Abstract ID: 1255756

Ecohydraulic Interactions in Headwater Floodplains Promote Flood Attenuation

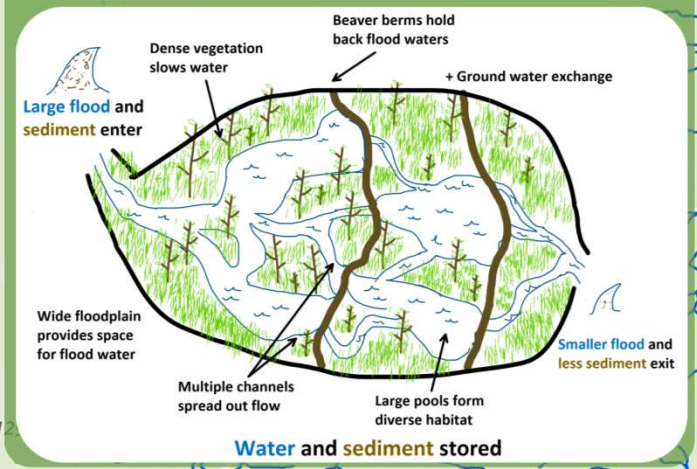
Nicholas Christensen, Ryan Morrison, Sara Rathburn, Ellen Wohl

Award 2142761

River Beads Framework

Features:
- Wide valleys
- Gentle slope
- Complex channels
- Often have beaver dams

Water and sediment attenuation



Questions

1. Identify attenuation hotspots in the watershed
2. Parameter sensitivity
3. Impact of management
4. Sediment retention
5. Network scale impacts

Methods

1. 2D hydrodynamic models across range of stream orders
2. Vary timing and magnitude
3. BACI studies on restored*
4. Repeat lidar and probing*
5. Hydraulic informed routing*

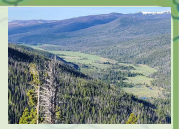
*in progress

Elkhorn Creek

- DA = 5.2 km^2
- W_{Q10}/ $W_{baseflow}$= 4.2
- Beaver berms present
- Heavily incised
- Low tech PBR 2022
- Pre restoration data presented

Beaver Creek

- DA = 12.5 km^2
- W_{Q10}/ $W_{baseflow}$= 15.7
- Beaver berms present
- Heavily incised
- Low tech PBR 2024?
- Floodplain heavily browsed
- West slope (2x precip.)



Little Beaver Creek

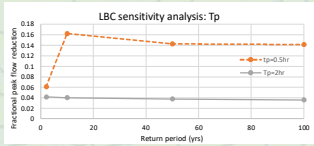
- DA = 37.6 km^2
- W_{Q10}/ $W_{baseflow}$=4.5
- Some side channels
- Beaver sign, no berms
- Low tech PBR 2024?
- Channel n calibrated
- Major floods 2023

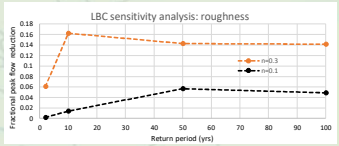
Results

Attenuation hotspots

- Attenuation normalized by stream length
- Highest attenuation/m in wider beaver meadows
- BC attenuation >EH during moderate floods
- Heavy incision at BC

Model Sensitivity:

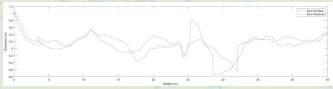




- High uncertainty in attenuation, depends on Tp & n

Sediment

LBC

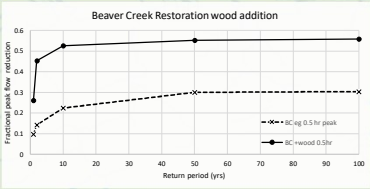


- XS before (blue) & after debris flow (yellow)
- Average XS change 1.27m^2 deposition
- ~840m^3 sediment deposited

Elkhorn

Sediment probing to refusal
Pre-PALS bed of gravels
Average 0.27m^2 deposition
63 m^3 of sediment captured behind PALS

Management



- Simulated restoration significantly increases attenuation
- >50% attenuation of Q_{100} in a beaver meadow. (Novel in hydraulic modeling)
- Models uncalibrated

Conclusions

Peak flow attenuation

Promoted	Not promoted
- Short durration	- Long durration
- High intensity floods	- Low roughness
- Post-fire storms	- Lower FP width
- Wide meadows	- Fewer flow paths
- Beaver berms	- Channelized flow
- High roughness	

Sediment

- 2 major types observed
- Gradual deposition behind PALS
- Major sporadic deposition during floods

Next Steps

- Better define CH-FP
- More calib. data
- Compare W/ Hydro. Routing
- Watershed scale analysis