Local and Longitudinal Patterns of Woody Debris Accumulation in Big Creek, Idaho

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1. Motivation and Background

- In March of 2014, a rain on snow event triggered a series of avalanches in the upper reaches of Big Creek, delivering thousands of logs into the channel and forming several channel-spanning log jams.
- Fire and insect herbivory have left many of the surrounding forests of Douglas and sub-alpine fir as stands of dead trees.
- Woody debris has a strong influence in channel form and sediment storage and routing.
- Log jams may also serve as habitat for young freshwater fish.
- Too much wood in a river can be a threat to infrastructure. If a large jam breaks free it may damages bridges or cause significant erosion.
- Quantitative rules for the mobility of log jams are lacking. The jams in Big Creek provide a unique opportunity (a "natural experiment") to study the deformation and mobility of large ensembles of wood in rivers.

2. Field Setting

Big Creek is a tributary of the Middle Fork Salmon River, within the Frank Church River of No Return Wilderness of Central Idaho. In the summer of 2015, two surveys were conducted in Big Creek to: (a) document the wood delivered to the upper reaches by the 2014 avalanches and (b), establish a census of the preexisting log jams along the mainstem of Big Creek.

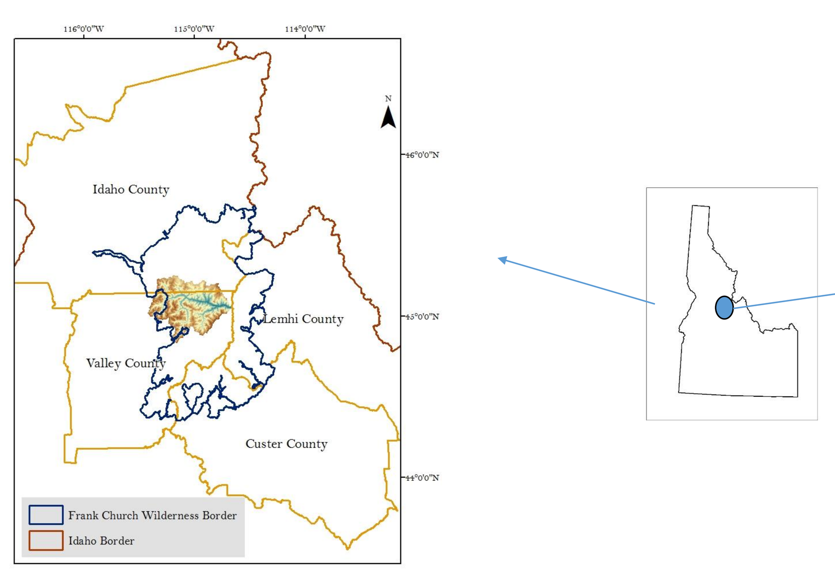


Figure 1. Overview map showing the adjacent counties of Idaho near the field site.

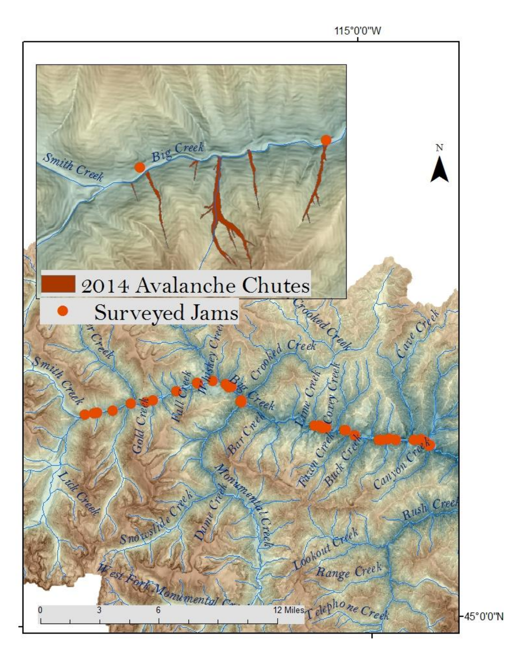


Figure 2. Map showing the locations of the surveyed log jams along Big Creek with an inset map of the avalanche paths of 2014.

