Aspect: NW
- December 2002 - BCTS (operator)

- BEC Zone: SBSwk1
- Active stream width 0.9m, Gradient 1%
- Elevation:780-820m.
- Aspect: SW
- July 2003- Canfor

Study Design

- The project employs a BACI-PS design:
  - Treatment data are compared to spatial controls before during and after the activity of interest.



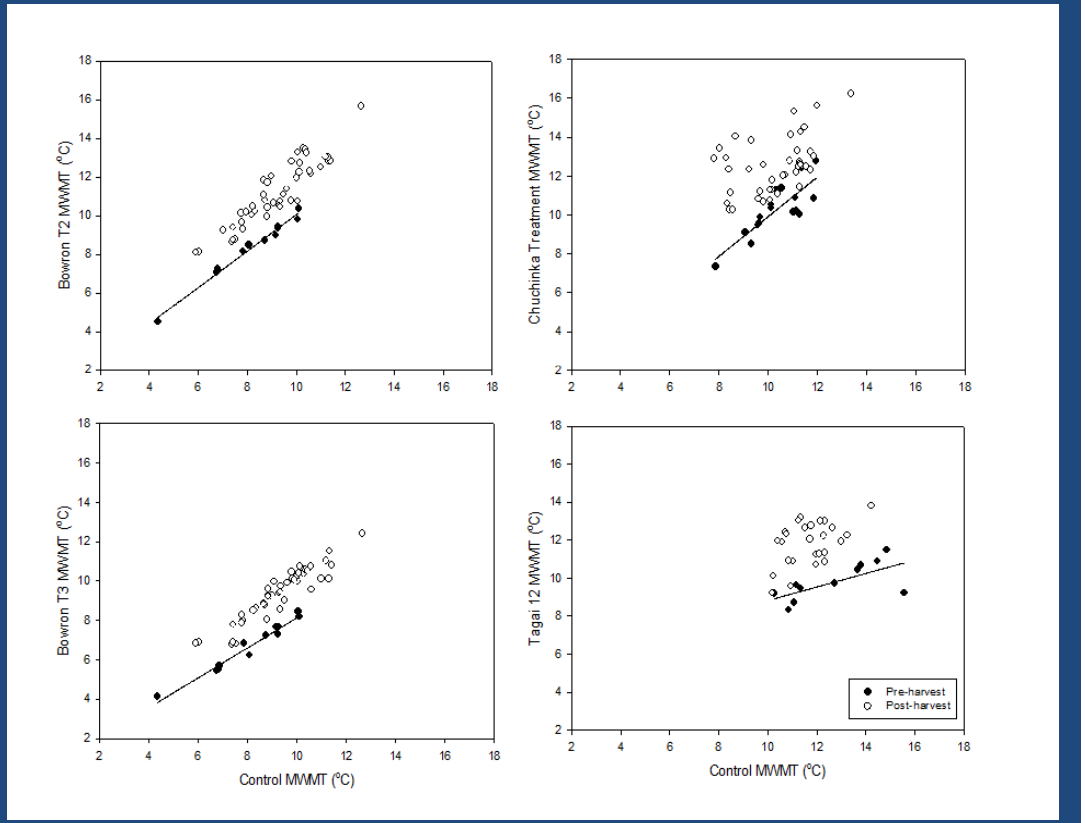


Project Components

Agency	Project Duties
Department of Fisheries and Oceans	Water Quality and Quantity Biological productivity (Primary and Secondary) Fisheries Surveys
Pierre Beaudry & Associates	Channel Morphology (LWD /Erosion) Riparian Tree Inventory Spherical Angular Canopy Densiometer
Ministry of Forests and Range	Air and Stream Temperature Project Management

Stream Temperature

- Statistically significant increase in water temperature following harvesting.
- Increase in mean weekly maximum temperature.
- Variable response based upon site conditions.



6-Year Summary Findings

Characteristic	Variable Measured	Level of Concern	MPB Salvage Considerations
Sediment Supply and transport	Turbidity, sediment sources	Low	**Road density and erosion control**
Channel Morphology	Width and depth	Moderate	Increase retention for higher flows
Large woody debris and litterfall	LWD in stream and source distance, litterfall	High	Increase retention
Air and Water Temperature	Temperature	Moderate	Increase retention
Nutrients	Nitrogen, phosphorus	Low	**Soil disturbance may alter levels**
Biologics	Periphyton, invertebrates, fish	Moderate	Increase retention for shade, litterfall, temperature

Addressing LWD Recruitment

- Source distance along bole:
  - 5m –> 50-68%[1]
  - 10m –> 77-98%

[1]Including synoptic sites.

- 10m may address litter fall, shade and temperature issues as well.

