IMAGING THE SUBSURFACE: THE EFFECT OF LOGJAMS ON GROUNDWATER-SURFACE WATER EXCHANGE

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https://openclipart.org/detail/245173/high-poly-raclawka-valley-creek
PROJECT OBJECTIVE

Does a logjam change the extent of hyporheic exchange? If so, how?

Can we accurately represent this using Electrical Resistivity Imaging (ERI)?
HYPORHEIC ZONE AND LOGJAMS

SELECT YOUR PLAYER
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https://cordis.europa.eu/result/rcn/200984_en.html
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- Flow and other stream features: may increase extent as well

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https://www.nap.edu/read/10967/chapter/8
RELEVANCE

- Nutrient cycling → biota (flora, fauna, prokaryotes, etc.)

http://www.bgs.ac.uk/research/groundwater/catchment/hyporheic_zone/home.html
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• Fast-forming logjams $\rightarrow$ change ecosystem

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RELEVANCE

• Nutrient cycling → biota (flora, fauna, prokaryotes, etc.)
• Fast-forming logjams → change ecosystem
• Importance:
  • Engineering logjams
  • Maintaining and conserving ecosystem
  • Water quality and quantity

http://www.bgs.ac.uk/research/groundwater/catchment/hyporheic_zone/home.html
PROBLEM AND SOLUTION

Traditional methods:
- Intrusive: cumbersome borehole installation
- Incomplete: point-verification (1D) limits understanding

Our methods:
- Accurate representation of the hyporheic zone’s complex processes using Electrical Resistivity Imaging (ERI)

https://andrewbelko.wordpress.com/2013/07/24/a-long-overdue-tanzania-update/

https://www.environmental-geophysics.co.uk/Tech_Resistivity.html
FIELD SET-UP

- Electrodes and cable installed on two cross-sections of stream to for 2D representation
- Salt injection allows us to trace solute’s path
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PROCESSING

- Resistivity-meter sends current → data tells us about the subsurface
- Programs: MATLAB data processing and plotting, R2 inversion software
SUBSURFACE RESISTIVITY

Bulk (or Apparent) Resistivity, $\rho_a$:

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  • $A, M, N, B$ = electrode positions
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Conductivity, $C$:

- $C = \frac{1}{R} \ (\frac{S}{m})$
FLUID CONDUCTIVITY

- Point-measurement
- Placed in stream
- Measures homogenous surface water
RESULTS

Fluid vs. Bulk Conductivity:

- Fluid has minimal tailing
- Bulk has substantial tailing
- Noise from fluid EC measurement
RESULTS

Control vs. Logjam:

- Control has slight bump after tracer ends
- Logjam tailing slower return to background
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More shallow slope than control
RESULTS

Flow:
• 0.8551 cfs June
• 0.2274 cfs July

• Low-flow (July) injection slower return to background
DISCUSSION

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• Logjam reach implies slower movement in the subsurface due to increase in hydraulic resistance
• Flow rate influences rate of solute discharge
KEY POINTS

- Fluid EC data incomplete; Bulk EC reigns
- Low-flow and logjam: may indicate longer residence time, meaning more filtration
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SUMMARY

- Logjams and low-flow may increase the extent of hyporheic exchange.
- ERI gives us a better model of the area of exchange using tracer injection.
- Study leads to improving methods in conserving, managing, and restoring riverine ecosystems.

[Research URL: https://ecology.wa.gov/Research-Data/Monitoring-assessment/River-stream-monitoring]
QUESTIONS?

ACKNOWLEDGMENTS

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REFERENCES

**Fluid vs Bulk Electrical Conductivity**

### Figure 1: Control June
- **Conductivity (μS/cm)**: Ranges from 20 to 120.
- **Time**: 12:00 to 12:00.
- **Data Points**: Conductivity values are plotted over time for fluid and bulk samples.

### Figure 2: Below Logjam June
- **Conductivity (μS/cm)**: Ranges from 40 to 65.
- **Time**: 12:00 to 12:00.
- **Data Points**: Conductivity values are plotted over time for fluid and bulk samples.

### Figure 3: Control July
- **Conductivity (μS/cm)**: Ranges from 20 to 120.
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### Figure 4: Below Logjam July
- **Conductivity (μS/cm)**: Ranges from 40 to 65.
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- **Data Points**: Conductivity values are plotted over time for fluid and bulk samples.