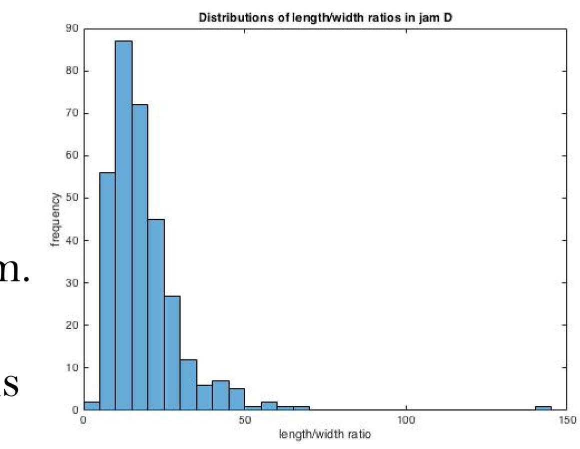
3. Objectives

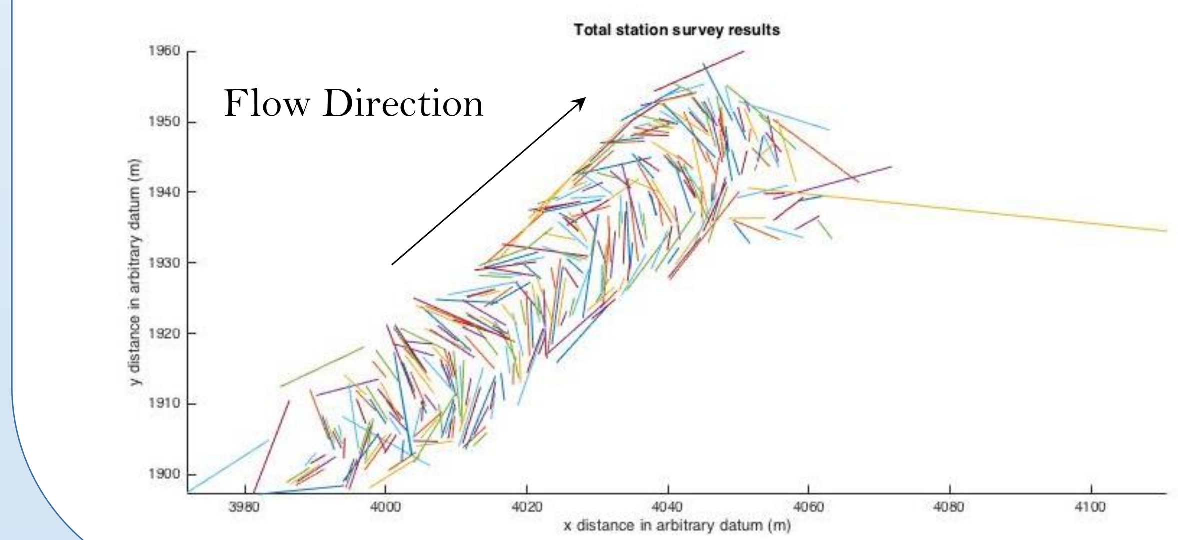
1. Survey to describe log size characteristics and jam geometry for Jam D: the avalanche jam. This will provide the framework for future experimental work on log jam deformation and mobility.
2. Survey to describe the downstream variability in log character.
3. Compare the avalanche jams to the downstream jams.
4. Investigate the relationship between piece size and drainage area in the downstream direction.
5. Establish a current census of major jams to aid future research.

Photo 1. An example of a log jam in Big Creek. This older jam is located on the outside of a meander bend.

