Jun 7th, 1:50 PM - 2:10 PM

Session C8 - Log Jam Distribution and Carbon Storage in Headwater Streams in Colorado's Front Range

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LOG JAMMING:
Log Jams and Carbon Storage in Headwater Streams of Colorado’s Front Range

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June 6, 2012

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Warner College of Natural Resources
200 years of human impact which can affect instream wood (Wohl and Goode, 2008)

- Tie drives
- Placer mining
- Logging
- Diversions

Log jams can be a key component of mountain stream habitat (Richmond and Fausch, 1995)

- form pools
- store sediment
- provide overhead cover for salmonids

19th century tie drive, Cheyenne National Forest, Wyoming
http://warnercnr.colostate.edu/geo/front_range/LandUse.php
Do we see significant differences in instream wood loads?
- Total wood load
- Jam density
Is there also an impact on carbon storage?
Can it lead to changes in fish habitat or forest/stream ecology
Background

Typical New Stand

Typical Old Growth
- **Ramp**
  - Log with one end anchored outside the channel
- **Bridge**
  - Log with both ends anchored outside the channel
- **Channel Spanning Jam (CSJ)**
  - Three or more logs touching and which also cross the entire channel
Data Collection

Selected 30 streams with varied:
- valley and channel geometry
- forest stand age
- history of human impact

Measured in the field:
- 2 levels of detail (reach vs jam)
- volume of standing wood (basal area)
- piece spacing and overall wood loads in streams
- longitudinal spacing of Channel Spanning Jams (CSJs)
- volume of wood in jams
- volume of retained sediment

Photo: Theresa Jedd
Data Collection
Data Collection

- Sample size
  - 30 reaches
  - 30 surveyed Channel Spanning Jams (CSJs)
- Elevations avg 2850m (2467-3089)
- Drainage area avg 35 km^2 (7.8 to 89)
- Average Slope 7% (range of 2-28%)
- Forest Ages from ~30 yrs to > 500 yrs
Results

- Significantly different Basal Area based on a priori classification
  - $m^2$/hectare

- Significantly different Total Wood Load
  - $m^3$/hectare channel surface
Results

Basal Area vs Total Wood Load

\[ y = 3.8231x^{0.593} \]

\[ R^2 = 0.5139 \]

Total wood load m³/hectare channel surface

Basal Area m²/hectare

Old Growth Altered Power (All)
\[ y = 0.464x + 1.1143 \]
\[ R^2 = 0.8066 \]
Ramp and Bridge Spacing vs Total Wood Load

$y = 311.77x^{-0.863}$

$R^2 = 0.8847$

Old Growth  Altered

Ramp and Bridge spacing m
Total wood load m$^3$/hectare channel surface
Fire burned Old Growth

Old Growth Forest
(>200 yrs since last disturbance)

Forest logged in last 200 years

Volume of wood in Jam, m^3
Fire burned Old Growth

Old Growth Forest
(>200 yrs since last disturbance)

Forest logged in last 200 years

Carbon Stored in Jams, kg

- From Sediment
- From Wood
Results

- Organic matter
  - Non old growth Jam vs Non-jam
  - All samples Jam vs Non-jam
Conceptual Model
Old Growth

High Basal Area

High Stream Wood Load
• Blow down
• Erosion
• Natural Mortality

Key Pieces
• Ramps and Bridges
• Less than 20m spacing

CSJ Formation
• Keyed on ramps and bridges

Geomorphologic effects
• Fine Sediment storage
• Floodplain connectivity
• Diverse habitat for fish
Conceptual Model
Logged Forest

Low Basal Area

Low Stream Wood Load
- Small diameter trees
- Low natural mortality

Lack of Key Pieces
- More than 20m between Ramps and Bridges

No CSJ Formation
- Mobile pieces exit the reach

Geomorphetic effects:
- Loss of fine sediment
- Reduced floodplain connectivity
- Reduced habitat diversity
Log jams form when there is a high wood load AND key pieces to anchor jams

Key pieces are necessary at a fairly high density (approx 20m spacing) in order to initiate historic numbers of CSJs

Overall, the loss of CSJs has lasting effects on the channel

- Loss of fine sediment and organic matter storage
- Loss of floodplain connectivity (Wohl and Beckman, in review)
- Loss of habitat diversity
Acknowledgements

Research Sponsors:
• American Water Resources Association Colorado Section
• Colorado State University
• Colorado Mountain Club
• Geological Society of America

Field Assistance:
• Allison Jackson
• Cole Green-Smith
• David Dust
• Mario Jimenez
• Richard Beckman
• Mike Magyar
(After Sibold, et al, 2006)
Hydrology

2010

Provisional Data Subject to Revision

2011

Provisional Data Subject to Revision