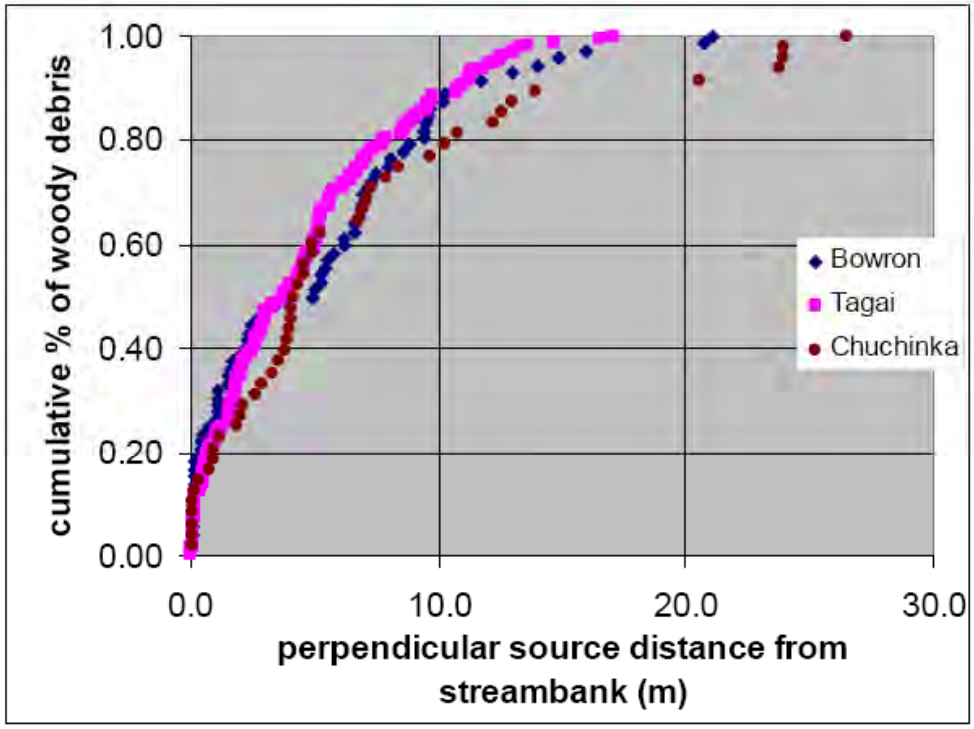


Figure 8. Contribution of woody debris from the riparian forest as distance from the stream bank lengthens.

[1]Source: Small Streams Annual Report 2006 (Pierre and Leisbet Beaudry)

Riparian Study Summary

- Minimum retention level is insufficient to maintain habitat value, it did not:
  - Maintain long and short-term supply of large woody debris (LWD),

Application: Results indicate the need for increased retention within 10m of the stream.

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Research Extension Opportunities

- Nature of research question and associated challenge in extension:
  - Floc Study- Basic Science
  - Riparian Study – Applied Science

"Sure it's beautiful, but I can't help thinking about all that interstellar dust out there."

Extension: Engaging End-Users

- Step 1 – Identify and find

*

- Step 2 – Identify tools for engagement:
  - Passive – ex. Journals and Conferences
  - Active – ex. community-based events, targeted workshops, extension articles, web-pages, on-site training.

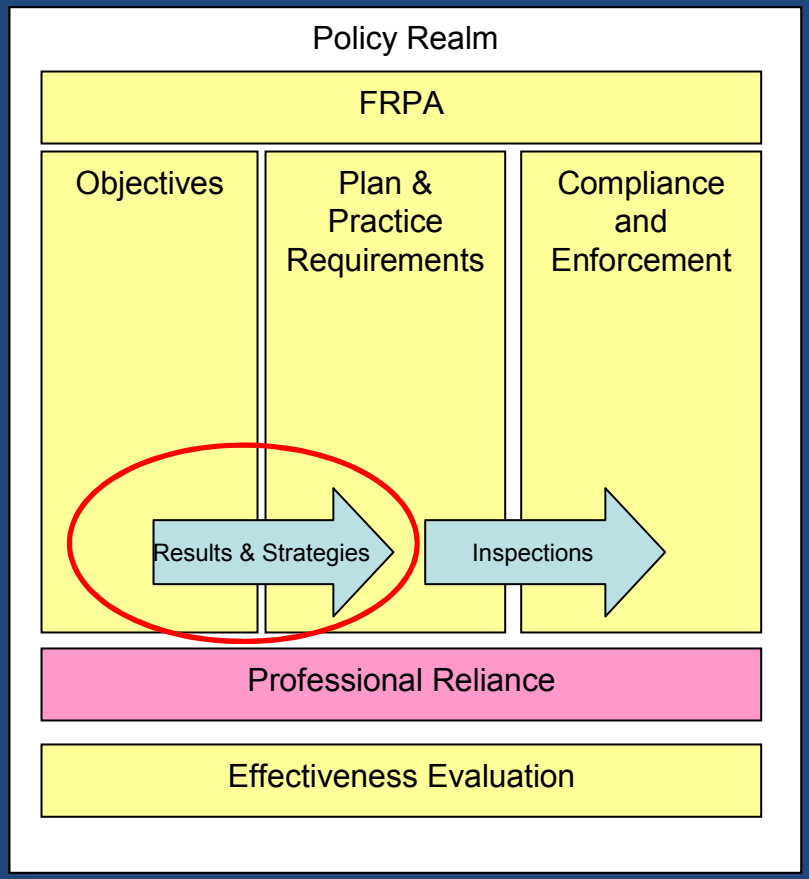
Note: agencies such as Forrex specialize in research extension and are available for researchers to access at no or low cost.

- Step 3 – Continued Involvement

*Image from wedgiedare.com/wedgie-hide-and-seek-game/

Application to Policy

- Identify where and how research can be applied.
- Is it directly policy related?
  - Ex. riparian study Forest Range Practices Act S. 8 52(2)
  - Professional Reliance Framework of FRPA
- Recognize status of research related to what is required for policy.



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