4. Survey Results

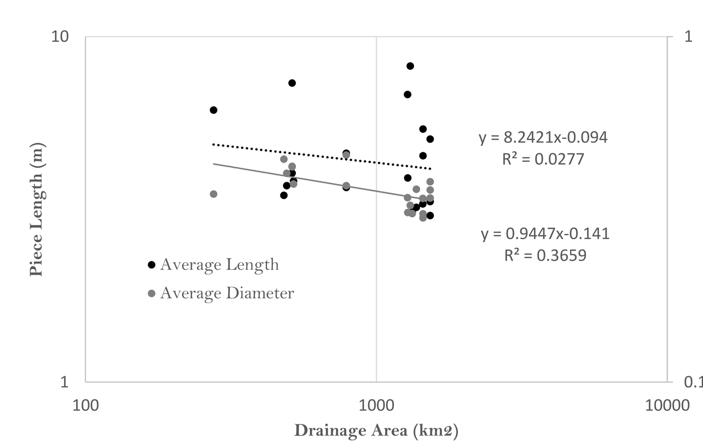
Total station surveys qualitatively show that 'Jam D' has an ordered, non-random geometry. The distribution of aspect ratios is also non-random. Connections between log dimensions and jam geometry is the subject of ongoing work.





7. Log Size vs Drainage Area

Weak Correlation between log size and drainage area.



Increased transport capacity is associated with a larger drainage area but does not have a significant correlation with log size.

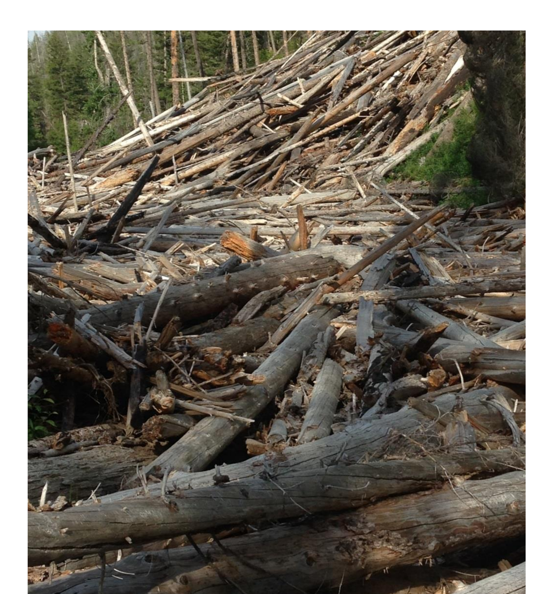
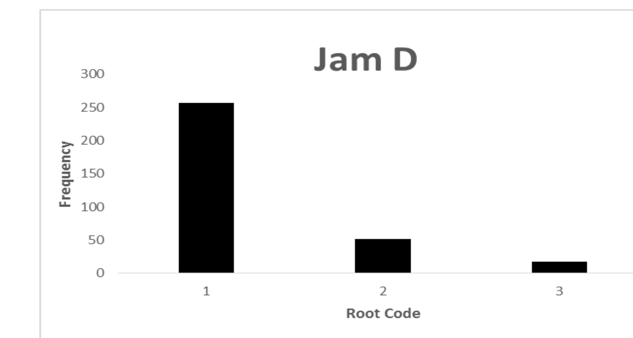
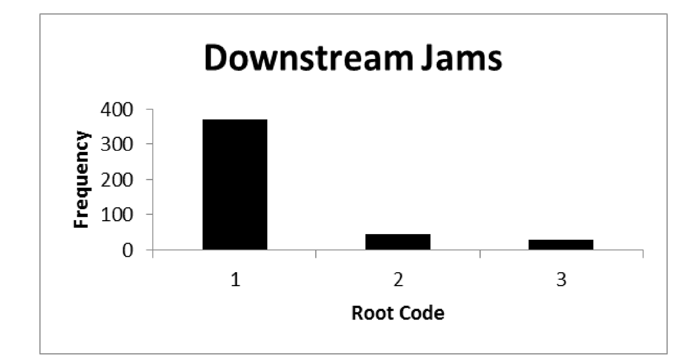


Photo 2. Looking downstream at 'Jam D'. This is the largest remaining channel spanning jam caused by the 2014 avalanches.

5. Root Wad Distribution

Presence of root wads is not common in Big Creek.





Root Code Key: 1.Snapped Ends 2. Root Bole Present 3. Visible Root Wad

Results

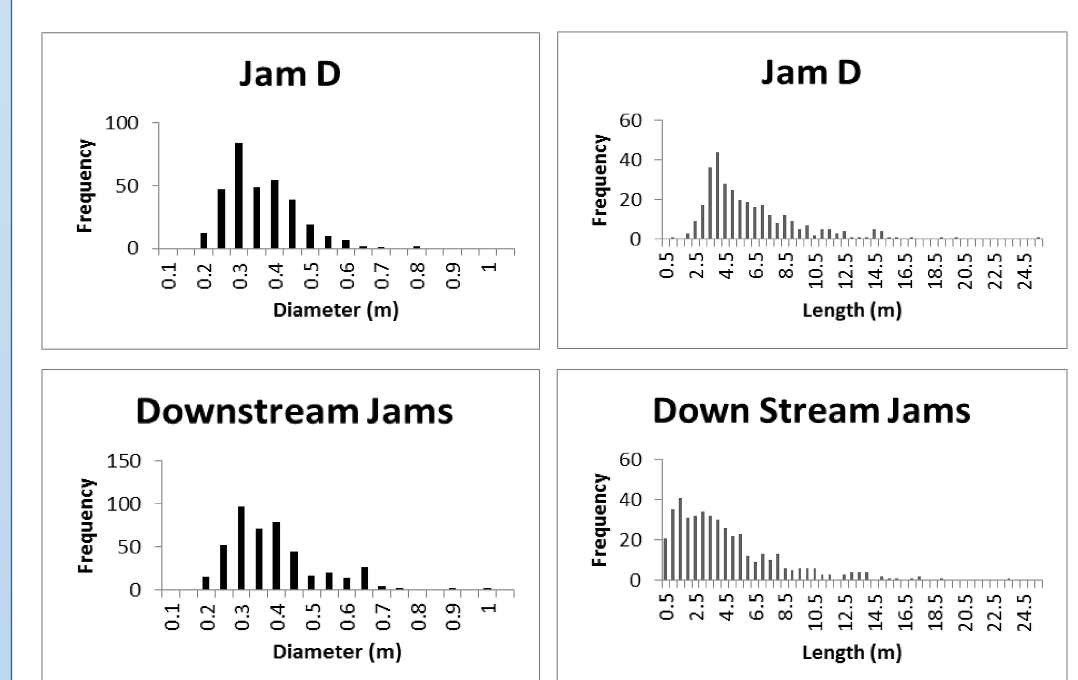
- 'Jam D' and the existing downstream jams have similar distributions of root code. Both have a majority of logs with snapped ends.
- Wood in the downstream jams was expected to contain more pieces with root wads, but did not.

Interpretation

In systems unaffected by fire or beetle kill, most riparian inputs to the channel are due to bank erosion undercutting trees, thus delivering live trees into the river, along with their full root wads. This type of bank input is likely not common to Big Creek.

6. Length and Diameter Distributions

Big Creek logs do not follow a normal size distribution



- Piece length and diameter had greater variance among the downstream jams than 'Jam D'
- Most logs in both surveys were small: 2m to 4m in length and 30 cm in diameter on average

Interpretation:

Less skew and a more normal distribution in size among logs of Jam D reflects a pattern of uniformity in the surrounding forests. The tress were dead standing from previous fire damage and were likely of a similar age.

8. Summary and Conclusions

1. Wood size distributions within the avalanche jam are closer to normal. This reflects the uniform character of the surrounding Douglas Fir forest.
2. The absence of root wads in both the avalanche debris and the downstream jams suggests most wood in Big Creek enters as dead logs.
3. If climate trends continue, the spring rain-on-snow events that lead to the avalanches of 2014 may increase in frequency. Wood recruitment in Big Creek is expected to remain high for years to come.
4. A strong relationship between drainage area and log size does not exist in Big Creek. In future studies, the relationship between jam frequency and upstream drainage area should be examined.
5. Ongoing research will investigate where and how jams form and break apart within Big Creek.

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